Effects of Increased Trade and Investment on Human Development in the U.S. and Mexican Border Communities

Joan B. Anderson

The Journal of Developing Areas, Volume 43, Number 2, Spring 2010, pp. 341-362 (Article)

Published by Tennessee State University College of Business
DOI: *https://doi.org/10.1353/jda.0.0055*

EFFECTS OF INCREASED TRADE AND INVESTMENT ON HUMAN DEVELOPMENT IN THE U.S. AND MEXICAN BORDER COMMUNITIES

Joan B. Anderson*
University of San Diego, USA

ABSTRACT

This paper analyzes the effects of increased trade and investment on population growth and the quality of life in the U.S. and Mexican border regions. The analysis on quality of life changes is based on 1990 and 2000 U.S. and Mexican census data. Quality of life is measured by a Border Human Development Index. We find that increased trade and investment has had a major impact on population growth and migration, especially in the Mexican border communities. With respect to changes in the quality of life, there is evidence of improvement on both sides of the border, but only the gains on the Mexican side appear to be linked to trade and investment. The evidence indicates that the increased U.S.-Mexican trade and investment has affected the border communities on the Mexican side of the border more so than those on the U.S. side.

JEL Classifications: O15, O18, F14, F21
Keywords: International trade, investment, border region, Human Development Index
Author's Email Address: joana@sandiego.edu

INTRODUCTION

In the aftermath of the Mexican debt crisis of 1982, Mexico readjusted its economic policies, turning from an inward to an outward focused economic model. Mexico joined the General Agreement for Tariffs and Trade (GATT) in 1986. By 1988 it had reduced the proportion of imports requiring licenses from 100 to 20 percent and lowered tariffs from an average of 27 to 10 percent. In addition, it liberalized restrictions on foreign investment and privatized a large number of state-owned enterprises, including banks (Arnold, 2003). By the early 1990's Mexico was actively negotiating with the U.S. and Canada to create a free trade agreement. The three countries signed the North American Free Trade Agreement (NAFTA) in 1993 and it was implemented beginning in January, 1994, involving a gradual decrease in tariffs and import licenses over a five year period for some goods, a ten year time period for most others and a 15 year period for a few "sensitive" items like sugar. The agreement also promised national treatment of foreign investors from the NAFTA countries.

These changes coincided with the worldwide trend towards freer trade and increasingly globalized production. The freeing of trade between the U.S. and Mexico increased the possibilities of production sharing given the complementarities of these two economies: Mexico with its relatively abundant supply of unskilled, relatively low-cost labor and the U.S. with its abundant, relatively low-cost capital. Labor intensive export processing on the Mexican side of the border increased exponentially during the 1990's while the sale of privatized firms attracted foreign investment to Mexico. Foreign, mainly U.S., investment was also flowing into the border region to finance the rapid expansion of the border manufacturing (maquiladora) industry.

The communities that touch the U.S.-Mexico border, on both sides, are the major points of contact for trade, investment, and flows of people. The object of this paper is to analyze the effects of the increase in U.S.-Mexico trade and investment on population growth and the quality of life in the U.S. and Mexican border regions. For purposes of this paper the Mexican border region is defined as the 38 municipios that touch the border and the U.S. border region consists of the 25 counties that touch the border. One research question addressed is: what is the relative impact on population growth, internal migration and foreign migration and are these trends different on the Mexican compared to the U.S. side of the border? A second question is how this increased growth is affecting the quality of life in border communities. A third question is whether the effects of trade and investment are qualitatively and/or quantitatively different in U.S. border communities from Mexican border communities.

TRADE, INVESTMENT AND THE BORDER COMMUNITIES

Following Mexico's entry into the GATT, total trade between the U.S. and Mexico increased dramatically. In 1990 it equaled $58.4 billion, increasing to $290.5 billion in 2005. The percentage of U.S. trade that is done with Mexico increased from 7.1 percent in 1991 to 11.4 in 2000 and to 11.2 percent in 2006 (U.S. International Trade Administration, 2007; US Census Bureau, 2006) . The proportion of Mexican trade that is with the U.S. increased from 75.7 percent in 1991 to 80.7 percent by 2000. An important part of this increase is intra-industry trade, connected to maquiladora (export processing) production in the Mexican border region. By 1999, 50 percent of total trade was attributed to intra-industry trade. With the exploding growth in maquiladora production during the last half of the 1990's, this type of trade increased by 83 percent between 1995 and 1999, with the majority of this trade being between plants located in the border region (Leon Gonzalez and Dussel Peters, 2001).

Since most of the trade between the U.S. and Mexico is overland in trucks and trains, the communities on the border are directly affected by the economic activity associated with this increase in trade and investment. Shipments by truck increased by 278 percent and by train increased by 179 percent between 1993 and 1999 (Clement, 2002). In response to this big increase in commercial activity, additional infrastructure, including new border crossings and additional and/or widened highways have been and are being added. Currently there are 43 border crossings over the almost 2000 mile-long U.S.-Mexico border. In some communities there are multiple ports of entry. For example, El Paso-Ciudad Juárez has five crossings, of which two have been constructed since the beginning of the 1990's.

The combination of Mexico's exploding border manufacturing and the large scale privatization of Mexican state-owned enterprises (SOEs), resulted in Mexico receiving a large share of Latin America's direct foreign investment, equal to one third of the total between 1990 and 1994. Inflows of direct foreign investment into Mexico tripled during the 1990's from an average of $4.5 billion between 1988 and 1993 to an annual average of $13 billion, annually between 1994 and 2000 (Zarsky and Gallagher, 2004, ECLAC, 2005). Between 70 and 80 percent of this investment was from the U.S. (Price, 2003). Much of the NAFTA induced foreign investment flows are concentrated in manufacturing in border communities. Between 1994 and 2002 about 630,000 manufacturing jobs were created, almost 83,000 per year. The number of maquiladora plants in the Mexican border region increased from 1260 in 1990 with 400,000 employees to 2759 plants and 1.2 million employees in 2001 (INEGI, 2002). Mexican foreign investment in the U.S. increased from $30 million in 1990 to $127.6 million in 2000, an increase of 322% (Guillen, 2002).

The NAFTA agreement, signed in 1993 and began in January of 1994, had the objective of increasing investment flows and trade in goods and services, but did not include provisions for labor flows, excepting at the managerial level. Expatriate managers are permitted to live and work in the other NAFTA countries, though the number of Mexican managers allowed into the U.S. is limited. Not only does the NAFTA agreement not allow for flows of labor, but very soon after the signing of the agreement, the U.S. increased its efforts to slow down the flow of undocumented Mexican workers coming into the U.S. In 1994, it started "Operation Hold the line" in the El Paso area, "Operation Gatekeeper" in the San Diego area, "Operation Safeguard" in Arizona and "Operation Rio Grande" in South Texas, all aimed at stopping the entrance of undocumented workers (Nevins, 2002). These operations included construction of higher, larger, less penetrable walls and increased border patrol agents and equipment, including highly technical military surveillance equipment around the major border crossing areas. These areas cover only a small percentage of the 2000-mile border, mainly in large urban areas. In addition, increases in inspections at border crossings have slowed down the flow of goods and people, working against the goals of closer economic ties that motivated the NAFTA agreement. These slow-downs have become even worse since the U.S. September 11, inspired "war on terrorism".

Both the expansion of trade and investment and the restrictive policies on labor flows have affected the border communities. The analysis on quality of life changes in these communities is based on 1990 and 2000 U.S. and Mexican census data. To separate the effects of the increases in trade and investment (T&I) from other economic events, the border communities are grouped into four separate categories based on the number of annual border crossings. The categories are: high traffic border crossings with 15 million or more per year; intermediate traffic border crossings with between 4 and 14 million per year; low traffic border crossings with less than 4 million per year and those communities that have no border crossings. (A list of the communities included in each category is presented in the appendix.) Based on the assumption that the border effects of increased trade and investment are principally experienced in the communities with high and intermediate border traffic, the paper analyzes whether growth rates and changes in quality of life indicators are different in those two areas, compared to the communities with small or no border crossings.

Quality of life is in this study is measured by developing a human development index, similar to that of the United Nations Development Program (UNDP, 2000), but modified to use data that is available at the local level and comparable between the U.S. and Mexico. The index used in this paper consists of the same trio of income, education and health for the measurement of human development as does the UNDP, but the specific indicators used were changed to indicators that are available at the local (county/municipio) level and are available for both U.S. and Mexican communities. Specifically the index includes per capita GDP, educational attainment (percent of adult population with 12 or more years of school), percent of school-aged population enrolled in school, and infant mortality. Indexes for each of these will be presented, as well as an aggregated human development index.

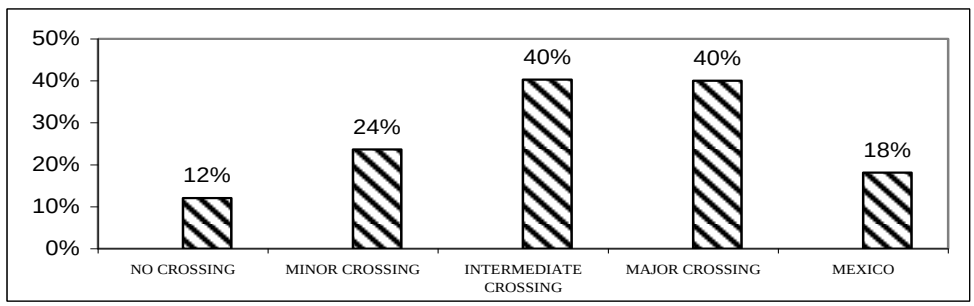
GROWTH IN POPULATION AND MIGRATION

The rapid rise of maquiladora and other manufacturing in the Mexican border region increased demand for labor so rapidly that many border cities experienced a shortage in the supply of "maquiladora grade" labor. This was evidenced by the permanent help-wanted signs posted on many maquiladoras. At the same time, in other parts of Mexico, the economy was in crisis, especially after the major peso devaluation that came at the end of 1994. Urban unemployment was increasing and at the same time there were significant displacements of farmers as a result of the agricultural liberalization that was a part of the NAFTA agreement (Zarsky and Gallagher, 2004). With a shortage of jobs in the interior of Mexico, but increased demand for unskilled labor in the border region and in the U.S., there has been a substantial migration of people toward and across the U.S.-Mexico border. To look at these migration effects I analyzed the change between 1990 and 2000 in three variables available in both the U.S. and Mexican census data: population growth; the proportion of population born in other states of each respective country; and the proportion who are foreign born (INEGI, 1990, 2000, US Bureau of the Census, 1990, 2000).

Population Growth

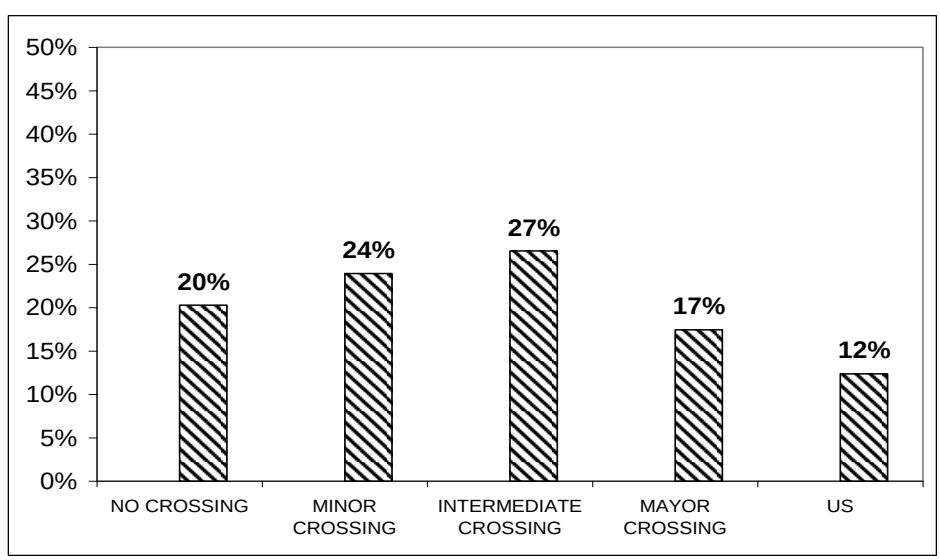
Figure 1 presents population growth in Mexico and in the border communities, grouped by border crossing activity. It shows a significantly larger growth in population in communities with intermediate and high border traffic, more that twice the national average. In communities with small border crossings growth was still higher than for Mexico as a whole, but those border communities with no border crossing grew slower than the national average.

FIGURE 1. % GROWTH IN MEXICAN POPULATION



In the U.S. all four of the border county groupings by type of border crossing have higher average population growth than the 12 percent population growth rate for the U.S. as a whole in the decade of the 1990s. See Figure 2. However, in contrast to the Mexican side, the slowest growing are the counties with high traffic crossings. The fastest growing U.S. border counties are those with intermediate traffic crossings. The very rapid growth in U.S. counties that have only minor crossings or no border crossing suggests that something other than T&I may be driving population growth on the U.S. side of the border, maybe the Sunbelt effect.

FIGURE 2. % GROWTH IN U.S. POPULATION, 1990-2000



A modified shift-share model is used to separate out the influence of T&I on population growth in the border communities from national and regional influences on that growth. Shift-share is a technique for decomposing economic change into three components: national share, industry mix and regional share. It is very often applied to employment, separating out the national, industrial and regional influences on employment growth for a set of local industries (Dinc, 2001). Unlike the traditional industry mix shift-share, where there are both national and regional growth rates for the industries, there are no national growth rates associated with the sub regions. Therefore this application requires the use of a modified shift-share model that involves a couple of heroic assumptions. The first of these is that the "pure border" population growth rate is the rate recorded for border regions with no crossing, requiring the assumption that this growth rate has no T&I influence. This rate is substituted for the individual industry rates that would be used in a traditional shift-share model. The second assumption is that the T&I influence is the whole remaining explanation of the population growth rate after accounting for the national and non-T&I border effects. Both of these are somewhat suspect. The no-crossing border communities, for example, tend to be small and rural as opposed to urban and this in itself may account for some of the difference. Despite its potential weaknesses, it was felt that enough additional insight can be gained from this analysis to be worth the exercise.

Table 1, column 9 is the actual population in 2000 minus that expected if each border category had grown at the national rate (column 8). It represents the excess population growth rate due to both border and T&I effects. Column 11 is the actual 2000 population minus the population if it had grown at the no-crossing border rate (column 10). This is interpreted as the excess growth rate due to T&I. Column 12, equal to column 9 minus column 11 then is the growth due to being on the border. The last two columns translate columns 11 and 12 into growth rates. For Mexico this calculates the additional population growth due to T&I in minor border crossing municipios as 10.9% while for intermediate and major border crossings it is 24.6% and 24.4%, respectively. The pure border effects are all negative ranging from -4.7% for major and intermediate crossings to -6.2% for the no crossing municipios. In the U.S, on the other hand, the T&I effects are very small and they are negative for major crossings. Minor crossings show the biggest T&I effect equals 3.6%. For the U.S. in all the sub regions the border effect (or perhaps better said the Sunbelt effect) is just under +8%. The negative change for U.S. communities with major crossings is an example of the problem with allocating all else to T&I. The decrease in these communities is more likely due to the rapidly rising house prices, especially in San Diego whose population is one third of the whole U.S. border population, rather than due to trade and investment. It may also reflect the movement of some manufacturing from the U.S. border region to the Mexican border region. With respect to population growth it appears that there is a substantial T&I effect in Mexican border *municipios*, but not in U.S. border counties. The rapid population growth on the U.S. side appears to be more a function of the Sunbelt

TABLE 1. SHIFT-SHARE ANALYSIS: NATIONAL, BORDER AND T&I EFFECTS ON POPULATION GROWTH

Mexico	2	3	4	5	6	7	8	9	10	11	12	T&I	Bor-der
Type Crossing	National population in millions		national	Border Population In 1000s		Border	Exp. Pop in 1000s if nat'l growth	Total Shift In 1000s	Exp. Pop In 1,000s if border growth	T&I Effect In 1000s	Comp Effect In 1000s	Proportion	
	1990	2000	change	1990	2000	change							
no crossing				355.0	400.6	.13	425.4	-24.8	400.6	0.0	-24.8	.00	-.06
Minor Intermediate				169.2	214.3	.27	202.7	11.6	190.9	23.4	-11.8	.11	-.06
				412.1	616.6	.50	493.8	122.8	465.0	151.6	-28.8	.25	-.05
Major				2953.2	440.7	.49	3538.9	868.3	3332.4	1074.7	-206.4	.24	-.05
Total	81.2	97.3	0.20	3881.7	562.7	.45	4651.5	975.3	4380.1	1246.6	-271.3	.22	-.05

US	2	3	4	5	6	7	8	9	10	11	12	T&I	Bor-der
	1990	2000		1990	2000								
no crossing				190.6	233.4	.22	215.7	17.8	233.5	0.0	17.8	.00	.08
Minor Intermediate				741.4	941.8	.27	838.9	102.9	908.1	33.7	69.2	.04	.07
				309.3	403.3	.30	350.0	53.3	378.8	24.5	28.9	.06	.07
Major				3975.8	4733.6	.19	4498.7	235.0	4869.6	-136.0	370.9	-.03	.08
Total	248.7	281.4	0.13	5217.2	6312.2	.21	5903.2	409.0	6390.0	-77.7	486.8	-.01	.08

9= actual 2000 population less that expected if had grown at national rate--excess growth due to border & T&I; 10=expected growth in each border site if had grown at border no crossing (border, but no T&I effect) rate; 11=actual 2000 minus if had grown at no border crossing border rate--excess growth due to T&I; 12 = Total shift less T&I effect or excess growth due to the border

Migration Effects of NAFTA

To analyze the influence of T&I on internal and external migration, the paper uses census data on the proportion of population born in other states within the country and the proportion of population that is foreign born and investigates the changes in these two variables between 1990 and 2000. Figures 3 and 4 present the percentage change in population that were born nationally, but in other states. The change in that figure represents internal migration from other states between 1990 and 2000. The change in the foreign-born represents foreign migration during that decade.

FIGURE 3. % CHANGE IN MIGRANT POPULATION: MEXICO

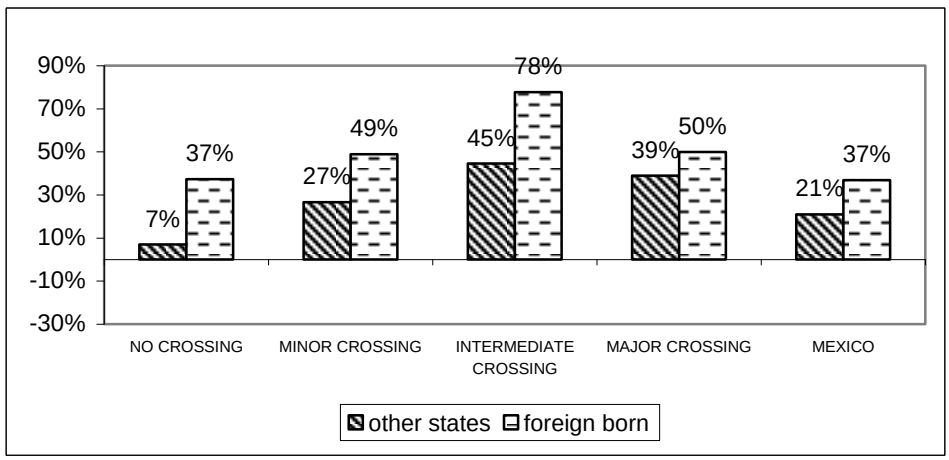
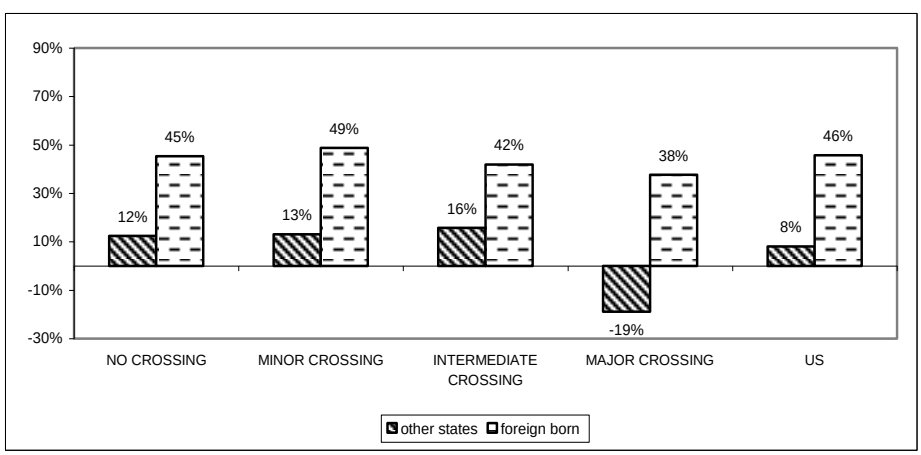


FIGURE 4. % CHANGE IN MIGRANT POPULATION: US



With respect to internal migration from other states in the country, the increase in population from that source is much greater in the Mexican border region than in the U.S. border region. For both, the highest percentage increase in internal migration is in those communities with intermediate traffic crossings, but the proportion is much higher in the Mexican communities, 45 percent compared to 16 percent in U.S. border communities. In both cases the percentage change in people born in other states is less for communities with no crossings than for those with minor crossings, which is less than those with intermediate crossings. The biggest contrast between the countries is in

communities with major border crossings. In the Mexican major-crossing communities, there is a substantial 39 percent increase in migrants from other states while on the U.S. side, major crossing communities actually experienced an internal out-migration, with population born in other states decreasing by 19 percent. This out-migration may well be the combination of high unemployment during the first half of the 1990's and rapidly increasing housing costs, especially in San Diego county.

With respect to foreign migration, there are substantial increases in both. However, the percentages in the Mexican communities may be deceptive because there are very small foreign- born populations. For example, the 78 percent increase in foreign born in the Mexican intermediate crossing communities represents an increase in 7,000 people, which increases the proportion of foreign-born from 1.5 percent of the population to 2 percent. The 42 percent increase in the U.S. intermediate-crossing communities, however, represents an increase of slightly over 32,000 people, increasing the proportion of foreign-born population from 20.4 to 23.7 percent of the population. For U.S. communities with major border crossings the 38 percent increase represents and additional 360,558 people. On the Mexican side the 50 percent increase represents 42,629 additional people.

The rapidly expanding manufacturing sector in the Mexican border region due to increased trade and investment has had a major impact on migration to those communities with major and intermediate border crossings, They have experienced a greater percentage increase in both internal and foreign migrants than is true of minor and no crossing border communities and Mexico as a whole. In terms of numbers of people, the overwhelming amount of the migration has been internal. For major crossings the comparison is 508,277 additional people from other Mexican states relative to 42,629 from other countries and for minor crossings 56,000 compared to 7,000. On the U.S. side, however, there is a substantial gain in foreign migrants compared to a loss in the proportion of people born in other states in communities with major border crossings. For communities with intermediate border crossings, close to an equal number of foreign-born and born-in-other-states have migrated into the communities (a little over 20,000 people in each category). The percentage increase in foreign born population is smaller in the U.S. communities with major and intermediate border crossings than in those with less border crossing activity and in the U.S. as a whole. This may be due more to the shift in migrant flows resulting from the U. S. anti-migrant operations than due to T&I. It appears that the T&I effect on migration is stronger in the Mexican communities than in the U.S. communities.

TRADE, INVESTMENT, AND HUMAN DEVELOPMENT

It is clear that the increases in trade and investment have affected population growth and migration, especially on the Mexican side of the border. The next question is how the increased growth has impacted the quality of life of people living in border communities. Has the increased trade and investment translated into economic development within the communities touching the U.S.-Mexico border? According to ul Haq (2003), the basic purpose of development is to enlarge people's choices. No simple numerical measurement can possibly portray the level of development in all of its dimensions and

complexity. Though real per capita income has often been used as a crude indicator of the level of well-being and economic development it is well-known that it hides a number of important factors, such as environmental conditions, political and civil liberties, non-market transactions, leisure, and the negative effects of some goods and services, for example tobacco.. Importantly, per capita income fails to reflect income distribution. The same per capita income will reflect a very different overall quality of life in a society where 60% of the income is concentrated in the richest 20% of population, compared to a society where income is more equally distributed.

The search for alternatives to GDP per capita led development economists to alternative quality of life measures, such as life expectancy, infant mortality, physicians per capita, literacy, access to safe drinking water, caloric intake, quality of housing, radios per capita, kilometers of highway, and so forth. The desire for a simple, but more comprehensive indicator led to the development of the Physical Quality of Life Index (PQLI) by Overseas Development Council, Washington, D.C. in 1979. This index included education, life expectancy and infant mortality, all sensitive to income distribution. However, its exclusion of income led to a new index. In 1990, development economists at the United Nations Development Program (UNDP) created the Human Development Index (HDI). This index provides a summary measure of the level of human development by combining standard of living (per capita income), education (enrollment and attainment) and longevity/health (life expectancy) each weighed by one-third. Though acknowledged by its innovators that no simple index can provide an accurate comparison of human development levels in different countries, it is still viewed as a significant improvement over the PQLI and even more so over the GDP per capita indicator (Sen, 1999). The index is categorized by those countries above .8 in the high human development category, those between .5 and .79 in the medium human development category and those below .5 in the low human development category. One important aspect of this measure is that its ranking can differ substantially from the level of economic prosperity, especially where economic prosperity has a highly unequal distribution (UNDP, 2000, pp. 147-50).

Calculation of a Border Community HDI

In light of its usefulness for comparing economic development levels between regions and over time, following the methodology of the UNDP's Human Development Index, we have created a Border Human Development Index (BHDI) for the 25 U.S. counties and 38 Mexican *municipios* that touch the U.S.-Mexico Border (Anderson and Gerber, 2004). We grouped the data according to the type of border crossing in order to gain insight into the question of how much economic development has occurred in these communities as a result of increases in trade and foreign investment. Both the U.N. and Border indices are composed of the three, equally weighted components of per capita income, education and health. However, within the broad education and health categories some specific data series differ in order to have data series that are available at the local level and comparable

between the U.S. counties and Mexican *municipios*. The general formula for calculating each sub-index is:

$$\text{Index} = \frac{\text{Actual } x_i \text{ value- minimum } x_i \text{ value}}{\text{Maximum } x_i \text{ value} - \text{minimum } x_i \text{ value}} \quad (1)$$

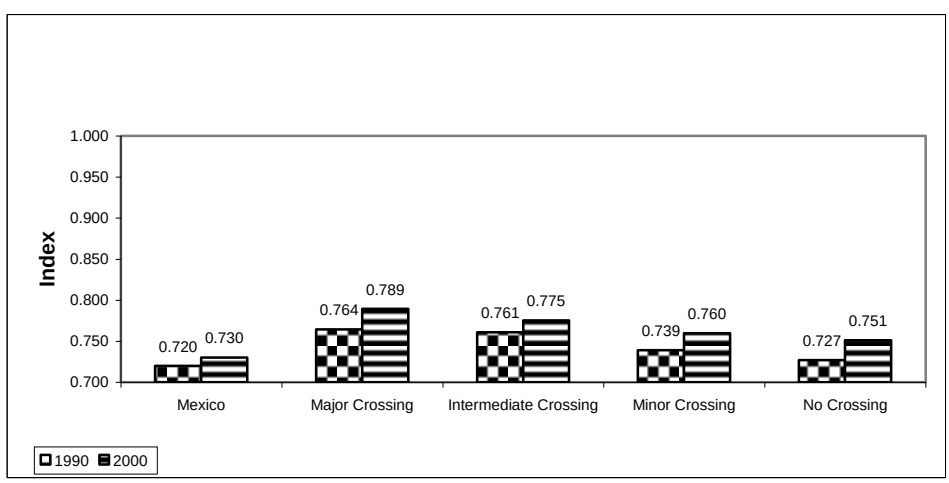
The numerator in each case represents the gap between the actual value and the minimum possible value, while the denominator is the difference between the maximum and the minimum. Consequently, the ratio is the share of difference between the minimum and maximum that has actually been traveled by the region.

Estimating Border Incomes

Income is a proxy for a decent standard of living. As is true for the UNDP, the data used for income are per capita GDP, converted to U.S. dollars using purchasing price parity exchange rates. The per capita GDP used in the Border HDI are in constant 1996 dollars. For the US counties, the United States Department of Commerce's Regional Economic Information System (REIS) provides estimates of US personal income at the state, county, and MSA level (U.S. Department of Commerce, 2002). These estimates needed to be transformed from personal income to the more comprehensive aggregate measure of gross domestic product. US personal income at the county level is therefore adjusted upward by a factor that compensates for the difference between personal income and the gross product. This is done by increasing county level personal income by the ratio (GDP/personal income) taken from the national level. The US CPI is used to convert the data to 1996 dollars and income is then measured in per capita terms. The income or output of Mexican municipalities is less straightforward to estimate. Mexico's national statistical agency, Instituto Nacional de Estadística, Geografía, e Informática (INEGI), does not calculate income levels below the state level. Gross State Product (GSP) for the six Mexican border states are disaggregated into municipal shares based on each economic sector's share of GSP and each municipality's share of state employment in each of nine sectors. Then the municipality's share of state income is assumed to equal the sum of the products of state-level sectoral income shares times municipal-level employment shares. This assumes the same productivity within a given sector and across the municipalities of a given state. Conversion from current pesos to constant 1996 dollars at purchasing power exchange rates is accomplished using the series RGDPCH (chained real international dollars) from the Penn World Table, version 6.1 (Heston, Summers, and Aten, 2002).[1] Once the GDP per capita is estimated the income sub index is formed following the UNDP methodology of using equation (1) and $40,000 as the maximum income value and $100 as the minimum. Since income is used as a proxy for a standard of living and "achieving a respectable level of human development does not require an unlimited income," the income index is calculated as a function of the logarithm of income (UNDP, 2000, p. 269). Using the log of income discounts the value of increases in income where it is already at relatively high levels.

Calculations of the data grouped by border crossing category and country show the increases in real income between 1990 and 2000. See Figures 5 and 6 for the Mexican and U.S. national and border per capita indices for 1990 and 2000. In Mexico all of the border income indices are greater than the national index and showed a larger increase between 1990 and 2000. The group of communities with the highest traffic border crossings showed the largest increase, 2.5 index points compared with 1.1 nationally, suggesting a strong T&I effect on income around major border crossings. However, improving almost as much are the communities with no crossings. In 1990 they were not much above the national level, but jumped up 2.4 points during the 1990's. Communities with intermediate border crossings, those that experienced the most rapid population growth, have had the least increase in the income index, increasing just slightly more than the national with a 1.4 point increase. In the U.S., the national income index is higher than any of the border community groupings and grew faster between 1990 and 2000 than any of the four border groups, a 2.9 point increase. As is true on the Mexican side, the communities with major border crossings experienced the largest increase in the income index, 2.5 points and the intermediate crossing communities the slowest at 1.2 points. Whatever T&I effect there may have been on the U.S. border communities, it does not appear to be great enough to stimulate these communities enough to keep up with the rest of the country.

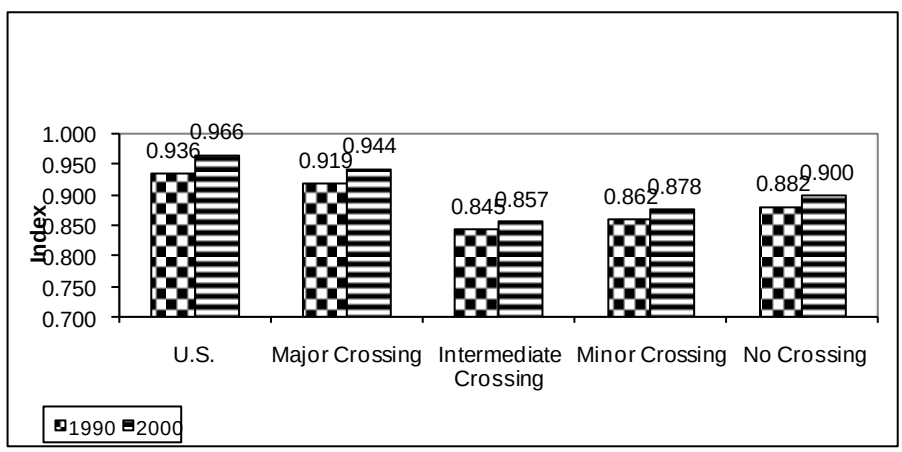
FIGURE 5. PER CAPITA INCOME INDEX: MEXICO



Estimating the Health Index

The UNDP uses life expectancy at birth, a measure of longevity, for the indicator of health. Life expectancy data is available at the national and state levels for both the U.S. and Mexico, but is not available at the county or municipio level for either country. Therefore, we have substituted the infant mortality rate in calculating the BHDI. Infant mortality is a proxy for not only the level of medical care available, but it is also closely related to conditions of housing, sanitation
and safe water supply. It has been used in other indices that attempt to measure economic development and/or quality of life, for example the Physical Quality of Life Index. The infant mortality rate gives the number of infant deaths per 1000 live births. A higher infant mortality rate indicates worse conditions in health care, housing,

FIGURE 6. PER CAPITA INCOME INDEX: U.S.



sanitation and water. Since the other indicators in the Human Development Index imply improvement with higher values, the infant mortality rate must be converted into an infant survivability rate, equal to 1000 minus the infant mortality rate. It is the number of infants who survive out of 1000 live births with a maximum of 1000 and minimum of zero. For example, in 2000 the Mexican border region had an infant mortality rate of 15.4 infant deaths per 1000 live births. This translates into 984.6 infants surviving per each 1000 live births.

The infant survivability indices for the Mexican and U.S. border regions, as calculated using equation 1, are shown in Figures 7 and 8. In Mexico and in all the border communities, except those with minor border crossings, there was a big improvement in infant survivability, equal to a full index point. The largest gain was in

communities with intermediate crossings. On the U.S. side gains are also largest in the intermediate border crossing communities, but the gain is much smaller, equal to 0.2 of an index point. By 2000, the gap between the U.S. and Mexican sides of the border in this health indicator had become very small.

FIGURE 7. INFANT SURVIVABILITY INDEX: MEXICO

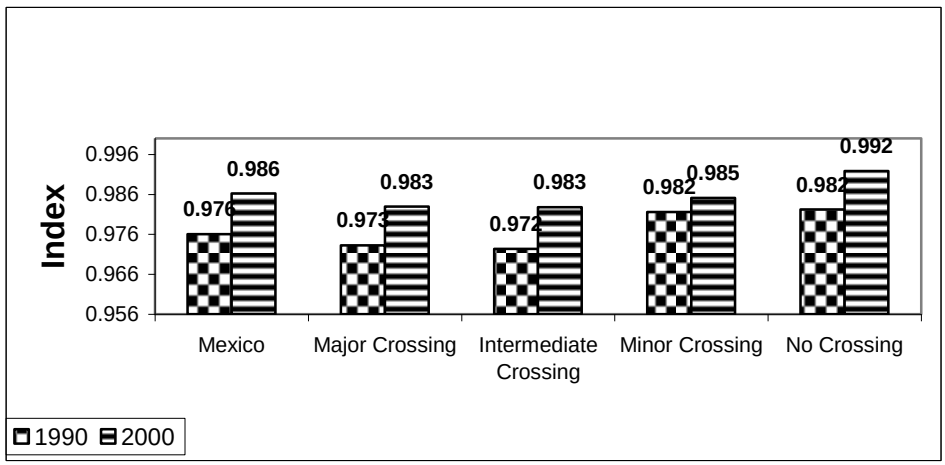
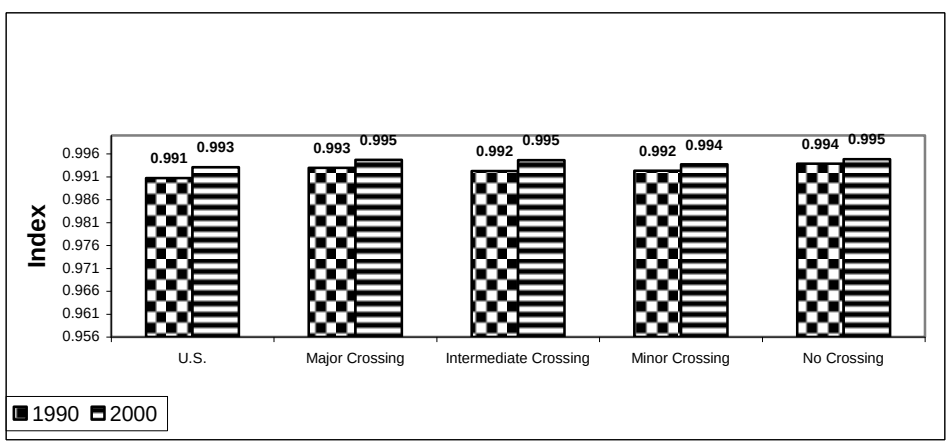


FIGURE 8. INFANT SURVIVABILITY INDEX: U.S.



Estimating Educational Attainment

The educational component of the BORDER HUMAN DEVELOPMENT INDEX is composed of two data series: the proportion of school-aged population that are enrolled in school and the proportion of population 25 and older who have graduated from high school (i.e. completed 12 years of schooling). The educational attainment segment of the education index as calculated by the UNDP is the literacy rate. However, in the United States after 1970 the census bureau ceased to gather data on literacy at state and local levels.[2] In order to have comparable data on both sides of the border, percent of adult population 25 and older with high school or more is used as the measure of educational attainment. The enrollment component is the same as that used by the UNDP and is calculated by dividing the number of people enrolled in kindergarten through twelfth grade by the population between 5 and 19 years of age for the U.S. and 6 and 19 years of age for Mexico. Both components of the education sub index are proportions with maximum values of 100 and minimums of 0. In calculating the educational index attainment is weighted by two thirds and enrollment by one third, the same weightings as those used in the UNDP index.

The calculated education indices for 1990 and 2000 for each of the border regions are shown in Figures 9 and 10 for Mexico and the U.S., respectively. The gap between the U.S. and Mexico is largest in the education component of the index and at the national level it widened during the 1990s. However, in the border regions there was more improvement in the Mexican border region than in the U.S. border region, slightly narrowing the education gap at the border. In both countries, with one exception, the national education indices were greater than the indices of the border regions, as grouped by type of border crossing. The one exception to this is in the Mexican border communities with large border crossings where the education index increased by 6.6 index points, compared to an increase of 0.5 index points for Mexico. The education index for major border crossings in Mexico in 2000 was .461, compared to the national index of .453. The largest educational gains were for the Mexican border communities with minor border crossings, where the gain was 11.5 index points. Minor border crossings also showed the most improvement of the border community groupings on the U.S. side, growing 5.4 index points, equal to the national average increase, during the decade of the 1990s. On both sides of the border, the communities with intermediate crossings showed the smallest gains in the education index, a 4.8 point increase in the Mexican communities compared to a 2.9 point increase on the U.S. side.

FIGURE 9. EDUCATION INDEX: MEXICO

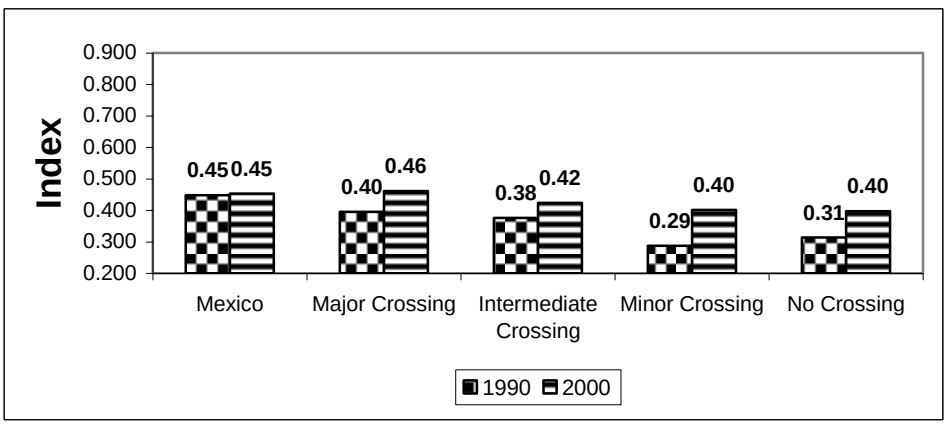
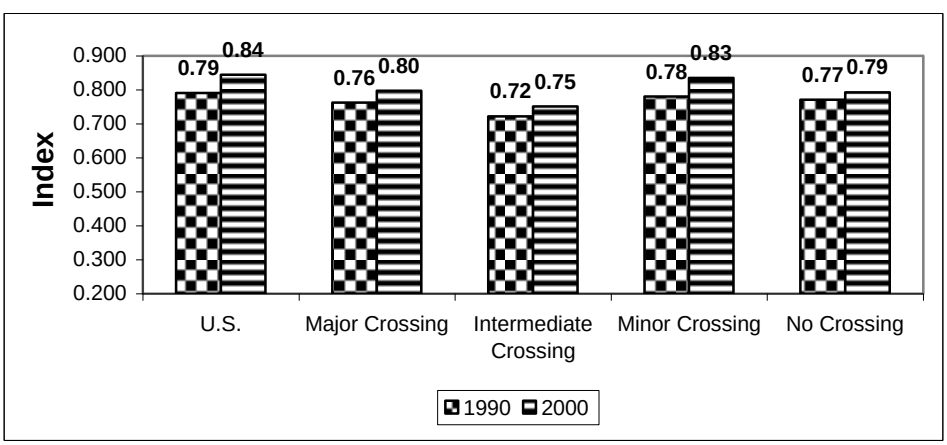


FIGURE 10. EDUCATION INDEX: U.S.



Border Human Development Index

In order to compare levels of economic development among the communities in the border region, the Border Human Development (BHDI) Index is calculated as the simple average of these three sub indices:

BHDI = 1/3*(Income Index) + 1/3*(Education Index) +1/3*
(Infant Survivability Index). (2)

As such, the BHDI presents a much broader view of economic development than just income. In fact, by using the logarithm of income rather than its absolute value, increases in income contribute less and less to the level of economic development as income rises.

Examining this summary statistic for progress in human development indicates that all four types of Mexican border communities improved much more than the national rate. See Figures 11 and 12. Overall Mexico's human development index increased from .715 to .724 or 0.9 of an index point, less than the 2.8 index point US national increase. During the decade of the 1990's Mexican border communities with major crossings rose from slightly under the national rate to .745 or 2.1 index points above the national rate. The communities with intermediate crossings showed the least overall improvement with an increase of 2.4 index points, but even that was enough to raise those communities to above the national HDI.

The rapid migration into the Mexican intermediate border crossing communities with its accompanying strains on infrastructure appears to have slowed human development in those communities. In contrast, the U.S. border communities continue to have lower BHDIs than the national HDI, and they also all increased less than the national index. Nationally the U.S. HDI improved by 2.8 index points during the decade, while communities with minor border crossings, the group with the greatest increase of the four categories, showed a 2.4 point increase. The two groups of communities with the least improvement in human development are those with intermediate crossings and those with no crossings, both showing a 1.4 point increase in human development. US major border crossings communities' BHDI increased by 2.1 points.

FIGURE 11. HUMAN DEVELOPMENT INDEX: MEXICO

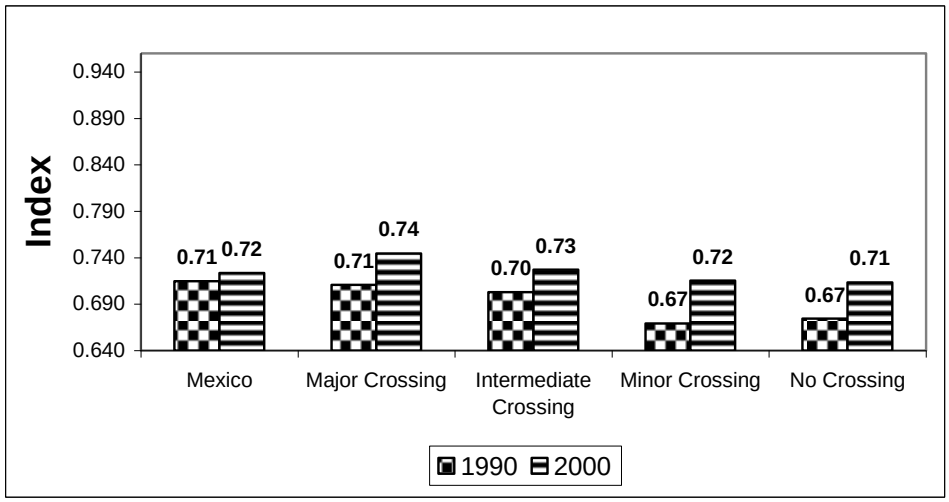
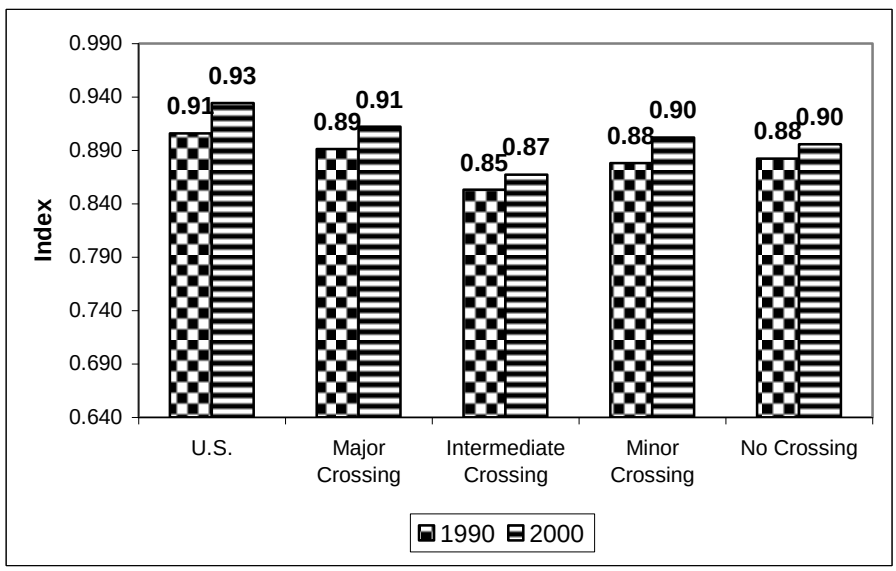


FIGURE 12. HUMAN DEVELOPMENT INDEX: U.S.



CONCLUDING REMARKS

This article examines the effects of increased trade and investment between the U.S. and Mexico on population growth and quality of life on the communities that touch the U.S.-Mexican border. The communities were grouped according the type of border crossing under the assumption that most T&I affects would be found in those communities that have major and intermediate crossings. Based on this assumption we do find that increased trade and investment had a major impact on population growth and migration in the Mexican border communities. On the U.S. side population grew fastest in communities with intermediate and minor crossings. Communities with major crossings actually had a net internal out migration, perhaps due to rapidly rising housing prices, rather than related to trade and investment.

With respect to human development, the increases in the BHDI for communities with major border crossings in Mexico, are very likely a positive effect of increased trade and investment. The lower levels of BHDI in Mexican communities with intermediate crossings may also be related to the increased trade and investment. The rapid population growth in these communities in response to T&I-related economic opportunities appears to have put stress on infrastructure, slowing growth in the areas of health and education. In the U.S. border communities there is much less evidence of effects due to increased trade and investment. The BHDI is lower than the national HDI and is growing slower. It appears that the increased U.S.-Mexican trade and investment has affected the border communities on the Mexican side of the border more so than those on the U.S. side.

APPENDIX

CLASSIFICATION OF BORDER COMMUNITIES BY SIZE OF BORDER CROSSING

MEXICO	UNITED STATES
High Traffic Crossing	
TIJUANA	SAN DIEGO
MEXICALI	IMPERIAL
JUAREZ	EL PASO
NUEVO LAREDO	WEBB
REYNOSA	HIDALGO, TX
MATAMOROS	CAMERON
Intermediate Traffic Crossing	
AGUA PRIETA	COCHISE
NOGALES	SANTA CRUZ, AZ
SAN LUIS RIO COL	YUMA
ACUÑA	VAL VERDE
PIEDRAS NEGRAS	MAVERICK
Low Traffic Crossing	
TECATE	PIMA
PUERTO PEÑASCO	LUNA
NACO	PRESIDIO
ASCENCION	ZAPATA
OJINAGA	STARR
MIGUEL ALEMAN	
CAMARGO	
No Crossing	
CABORCA	HIDALGO, NM
ALTAR	GRANT
SARIC	DONA ANA
SANTA CRUZ, SON	HUDSPETH
CANANEA	CULBERSON
JANOS	JEFF DAVIS
GUADALUPE	BREWSTER
P.G. GUERRERO	TERRELL
MANUEL BENAVIDES	KINNEY
OCAMPO	
JIMENEZ	
GUERRERO, COA	
HIDALGO, COA	
NAVA	
ANAHUAC	
GUERRERO, TAM	
MIER	
GUSTAVO DIAZ ORDAZ	
RIO BRAVO	
VALLE HERMOSO	

ENDNOTES

*I wish to thank James Gerber, San Diego State University for his input and collaboration in developing the BHDI and also my research assistant, Ivonne Jimenez for her work in regrouping and presenting the data.

[1]For a more detailed description of this methodology, which was developed by James Gerber, see Anderson and Gerber, 2004.

[2]The type of data gathered by a country's census is highly influenced by the level of its economic development. The differences in development levels between the U.S. and Mexico add to the difficulties in getting compatible data.

REFERENCES

Anderson, Joan and James Gerber, "A Human Development Index for the United States-Mexico Border", *Journal of Borderlands Studies* 19(2), 2004, pp.1-26.

Arnold, Bruce, *The Effects of NAFTA on U.S.-Mexican Trade and GDP*, Congressional Budget Office, May 2003,http://www.cbo.gov/showdoc.cfn?index=4247&sequence=2&from=0.

Clement, Norris, ed., "The U.S. Mexican Border Environment: U.S.-Mexican Border Communities in the NAFTA era", SCERP Monograph Series, no. 4, 2002, San Diego, CA: San Diego State University Press.

Dinc, Mustafa, Local and regional Economic Tools of Analysis, http://www.worldbank.org/wbi/publicfinance/documents/module%2015/dinc_presentation.ppt http://www.erudit.org/prepub/doc/000250pp.pdf, May 2001.

ECLAC (Economic Commission for Latin America), "Foreign Investment in Latin America and the Caribbean 2004", March 2005, http://www.eclac.cl/cgi-bin/getProd.asp?xml=/publicaciones/xml/0/20930/P20930.xml&xsl=/ddpe/tpl-i/p9f.xsl&base=/tpl/top-bottom.xslt.

Guillien, Arturo, "Foreign Direct Investment in North America under NAFTA", Universite du Quebec a Montreal, CEIM, http://www. erudit.org/ prepub/doc/ 00250pp.pdf, May 2002.

Heston, Alan, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002.

INEGI (Instituto nacional de estadísitca , geografia e informática), *Censo general de población y vivienda*, México, D.F.: Secretaría de Programación y Presupuesto, Coordinación General de los Servicios nacionales de estadística, geografía e informática, 1990, 2000.

INEGI (Instituto nacional de estadísitca , geografia e informática), *Estadística de la industria maquiladora de la exportación*, 2002, http://www.inegi.gob. mx/est/ contenidos/ espanol/rutinas/ept.asp?t=emp75&c=1811.

León González Pachecoy, Alejandra y Enrique Dussel Peters, "El comercio intraindustrial en México, 1990-1999", *Comercio Exterior*, vol. 51 (7), 2001, julio, http://revistas.bancomext.gob.mx/rce/sp/articleReader.jsp?id=7&idRevista=34.

Nevins, Joseph, *Operation Gatekeeper: The Rise of the 'Illegal Alien' and the Making of the U.S.-Mexico Boundary*, 2002, New York: Routledge Press.

Price, John, "Can Mexico Outgrow its Maquiladora Past? A special report on Mexican Foreign Investment" *InfoAmericas Tendencias* vol. 38, June 2003, http://tendencias.infoamericas.com/article_archive/2003/038/038_regional_trends.htm.

Sen, Amartya, "Assessing Human Development," *Human Development Report 1999*, 1999, United Nations Development Program, United Nations.

ul Haq, Mahbub, cited in United Nations Human Development Program, *Human Development Report, 2003*, 2003, United Nations.

UNDP, United Nations Development Programme, *Human Development Report, 2000*, 2000, Oxford, England: Oxford University Press.

U.S. Bureau of the Census, *Census of Population and Housing: Summary of Social, Economic and Housing Characteristics*, Washington, D.C.: U.S. Department of Commerce, Economics and Statistic Administration, 1990, 2000.

U.S. Bureau of the Census, *Foreign Trade Division, Data Dissemination Branch*, Washington, D.C., 2006,
http://www.census.gov/foreign-trade/balance/c2010.html.

U.S. Department of Commerce, *Regional Economic Information System*, Washington, DC., 2002, http://fisher.lib.virginia.edu/reis/.

U.S. International Trade Administration, *Shifts in Merchandise Trade: All Merchandise Country Quarterly Update*, 2007, (downloaded May 1, 2007), http:// dataweb.usitc. gov/scripts/trade_shift/trade_by_ctry_mv.asp.

Zarsky, Lyuba and Kevin P. Gallagher, "NAFTA, Foreign Direct Investment and Sustainable Industrial Development in Mexico, Americas Policy Brief, January 28, 2004, www.americaspolicy.org/briefs/2004/0401mexind_body.html.