Globalization and Labor Income in Mexico

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Abstract. In this paper, I examine the change in the distribution of labor income across regions of Mexico during the country's decade of globalization in the 1990's. I focus the analysis on men born in states with either high-exposure to globalization or in states with low-exposure to globalization, as measured by the share of foreign direct investment, imports, or export assembly in state GDP during the 1990's. Controlling for regional differences in the distribution of observable characteristics and for initial differences in regional incomes, the distribution of labor income in high-exposure states shifted to the right relative to the distribution of income in low-exposure states. This change in regional relative incomes was primarily the result of a shift in mass in the income distribution of low-exposure states from upper-middle income earners to lower income earners. On average, labor incomes in states with high exposure to globalization increased by 8-9% relative to low-exposure states.

1. Introduction

There is now an immense body of literature on how globalization affects labor markets. Early research centered on the United States (Freeman, 1995; Richardson, 1995), motivated in part by an interest in understanding what caused marked changes in the U.S. wage structure during the 1980's and 1990's (Katz and Autor, 1999). A common theme in this work is that globalization – especially in the form of global outsourcing – has modestly but significantly contributed to increases in wage differentials between more and less-skilled workers (Feenstra and Hanson, 1999 and 2003). A small effect for international trade is perhaps not surprising, given the large size of the U.S. economy and the still limited role that trade plays in U.S. production and consumption (Feenstra, 1998; Freeman, 2003). Later research shifted attention to other countries, and to the developing world in particular, which in the 1980's began to lower barriers to trade and capital flows. The tendency for rising wage inequality to follow globalization is not limited to the United States or other rich countries. Expanding trade and capital flows have been associated with increases in the relative demand for skilled labor in a large number of economies, including Chile (Pavcnik, 2003), Columbia (Attanasio, Goldberg, and Pavcnik, 2004), Hong Kong (Hsieh, 2003), Indonesia (), Mexico (Feenstra and Hanson, 1997), and Morocco (Currie and Harrison, 1997).[1]

In most research to date, the focus has been on the relationship between globalization and earnings inequality. Comparatively little attention has been devoted to how globalization affects income levels. This comes as something of a surprise, given the long-standing interest of developing-country research in how changes in policy affect the well-being of the poor. The lack of attention to the impact of globalization on

[1] See Pavcnik and Goldberg (2004) for a survey of selected papers.

poverty is perhaps partly attributable to methodology. The most established empirical techniques for identifying the effects of shocks such as globalization or technological change on earnings relate to estimating changes in the relative demand for labor of different skill types (Katz and Autor, 1999). The lack of attention may also reflect a U.S.-bias in the type of questions being asked. The overwhelming emphasis in U.S. research on why earnings inequality has increased may have spilled over into research on other countries, partially crowding out other issues.

In this paper, I examine how the distribution of income changed in Mexico during country's decade of globalization in the 1990's. Taking the income distribution as the unit of analysis makes it possible to examine changes both in the nature of inequality – reflected in the shape of the distribution – and in the level of income – reflected in the position of the distribution. Mexico is an interesting case because over the last two decades the country has aggressively opened its economy to the rest of the world. This process began with a unilateral liberalization of trade in 1985, continued with the elimination of many restrictions on foreign capital in 1989, and culminated with the North American Free Trade Agreement (NAFTA) in 1994.[2]

An obvious empirical challenge in studying income distributions, rather than individuals or industries, is the paucity of degrees of freedom. Income distributions are aggregate entities, implying the number of observations is limited to the number of time periods in the sample. In my case, I really have only two observations, 1990 and 2000, corresponding to the most recent years in which Mexico conducted its census of

[2] See Chiquiar (2003) for a discussion of recent policy changes in Mexico. For other work on the labor-market implications of globalization in Mexico, see Ariola and Juhn (2003), Cragg and Epelbaum (1996), Farris (2003), Feliciano (2001), Revenga (1997), Hanson and Harrison (1999), and Robertson (2003). See Hanson (2004) for a review of this literature. For work on trade reform and wage inequality in Latin America, see Behrman, Birdsall, and Szekely (2003).

population and housing. My strategy for identifying the impact of globalization on Mexico's income distribution is to exploit regional variation in exposure to foreign trade and investment. As discussed in section 2, geography and history have made states in Mexico's north and center highly exposed to globalization and left states in Mexico's south relatively disengaged from the global economy. I take states with high exposure to globalization to be the treatment group and states with low exposure to globalization to be the control group (leaving states with intermediate exposure to globalization out of the analysis). I then apply a difference-in-difference strategy by comparing the change in the income distribution for high-exposure states to the change in income distribution for low-exposure states during Mexico's globalization decade.

The analysis is complicated by a host of issues, three of which stand out. One is that income distributions change both because the characteristics of the population change and because the returns to these characteristics change. To identify the effects of globalization, I want to examine changes in returns to characteristics (in my case, inter-regional differences in these changes), while holding the distribution of characteristics constant. To perform this exercise, I apply non-parametric techniques from DiNardo, Fortin, and Lemieux (1996) and Leibbrandt, Levinsohn, and McCrary (2004), which I describe in section 3. I also compare results from this approach to results from a more-standard parametric approach, both of which are presented in section 4. A second issue is that other shocks in the 1990's may also have had differential effects on regions with high versus low exposure to globalization. This is an important concern, which I address by way of discussing qualifications to my results in section 5.

A third issue has to do with measurement. There are many components to income, including labor earnings, capital returns, rental income, government transfers, gifts, and remittances from family members abroad. Surveys that measure each of these components carefully, such as Mexico's National Survey of Household Income and Expenditure, are not representative across the regions of the country (Cortes et al., 2003), which makes it impossible to apply my estimation strategy to these data. Surveys that are representative across Mexico's regions, such as the Census of Population and Housing, measure labor income with relatively high precision, but lack complete data on other income categories. To ensure my data are regionally representative, I use the Mexican Census, and to minimize the impact of measurement error, I focus the analysis on labor income. Excluding other sources of income has the obvious drawback of limiting the analysis to labor earnings, rather than to the full distribution of income.

To preview the results, states with high-exposure to globalization began the 1990's with higher incomes than low exposure states, even after controlling for regional differences in the observable characteristics of individuals. During the 1990's, high-exposure states had more rapid growth in labor income than low-exposure states. This took the form of a right-ward shift in the income distribution of high-exposure states relative to low-exposure states. The result of this income shift was an increase in average labor earnings of 8-9% for individuals from states with high exposure to globalization relative to individuals from states with low exposure to globalization.

2. Regional Exposure to Globalization

2.1 Data Sources

Data for the analysis come from two sources. In 1990, I use the 1% microsample of the *XII Censo General de Poblacion y Vivienda, 1990,* and in 2000 I sue a 10% random sample of the 10% microsample of the *XIII Censo General de Poblacion y Vivienda, 2000.* The sample is working age men with positive labor earnings. I focus on men, since labor-force participation rates for women are low and vary considerably over time, ranging from 21% in 1990 to 32% in 2000. This creates issues of sample selection associated with who supplies labor outside the home. Compounding the problem, many women who report zero labor earnings may work in the family business or on the family farm. For men, problems of sample selection and measurement error also exist but appear to be less severe. Their labor-force participation rates vary less over time, rising modestly from 73% in 1990 to 74% in 2000. Still, differences in labor-force participation over time and across regions could affect the results reported in section 4. In section 3, I discuss corrections for self-selection into the labor force.

2.2 The Opening of Mexico's Economy

In Mexico, the last two decades have not been a quiet period. Since 1980, the country has had three currency crises, bouts of high inflation, and several severe macroeconomic contractions, the most recent of which occurred in 1995 following a large devaluation of the peso that precipitated the country's conversion from a fixed to a floating exchange rate. The liberalization of the country's trade and investment policies has been, in part, a response to this turmoil. Mexico's currency crises and ensuing

contractions have had very negative consequences on the country's poor. Table 1 shows that poverty rates rose sharply after the 1995 peso crisis.

Mexico's economic opening began in 1982, when the government responded to a severe balance of payments crisis by easing restrictions on export assembly plants known as *maquiladoras*. In 1985, Mexico joined the General Agreement on Trade and Tariffs (GATT), which entailed cutting tariffs and eliminating many non-tariff barriers. In 1989, Mexico eased restrictions on the rights of foreigners to own assets in the country. In 1994, NAFTA consolidated and extended these reforms. Partly as a result of these policy changes, the share of international trade in Mexico's GDP has nearly tripled, rising from 11% in 1980 to 32% in 2002. Mexico is now as closely tied to the U.S. economy as it has been at any point in its history. In 2002, the country sent 89% of its exports to and bought 73% of its imports from the United States.[3]

Mexico's maquiladoras, shown in Figure 1, have been instrumental in the country's export conversion. Between 1983 and 2002, real value added in maquiladoras grew at an average annual rate of 11%, making it the most dynamic sector in the country. In 2002, these export assembly plants accounted for 45% of Mexico's manufacturing exports and 28% of the country's manufacturing employment (up from 4% in 1980). Their concentration in northern Mexico in part accounts for the differential regional impact of globalization in the country. A brief history of Mexico's trade policy reveals the origins of northern Mexico's advantage in export production.

In the 1940's, Mexico adopted a strategy of import substitution industrialization. To import most manufacturing products, firms had to obtain a license from the

[3] Concomitant with its economic opening, Mexico privatized state-owned enterprises, deregulated entry restrictions in many industries, and used wage and price restraints to combat inflation.

government and to pay moderate to high tariffs. In 1965, Mexico softened its import substitution strategy by allowing the creation of maquiladoras (Hansen, 1981).[4] Firms could import free of duty the inputs, machinery, and parts needed for export assembly operations, as long as they exported all output. To ensure firms abided by this rule, they were required to buy a bond equal to the value of their imports that would be returned to them once they had exported all their imported inputs in the form of final goods (hence the term in-bond assembly plants). In contrast to other firms in the country, maquiladoras could be 100% foreign owned. Bureaucratic restrictions on maquiladoras kept the sector small until 1982, when the government streamlined regulation of the plants.

Initially, maquiladoras were required to locate within 20 miles of an international border or coastline. In 1972, the government relaxed these rules and allowed maquiladoras to locate throughout the country. However, the plants continued to concentrate near the United States. As seen in Figure 2, 83% of maquiladora employment is still located in states on the U.S. border. Proximity to the U.S. market is motivated in part by a desire to be near U.S. consumers, to whom maquiladoras export nearly all of their production, and in part by a desire to be near U.S. firms, who often manage Mexican maquiladoras out of offices based in U.S. border cities.

U.S. trade policies initially gave maquiladoras an advantage over other Mexican producers in exporting to the U.S. market. Prior to NAFTA, a U.S. firm that made components, shipped them to a plant in Mexico for assembly, and then reimported the finished good only paid U.S. import duties on the value of Mexican labor and raw materials

[4] The original motivation for this program was to create employment opportunities for Mexican workers returning to the country after working in the United States as temporary farm laborers under the Bracero Program. The U.S. government ended the Bracero Program in 1964 and the Mexican government was concerned that the returning working would raise unemployment in border states.

used in assembly. NAFTA ended this special status for maquiladoras by giving all Mexican firms duty free access to the U.S. market.[5] Yet, as seen in Figure 1, NAFTA did little to stunt the growth of maquiladoras. In a purely legalistic sense, NAFTA did mean the end of the maquiladora regime; it eliminated the "in-bond" arrangement under which maquiladoras operated. However, Mexico's low wages continue to give the country a comparative advantage in the assembly of manufactured goods for the U.S. economy.

2.3 Regional Exposure to Globalization

Mexico's trade and investment reforms have dramatically increased the openness of its economy. These policies appear to have affected some parts of the country much than others. Figure 3 plots the share of state GDP accounted for by valued added in maquiladoras during the 1990's against distance to the United States. For three of the six states that border the United States (Baja California, Chihuahua, Tamaulipas), the maquiladora share of GDP is over 18%. For two of the three others (Coahuila, Sonora) it is over 8%. In the rest of the country, the maquiladora share of GDP is below 5%.

While maquiladoras are a large part of Mexico's exports, they are by no means the whole story. Export production also occurs in states with relatively large supplies of skilled labor, which have attracted multinational auto companies (as in Aguascalientes) and electronics producers (as in Jalisco). Figure 4 plots the share of foreign direct investment in state GDP against the share of maquiladora value added in state GDP, both averaged over the 1990's. While border states show up as high in both categories, other states have attracted foreign direct investment in forms besides maquiladoras. These

[5] With NAFTA, all firms in Mexico obtained duty-free access to the U.S. market as long as they comply with NAFTA rules of origin. NAFTA also exposes maquiladoras to rules of origin (from which they had been exempt previously), but not also allows the plants to sell goods on the Mexican market.

include states in which Mexico's most important industrial cities are located (Mexico City, Federal District; Monterrey, Nuevo Leon; Guadalajara, Jalisco).

Beyond FDI and maquiladoras, some states are exposed to globalization by virtue of having ports and being large importers. This is seen in Figure 5, which plots FDI as a share of state GDP against imports as a share of state GDP.[6] A few states, such as Yucatan and Sinaloa, have high imports, while attracting little in the way of FDI.

To categorize states as having high or low exposure to globalization, I use the three measures described in Figures 3-5: the share of maquiladora value added in state GDP, the share of FDI in state GDP, and the share of imports in state GDP (each averaged over the period 1993-1999). Using all three measures is important, since with the exception of FDI and imports they are relatively weakly correlated across states, as reported in Table 2. Table 3 reports the globalization measures for Mexico's 32 states, where states are sorted according to their average rank across the three measures. I select as states with high exposure to globalization those whose average rank across the three measures is in the top third (and that have at least one individual rank in the top third) and I select as states with low exposure to globalization those whose average rank is in the bottom third (and that have no single rank in the top third).

Finally, it is important to note that exposure to globalization is not simply a proxy for the opportunity to migrate to the United States. Contrary to popular belief, migration to the United States is not especially common among residents of Mexican states on the U.S. border. Mexico's high migration states are in agricultural regions in central and western Mexico, which have dominated migration to the United States for most of the last century (Durand, Massey, and Zenteno, 2001). Most of these states have low

[6] In Mexico, there are no data on exports at the state level (other than data on maquiladora exports).

exposure to FDI or to trade, as seen in Figures 6 and 7, which plot the fraction of the state population migrating to the United States over the period 1995-2000 against the share of FDI in state GDP or the share of imports in state GDP. This suggests that high exposure to globalization does not indicate high exposure to emigration.

3. Empirical Methodology

The empirical analysis involves comparing changes in income distribution during Mexico's globalization decade between two groups of states, states with high exposure to globalization and states with low exposure to globalization. In this section, I describe non-parametric and parametric approaches for making these comparisons.

3.1 Estimating Counterfactual Income Densities

Let $f(w|x,i,t)$ be the density of labor income, w, conditional on a set of observed characteristics, x, in region i and time t. Define $h(x|i,t)$ as the density of observed characteristics among income earners in region i and time t. For regions, $i=H$ indicates high exposure to globalization and $i=L$ indicates low exposure to globalization; for time periods, $t=00$ indicates the year 2000 and $t=90$ indicates the year 1990. The observed density of labor income for individuals in region i and time t is,

$$g(w \mid i,t) = \int f(w \mid x,i,t)h(x \mid i,t)dx \qquad (1)$$

Differences in $f(w \mid x,H,t)$ and $f(w \mid x,L,t)$ capture differences in returns to observable characteristics in regions with high versus low exposure to globalization; differences in $h(x|H,t)$ and $h(x|L,t)$ capture differences in the distribution of observed characteristics in high versus low-exposure regions.

To evaluate the change in income distributions across time and across regions, I would like to compare changes in $f(w|x,H,t)$ and $f(w|x,L,t)$, while holding the distribution of x constant. However, in the data I do observe not these conditional densities, but the only marginal densities, $g(w|x,H,t)$ and $g(w|x,L,t)$. To evaluate these densities, I apply techniques from DiNardo, Fortin, and Lemieux (1996). First, consider the cross-time change in income distribution in the high-exposure region that is due to changes in returns to observable characteristics, which can be written as

$$\int f(w|x,H,00)h(x|H,90)dx - \int f(w|x,H,90)h(x|H,90)dx \qquad (2)$$

Equation (2) evaluates the change in income distribution in high-exposure regions between 1990 and 2000, fixing the marginal density of observables to be that in high-exposure regions in 1990. Rewrite equation (2) as

$$\int [\theta^{H90\to H00} - 1] f(w|x,H,90)h(x|H,90)dx \qquad (3)$$

where

$$\theta^{H90\to H00} = \frac{f(w|x,H,00)}{f(w|x,H,90)} \qquad (4)$$

Equation (3) is simply the observed marginal income density in high-exposure regions in 1990, adjusted by a weighting function. Given an estimate of the weighting function in (4), it would be straightforward to apply a standard kernel density estimator to equation (3). The key, then, to estimating the change in income distribution that is due to changes in returns to observables is estimating the weighting function in (4).

Before turning to the weighting functions, consider the analog to equation (2) for regions with low exposure to globalization. The change in income distribution in low-exposure regions that is due to changes in returns to observables is

$$\int f(w \mid x, L, 00) h(x \mid H, 90) dx - \int f(w \mid x, L, 90) h(x \mid H, 90) dx \qquad (5)$$

Equation (5) evaluates the change in income distribution in regions with low exposure to globalization between 1990 and 2000, again fixing the marginal density of observables to be that in high-exposure regions in 1990. To rewrite equation (5) in terms of the marginal density of income in high-exposure regions in 1990, apply the weights

$$\theta^{H90 \to L00} = \frac{f(w \mid x, L, 00)}{f(w \mid x, H, 90)} \quad and \quad \theta^{H90 \to L90} = \frac{f(w \mid x, L, 90)}{f(w \mid x, H, 90)} \qquad (6)$$

which yields

$$\int [\theta^{H90 \to L00} - \theta^{H90 \to L90}] f(w \mid x, H, 90) h(x \mid H, 90) dx \qquad (7)$$

As in estimating equation (3), estimating equation (7) comes down to applying the appropriate weighting function to a standard kernel density estimator.

The changes in conditional income densities in equations (2) and (5) reflect in part the impact of globalization and in part the impact of other aggregate shocks to the Mexican economy. The *difference* between these changes amounts to a difference-in-difference estimator, which evaluates the change in returns to observables in regions with high exposure to globalization relative to change in returns observables in regions with low exposure to globalization. Putting equations (3) and (7) together,

$$\begin{aligned} &\left(\int f(w \mid x, H, 00) h(x \mid H, 90) dx - \int f(w \mid x, H, 90) h(x \mid H, 90) dx\right) - \\ &\left(\int f(w \mid x, L, 00) h(x \mid L, 90) dx - \int f(w \mid x, H, 90) h(x \mid H, 90) dx\right) = \\ &\int \left\langle \left(\theta^{H90 \to L00} - 1\right) - \left(\theta^{H90 \to L00} - \theta^{H90 \to L90}\right) \right\rangle f(w \mid x, H, 90) h(x \mid H, 90) dx \end{aligned} \qquad (8)$$

Equation (8) shows the 1990-to-2000 change income distribution in high-exposure regions relative to low-exposure regions, holding the distribution of observables constant.

I use equation (8) to evaluate the impact of globalization on income distribution in Mexico. The choice of the high-exposure region in 1990 as the base case is purely arbitrary and should not affect the density difference. To check the robustness of the results, I will discuss estimates using other base cases.

To estimate the weighting functions in (4) and (6), I use Leibbrandt, Levinsohn, and McCrary's (2004) extension of the DiNardo, Fortin, and Lemieux (1996). Applying Bayes' Axiom to the weighting equations,

$$\theta^{H90\to H00} = \frac{f(w\mid x,H,00)}{f(w\mid x,H,90)} = \frac{Pr(t=00,i=H)\mid w,x)}{1-Pr(t=00,i=H)\mid w,x)}\frac{1-Pr(t=00,i=H)\mid x)}{Pr(t=00,i=H)\mid x)}$$

$$\theta^{H90\to L00} = \frac{f(w\mid x,L,00)}{f(w\mid x,H,90)} = \frac{Pr(t=00,i=L)\mid w,x)}{1-Pr(t=00,i=L)\mid w,x)}\frac{1-Pr(t=00,i=L)\mid x)}{Pr(t=00,i=L)\mid x)}$$

$$\theta^{H90\to L90} = \frac{f(w\mid x,L,90)}{f(w\mid x,H,90)} = \frac{Pr(t=90,i=L)\mid w,x)}{1-Pr(t=90,i=L)\mid w,x)}\frac{1-Pr(t=90,i=L)\mid x)}{Pr(t=90,i=L)\mid x)} \qquad (9)$$

Each weighting function is the product of odds ratios. Consider the first weight. The first ratio is the odds an individual is from a high-exposure region in 2000 (based on a sample of individuals from high-exposure regions in 1990 and 2000), conditional on observables, *x*, and labor income, *w*. The second ratio is the (inverse) odds an individual is from a high-exposure region in 2000 (again, based on a sample of individuals from high-exposure regions in 1990 and 2000), conditional on just on *x*. I can estimate the odds ratios by estimating two logit models. In each case, the dependent variable is a 0-1 variable on the outcome *i=H* and *t=00* (based on a sample of *i=H* and *t=90* or *00*). For the first logit model, the regressors are *x* and *w*; for the second, the regressor is *x*, alone. The other weights can be estimated analogously.

After estimating the weights, I apply them to a standard kernel density estimator to obtain estimates for the densities described by equations (3), (7), and (9). These estimates are for the *difference* in income densities, in the case of (3) and (7), and for the *double difference* in income densities, in the case of equation (9).

3.2 A Parametric Analog

The advantage of the approach described in section 3.1 is that it characterizes the difference in income across time periods and/or regions at all points in the distribution. The disadvantage is that there are no standard errors for these density differences. To examine the statistical significance of the results, I estimate a parametric analog to equation (8), which is simply a difference-in-difference wage equation.

I pool data on working age men in 1990 and 2000 from states with either high exposure or low exposure to globalization and then estimate the following regression,

$$\ln w_{hst} = \alpha_s + X_{hst}(\beta_1 + \beta_2 Y2000_{ht} + \beta_3 High_{hs}) + \phi * Y2000_{ht} * High_{hs} + \varepsilon_{hst} \quad (10)$$

where w is labor market earnings, X is a vector of observed characteristics, *Y2000* is a dummy variable for the year 2000, and *High* is a dummy variable for high-exposure states. The regression includes controls for state fixed effects and allows returns to observable characteristics to vary across regions and across time. The coefficient, φ, captures the differential change in earnings from 1990 to 2000 between high-exposure and low-exposure states. The disadvantage of this approach, relative to equation (8), is that it uncovers only the mean differential in income growth between regions.

3.3 Estimation Issues

Several estimation issues merit attention. First, individuals self-select into regions. Individuals who have chosen to live in a state with high-exposure to globalization may have relatively high drive or ambition and may have moved to the state precisely to take advantage of the opportunities globalization offers. Similarly, individuals who have chosen not to leave states with low-exposure to globalization may have relatively low drive or ambition. Given this pattern of selection, unobserved components of labor income would tend to be positive for individuals in high-exposure states and negative for individuals in low-exposure states. The estimation exercises in (9) and (10) would then be polluted by systematic differences in unobserved characteristics between regions. To avoid this problem, I categorize individuals by birth state and not by state of residence. In this way, I pick up earnings differences in where people live based on where they were born – a factor out of their control – and not on where they have chosen to reside – a factor in their control. Consistent with expectations, in 1990 83% of those born in high-exposure states still lived in those states, compared to only 73% of those born in low-exposure states. In 2000, the figures were 82% and 70%.

A second estimation issue is that individuals self-select into the labor force. This is partly due to age. Over time, young workers enter the labor force and older workers exit. To control for these movements, I limit the sample to the cohort of men who were 25 to 55 years old in 1990 (and so 35 to 65 years old in 2000). Relatedly, if over the 1990's labor-market conditions improved by more in high-exposure states than in low-exposure states, high-exposure states may have registered a larger increase the fraction of low-ability individuals participating in the labor force. Given this pattern of selection,

unobserved components of labor income may have increased by less in high-exposure states and than in low-exposure states.[7] To control for selection into the labor-force, I follow Lee (2004) and trim the four samples of men (i.e., for $i=H,L$ and $t=90,00$) such that the fraction included in the estimation is the same for each group.

A third estimation issue is that shocks other than globalization may have had differential impacts on regions with high versus low exposure to globalization. One such shock is the pesos crisis of 1995. After a bungled devaluation of the peso in 1994, Mexico chose to float its currency, which proceeded to plummet in value relative to the dollar. The ensuing increase in the peso value of dollar-denominated liabilities contributed to a banking collapse and a severe macroeconomic contraction. It is hard to gauge whether the peso crisis would have hurt states with high exposure to globalization more or less than states with low exposure. On the one hand, high-exposure states are more specialized in the production of exports and the devaluation of the peso would have increased demand for their output. On the other hand, high-exposure states are better integrated into Mexico's financial markets and the banking collapse may have hurt them more. Other important shocks in the 1990's included a reform of Mexico's land tenure system in 1992, the ongoing privatization of state-owned enterprises and deregulation of industries, and the ruling party's loss of majority control in Mexico's congress in 1997. Again, it is hard to say whether these shocks would have helped or hurt high-exposure states more. The existence of these other shocks leaves the results subject to the caveat that factors other than globalization may have accounted for any differential change in income distribution across regions of the country. I return to this issue in section 5.

[7] This suggests that selection into the labor force would work against selection into regions, in terms of the impact on unobserved components of earnings.

4. Empirical Results

The sample for the analysis is men aged 25 to 55 in 1990 or aged 35 to 65 in 2000 who were born in one of the seven Mexican states with high-exposure to globalization or one of the ten Mexican states with low-exposure to globalization. The dependent variable is log average hourly labor earnings.[8] I also discuss results using log total labor income as the dependent variable. Summary statistics are in Table 4.

To provide a starting point, consider the raw distributions of labor income in states with high exposure to globalization and in states with low exposure to globalization. Figure 8 shows kernel density estimates for hourly labor earnings in 1990 and 2000. In both years, the density for high-exposure states is shifted to the right compared to low-exposure states. Higher wages in high-exposure states reflect in part the fact these states have a more highly educated labor force, as shown in Table 4.

To control for regional differences in the distribution of observable characteristics, I apply the weights in equation (9) to the kernel density for high-exposure states in 1990. This produces the two sets of densities in Figure 9. The first graph shows the actual income density in 1990 for high-exposure states and a counterfactual density that would obtain were workers in high-exposure states in 1990 paid according to the returns to observable characteristics in low-exposure states in 1990, or

$$\int f(w \mid x, L, 90)h(x \mid H, 90)dx = \int \theta^{H90 \to L90} f(w \mid x, L, 90)h(x \mid H, 90)dx$$

[8] For Mexico, average hourly wages are calculated as monthly labor income/(4.5*hours worked last week); for the U.S., average hourly wages are calculated as annual labor income/(weeks worked last year*usual hours worked per week). Assuming individuals work all weeks of a month could bias wage estimates downwards. To avoid measurement error associated with implausibly low wage values or with top coding of earnings, I restrict the sample to be individuals with hourly wages between $0.05 and $20 (in 2000 dollars). This restriction is nearly identical to dropping the largest and smallest 0.5% of wage values.

Since the distribution of observable characteristics is the same in the actual and counterfactual densities, comparing the two makes it possible to isolate the regional differences in income densities that are attributable to regional differences in returns to characteristics. In Figure 9, the density for high-exposure states in 1990 is again right-shifted relative to low-exposure states, though the regional difference in incomes is smaller. Thus, even before Mexico's globalization decade, incomes were higher across the distribution in high-exposure states. These income differences may be due to high-exposure states historically having better infrastructure, being more specialized in the high-wage manufacturing sector, or being less specialized in the low-wage agricultural sector, among other factors (Chiquiar, 2003). This highlights the importance of controlling for initial income differences between states when examining changes in income distribution over time.

The second graph in Figure 9 shows income densities in 2000, evaluated based on the distribution of observable characteristics in high-exposure states 1990. For high-exposure states, the resulting counterfactual density is what workers in high-exposure states in 2000 would earn were they to have the observable characteristics of workers in high-exposure states in 1990, or

$$\int f(w \mid x, H, 00) h(x \mid H, 90) dx = \int \theta^{H90 \to H00} f(w \mid x, L, 90) h(x \mid H, 90) dx$$

For low-exposure states, the counterfactual is what workers in low-exposure states in 2000 would earn had they the characteristics of high-exposure states in 1990, or

$$\int f(w \mid x, L, 00) h(x \mid H, 90) dx = \int \theta^{H90 \to L00} f(w \mid x, L, 90) h(x \mid H, 90) dx$$

Comparing these counterfactuals isolates regional differences in income densities that are due to differences in returns to characteristics, rather than to the distribution of

observables. As in 1990, the density for high-exposure states in 2000 is right-shifted relative to low-exposure states. Comparing the two years, it appears that differences in income densities between high-exposure and low-exposure states have increased over time, suggesting relative incomes have risen in the former.

To explore these changes in more detail, Figure 10 shows estimates of equation (2) – the 1990-to-2000 change in income densities in high-exposure states – and of equation (5) – the 1990-to-2000 change in income densities in low-exposure states, where all densities are evaluated based on the distribution of observables in high-exposure states in 1990 (as shown in equations (3) and (7)). In low-exposure states, there was a pronounced shift in mass from the upper half of the distribution to the lower half of the distribution. In high-exposure states, there was a modest shift in mass from the upper part of the distribution to the middle of the distribution. While labor incomes in the 1990's deteriorated in both regions, caused in part by Mexico's peso crisis in 1995, the deterioration was much less severe in states with high-exposure to globalization.

The change in regional relative incomes is seen more clearly in Figure 11, which shows an estimate of equation (8), the change in income density in high-exposure states relative to the change in income density in low-exposure states (evaluated for the distribution of observable characteristics in high-exposure states in 1990). It is clear that the income of high-exposure states has increased relative to the income of low-exposure states. This appears as shift in mass in the double density difference from the lower half of the distribution to the upper half of the distribution. During Mexico's globalization decade, individuals born in states with high-exposure to globalization appear to have done much better than individuals born in states with low-exposure to globalization.

Throughout the analysis, we have evaluated labor income densities fixing the distribution of observable characteristics to be those in states with high-exposure to globalization in 1990. This choice of the base case is arbitrary and should not affect the results. To examine the robustness of the findings, Figure 12 re-estimates the double difference in income densities in equation (8), evaluating all densities based on the distribution of observables in low-exposure states in 1990. Figure 12 is very similar to Figure 11, confirming that the choice of base case does not matter for the results.

The income densities shown so far are for average hourly labor earnings. If changes in wages affect individual labor supply, changes in hourly labor earnings may understate changes in total labor income. To see if this might be the case, Figure 13 estimates of the double density difference in equation (8), evaluated in terms of total labor income rather than average hourly labor income. Figure 13 is similar to Figure 11, suggesting that regional changes in the distribution of total labor income mirror regional changes in the distribution of hourly labor income.

While the results in Figures 11-13 show a strong increase in relative incomes in states with high exposure to globalization they give no sense of the statistical precision of these estimates. As a check on the statistical significance of the results, Table 5 shows estimation results for equation (10). The dependent variable is log average hourly labor earnings. The regressors are dummy variables for educational attainment, a quadratic in age, a dummy variable for the year 2000 and its interaction with the age and education variables, a dummy variable for having been born in a state with high-exposure to globalization and its interaction with the age and education variables, dummy variables for the state, and the interaction of the year 2000 and high-exposure-to-globalization

dummy variables. This last variable captures the differential change in wage growth in high-exposure states relative to low-exposure states. Standard errors are adjusted for correlation across observations within the same state.

During the 1990's, the cohort of individuals born in states with high exposure to globalization enjoyed labor earnings growth that was 7.9 to 9.2 log points higher than earnings growth for individuals born in low-exposure states. These coefficients are precisely estimated. This is consistent with the counterfactual density estimates and again suggests that individuals in high-exposure states enjoyed higher growth in labor income that individuals in low-exposure states. The second two columns of Table 5 show results where the year200/high-exposure interaction is interacted with a dummy variable for an individual having completed a secondary education. This term allows relative earnings growth to be larger for more-educated workers. The interaction term is negative, but imprecisely estimated, suggesting that there is no statistically significant difference in regional relative earnings growth between more and less-educated workers.

5. Conclusion

In this paper, I examine the change in the distribution of labor income across regions of Mexico during the country's decade of globalization in the 1990's. I focus the analysis on men born in states with either high-exposure to globalization or in states with low-exposure to globalization, as measured by the share of foreign direct investment, imports, and export assembly in state GDP during the 1990's. Mexican states with high exposure to globalization are located along the U.S. border and in the relatively skill-abundant center-west region of the country; states with low exposure to globalization are

primarily located in more rural southern Mexico. I exclude from the analysis individuals born in states with intermediate exposure to globalization.

Controlling for regional differences in the distribution of observable characteristics and for initial differences in regional incomes, the distribution of labor income in high-exposure states shifted to the right relative to the distribution of income in low-exposure states. This change in regional relative incomes was primarily the result of a shift in mass in the income distribution of low-exposure states from upper-middle income earners to lower income earners. On average, labor incomes in states with high exposure to globalization increased by 8-9% relative to low-exposure states.

There are several possible interpretations of these results. One is that trade and investment liberalization raised incomes in states with high exposure to the global economy relative to states with low exposure to the global economy. However, trade and investment reforms were by no means the only shocks to the Mexican economy during the 1990's. The Mexican peso crisis in 1995 was another very important event. The results are also consistent with states that were more integrated into the global markets being better able to weather the large devaluation of the peso, the banking crisis, and the contraction in economic activity that occurred in Mexico during the mid 1990's. This should come as little surprise. High-exposure states are relatively specialized in export production and would stand to benefit from a depreciation of the currency.

Other policy changes, such as the privatization and deregulation of Mexican industry or the reform of Mexico's land-tenure system, may also have had differential regional impacts in Mexico. Privatization and deregulation appeared to weaken Mexico's unions and lower wage premiums enjoyed by workers in these sectors (Fairris, 2003).

Since more heavily unionized industries are concentrated in Mexico's north and center, and relatively absent in Mexico's south (Chiquiar, 2003), we might expect a loss in union power to lower relatives incomes in states with high-exposure to globalization, contrary to what we observe in the data. The reform of Mexico's land-tenure system allowed individuals to sell agricultural land previously held in cooperative ownership. In principal we might expect this opportunity to raise relative incomes in rural southern Mexico, where agriculture accounts for a relatively high share of employment and output. Again, this is contrary to what we observe in the data.

A brief review of Mexico's other policy reforms during the 1990's does not suggest any obvious reason why they should account for the observed increase in relative incomes in states with high-exposure to globalization. Still, it is important to be cautious about ascribing shifts in regional relative incomes to specific policy changes. In the end, we can only say that I find suggestive evidence that globalization has increased relative incomes in Mexican states that are more exposed to global markets.

References

Ariola, Jim and Chinhui Juhn. 2003. "Wage Inequality in Post-Reform Mexico." Mimeo, University of Houston.

Attanasio, Orazio, Pinelopi Goldberg and Nina Pavcnik. 2004. "Trade Reforms and Wage Inequality in Colombia." *Journal of Development Economics*, 74: 331-366.

Behrman, Jere, Nancy Birdsall, and Miguel Szekely. 2003. "Economic Policy and Wage Differentials in Latin America." Mimeo, University of Pennsylvania.

Chiquiar, Daniel. 2003. *Essays on the Regional Implications of Globalization: The Case of Mexico*. Ph.D. Dissertation, University of California, San Diego.

Cortes, Fernando, Daniel Hernandez, Enrique Hernandez Laos, Miguel Szekely, and Hadid Vera Llamas. 2003. "Evolucion y Caracteristicas de la Pobreza en Mexico en la Ultima Decada del Siglo XX." *Economia Mexicana*, XII(2): 295-328.

Cragg, Michael I. and Mario Epelbaum. 1996. "The Premium for Skills in LDCs: Evidence from Mexico." *Journal of Development Economics* 51(1): 99-116.

Currie, Janet, and Ann Harrison. 1997. "Trade Reform and Labor Market Adjustment in Morocco." *Journal of Labor Economics*, 15: S44-71.

DiNardo, John, M. Fortin, and Thomas Lemieux. 1996. "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach." *Econometrica* 64(5): 1001-1044.

Durand, Jorge, Douglas S. Massey, and Rene M. Zenteno. 2001. "Mexican Immigration in the United States." *Latin American Research Review* 36(1): 107-127.

Fairris, David H. 2003. Unions and Wage Inequality in Mexico. *Industrial and Labor Relations Review*, 56(3): 481-97.

Feliciano, Zadia. 2001. "Workers and Trade Liberalization: The Impact of Trade Reforms in Mexico on Wages and Employment." *Industrial and Labor Relations Review* 55(1): 95-115.

Feenstra, Robert C. 1998. "Integration of Trade and Disintegration of Production in the Global Economy." *Journal of Economic Perspectives*, 12: 31-50.

Feenstra, Robert C., and Gordon H. Hanson. 1997. "Foreign Direct Investment and Relative Wages: Evidence from Mexico's Maquiladoras." *Journal of International Economics,* 42(3-4): 371-394.

Feenstra, Robert C. and Gordon H. Hanson. 2003. "Global Production and Inequality: A Survey of Trade and Wages," in James Harrigan, ed., *Handbook of International Trade*, Basil Blackwell.

Feenstra, Robert C. and Gordon H. Hanson. 1999. "Productivity Measurement and the Impact of Trade and Technology on Wages: Estimates for the U.S., 1972-1990," *Quarterly Journal of Economics*, August, 114:907-940.

Freeman, Richard B., "Are Your Wages Set in Beijing?" *Journal of Economic Perspectives,* 9(1995):15-32.

Freeman, Richard B. 2003. "Trade Wars: The Exaggerated Impact of Trade in Economic Debate." NBER Working Paper no. 10000.

Goldberg, Pinelopi, and Nina Pavcnik. 2004. "Trade, Inequality, and Poverty: What Do We Know? Evidence from Recent Trade Liberalization Episodes in Developing Countries." NBER Working Paper no. 10593.

Hansen, Niles. 1981. *The Border Economy: Regional Development in the Southwest*. Austin: University of Texas Press.

Hanson, Gordon. 2004. "What Has Happened to Wages in Mexico since NAFTA?", in Toni Estevadeordal, Dani Rodrik, Alan Taylor, Andres Velasco, eds., *FTAA and Beyond: Prospects for Integration in the Americas*, Cambridge: Harvard University Press.

Hanson, Gordon H. and Ann E. Harrison. 1999. Trade, Technology, and Wage Inequality in Mexico. *Industrial and Labor Relations Review* 52(2): 271-288.

Hsieh, Chang-Tai. 2003. "The Impact of Outsourcing to China on Hong Kong's Labor Market," Mimeo, UC Berkeley.

Katz, Lawrence F. and David Autor, "Changes in the Wage Structure and Earnings Inequality," in Orley Ashenfelter and David Card, eds., *Handbook of Labor Economics, Vol. 3A*, Amsterdam: Elsevier Science, 1999, 1463-1555.

Lee, David. 2004. "Trimming for Bounds on Treatment Effects with Missing Outcomes." Mimeo, UC Berkeley.

Leibbrandt, Murray, James Levinsohn, and Justin McCrary. 2004. "Incomes in South Africa since the Fall of Apartheid." Mimeo, University of Michigan.

Pavcnik, Nina. 2003. "What Explains Skill Upgrading in Less Developed Countries?" *Journal of Development Economics*, 71: 311-328.

Revenga, Anna L. 1997. Employment and Wage Effects of Trade Liberalization: The Case of Mexican Manufacturing. *Journal of Labor Economics* 15(3): S20-43.

Richardson, J. David. 1995. "Income Inequality and Trade: How to Think, What to Conclude." *Journal of Economic Perspectives* 9: 33-56.

Robertson, Raymond. 2000. "Wage Shocks and North American Labor Market Integration." *American Economic Review* 90(4): 742-764.

Table 1: Percent of Mexico's Population with Per Capita Income below Threshold Needed to Achieve Minimum Caloric Intake

Area	**1992**	**1994**	**1996**	**1998**	**2000**
Urban Households	10.2	7.2	20.1	16.4	9.8
Rural Households	29.5	30.0	43.3	43.8	34.1
Source: Cortés, et.al (2003).					

Table 2: Correlation Matrix for Measures of Exposure to Globalization Across Mexican States in the 1990's

	Maquiladora Value Added/ State GDP	Foreign Direct Investment/ State GDP	Imports/ State GDP	Share of State Population Migrating to US, 1995-2000
Maquiladora Value Added/ State GDP				
Foreign Direct Investment/ State GDP	0.381			
Imports/ State GDP	-0.008	0.582		
Share of State Population Migrating to US, 1995-2000	-0.129	-0.371	-0.257	

Notes: Shares of state GDP (maquiladora value added, foreign direct investment, imports) are averages over the period 1993-1999. Correlations are weighted by state share of the national population (averaged over 1990 to 2000).

Table 3: Categorizing Mexican States by Exposure to Globalization in the 1990's

	State	Average Rank	Share of State GDP FDI	Imports	Maquiladoras
	Baja California	30	0.070	0.018	0.246
High	Chihuahua	28	0.030	0.018	0.214
Exposure	Nuevo Leon	28	0.039	0.027	0.023
to	Sonora	27	0.015	0.034	0.088
Globalization	Jalisco	25	0.018	0.027	0.029
	Tamaulipas	25	0.035	0.013	0.181
	Aguascalientes	25	0.015	0.014	0.046
	DF	22	0.055	0.058	0.000
	Coahuila	22	0.011	0.014	0.077
	Yucatan	21	0.005	0.023	0.031
	Puebla	19	0.009	0.015	0.015
	Baja California Sur	19	0.032	0.011	0.008
Intermediate	San Luis Potosi	18	0.028	0.011	0.013
States	Guanajuato	18	0.009	0.014	0.008
	Sinaloa	17	0.005	0.027	0.001
	Tlaxcala	17	0.019	0.010	0.020
	Queretaro	16	0.013	0.011	0.011
	Durango	16	0.001	0.012	0.035
	Tabasco	16	0.010	0.017	0.000
	Morelos	15	0.024	0.010	0.005
	Mexico	15	0.031	0.008	0.004
	Michoacan	15	0.000	0.016	0.000
	Zacatecas	15	0.003	0.013	0.008
Low	Quintana Roo	12	0.006	0.011	0.000
Exposure	Nayarit	10	0.006	0.011	0.000
to	Colima	9	0.002	0.014	0.000
Globalization	Guerrero	9	0.004	0.007	0.002
	Veracruz	8	-0.004	0.012	0.000
	Chiapas	6	0.000	0.011	0.000
	Campeche	5	0.001	0.008	0.000
	Hidalgo	4	0.000	0.007	0.000
	Oaxaca	2	0.000	0.005	0.000

Notes: Shares of state GDP (foreign direct investment, imports, maquiladora value added) are averages over the period 1993-1999.

Table 4: Summary Statistics

Year		Variable	High Exposure to Globalization		Low Exposure to Globalization	
			Mean	St. Dev.	Mean	St. Dev.
1990		Age	33.6	5.9	33.9	5.9
	High Grade	0	0.055	0.229	0.132	0.338
	of	1 to 5	0.185	0.388	0.285	0.452
	Schooling	6 to 8	0.273	0.445	0.255	0.436
	Completed	9 to 11	0.208	0.406	0.141	0.348
		12 to 15	0.139	0.346	0.100	0.300
		16+	0.140	0.347	0.087	0.282
		Wage	2.590	2.610	1.781	2.073
		N	13,771		19,352	
2000		Age	43.0	5.7	43.2	5.8
	High Grade	0	0.036	0.187	0.093	0.290
	of	1 to 5	0.178	0.383	0.255	0.436
	Schooling	6 to 8	0.259	0.438	0.259	0.438
	Completed	9 to 11	0.207	0.405	0.157	0.364
		12 to 15	0.142	0.349	0.109	0.312
		16+	0.177	0.382	0.128	0.334
		Wage	2.656	2.798	1.674	1.965
		N	11,807		17,967	

Note: Sample is men with positive labor earnings aged 25-55 in 1990 or 35-65 in 2000 born in states with either high-exposure to globalization or low-exposure to globalization. Wages are average hourly levels in 2000 U.S. dollars.

Table 5: Regression Results

	All Workers	Workers w/ 20-80 Hour Work Week	All Workers	Workers w/ 20-80 Hour Work Week
Year 2000*High Exposure	0.092	0.079	0.115	0.116
	(0.039)	(0.033)	(0.053)	(0.050)
Year 2000*High Exposure* Secondary Education			-0.050	-0.079
			(0.042)	(0.046)
R^2	0.337	0.373	0.337	0.373
N	45,012	42,298	45,012	42,298

Notes: The dependent variable is log average hourly labor earnings. In columns 1 and 3, the sample is non-self-employed males born in states with high exposure to globalization or states with low exposure to globalization; in columns 2 and 4, the sample includes only the non-self-employed who report working 20-80 hours a week. Other regressors (quadratic in age, dummies for year of education, and their interactions with year 2000 dummy and with High Exposure dummy; year 2000 dummy variable; state dummy variables) are not shown. Standard errors are in parentheses and are adjusted for correlation across observations within birth states.

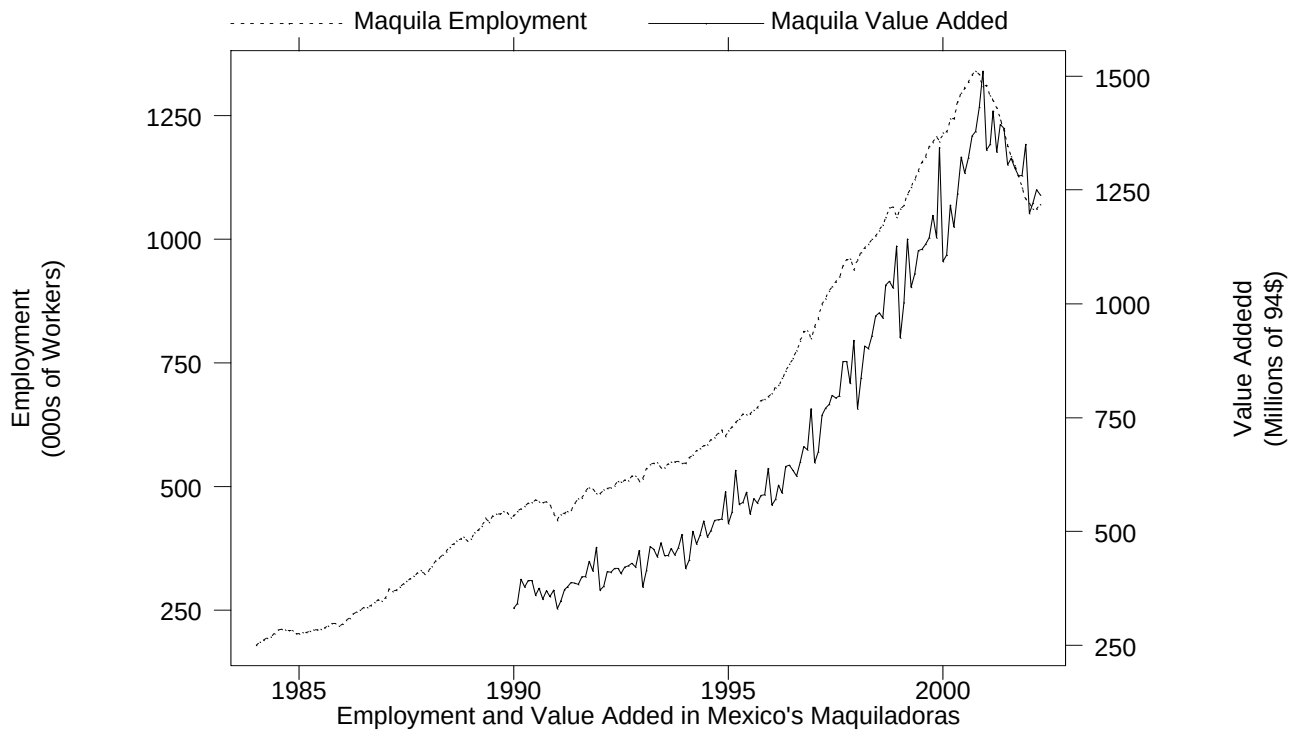


Figure 1

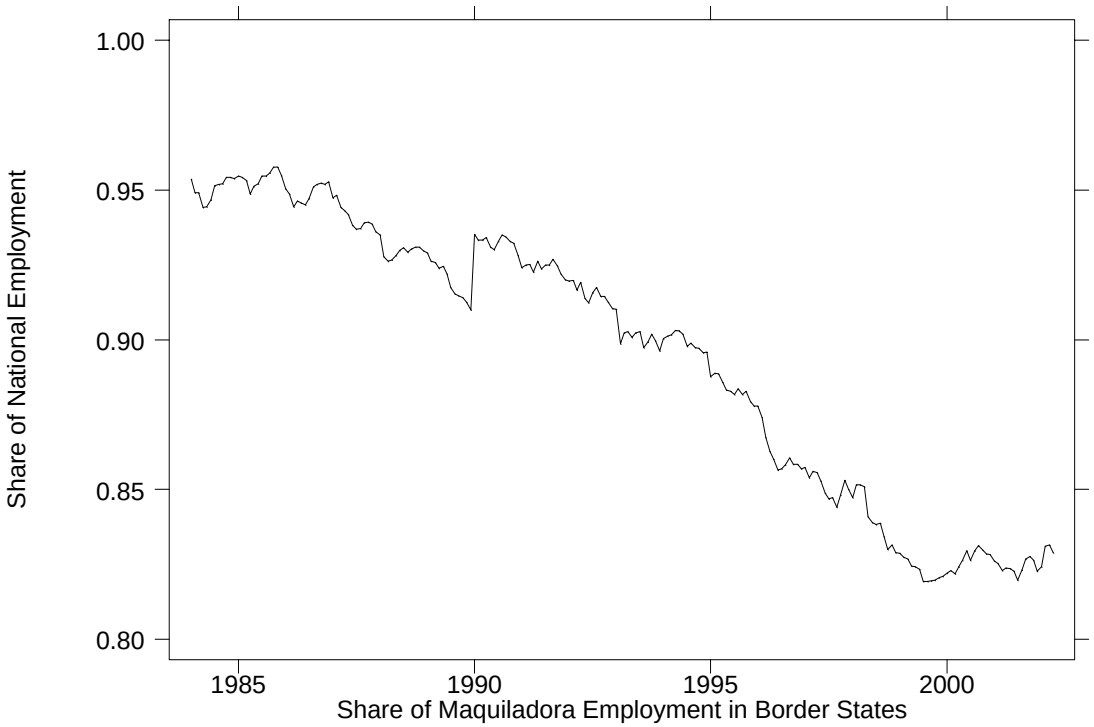


Figure 2

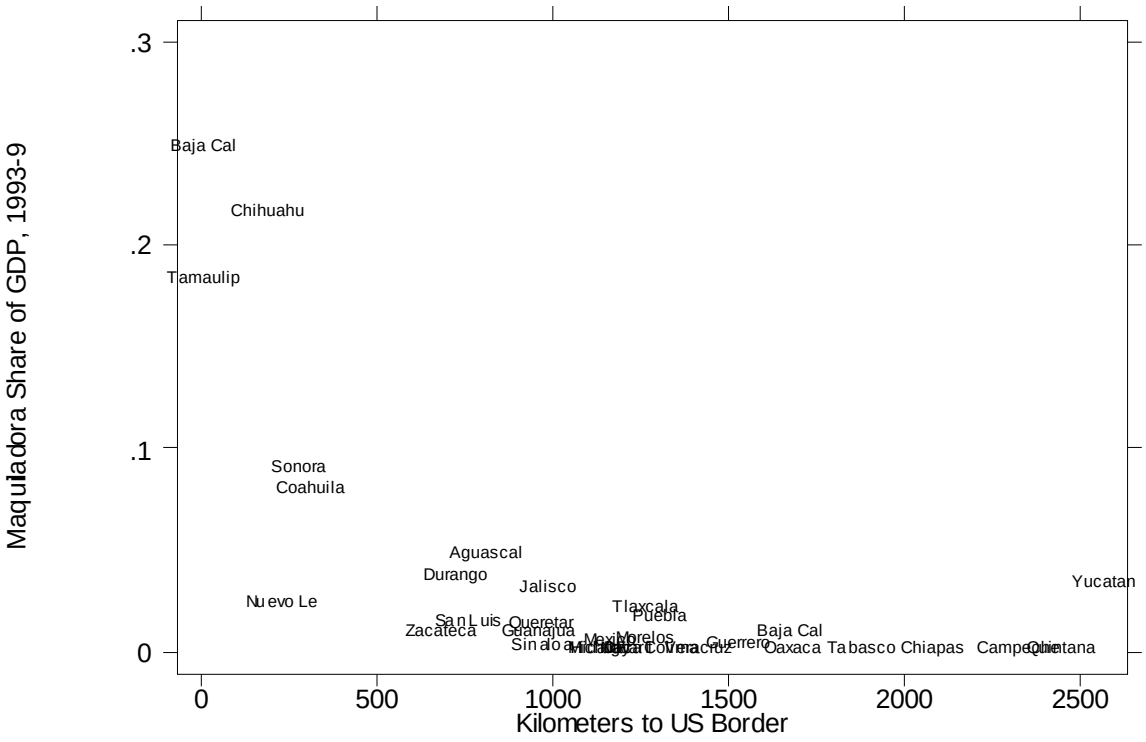


Figure 3

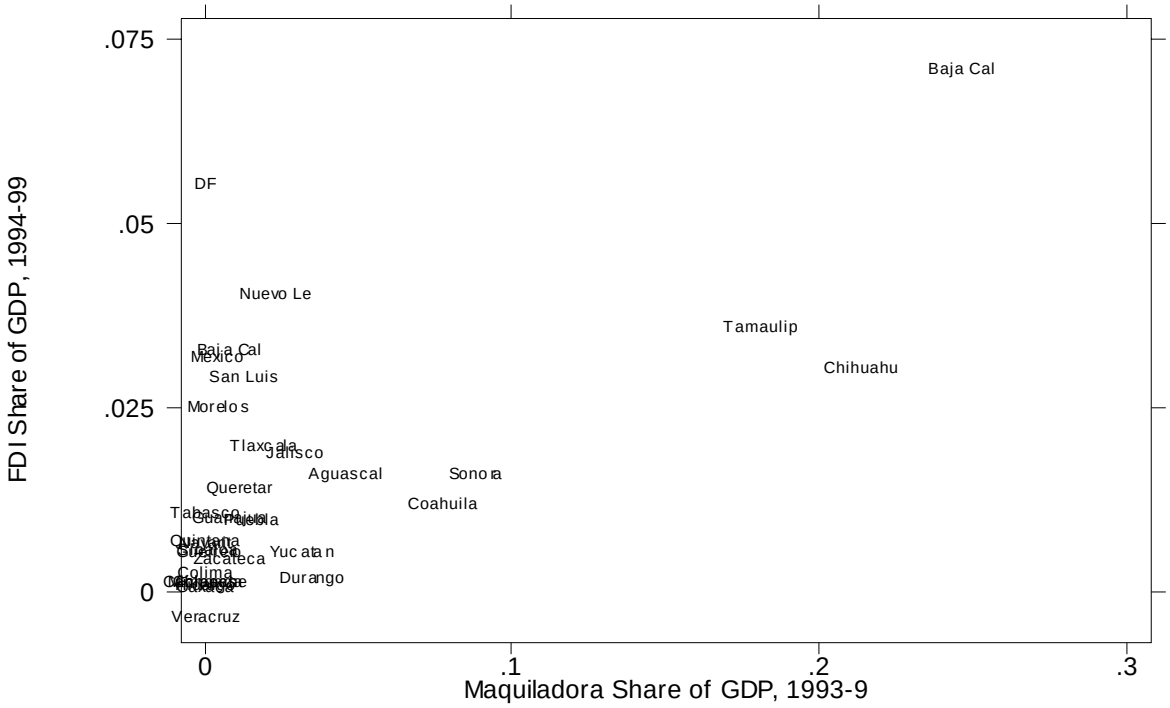
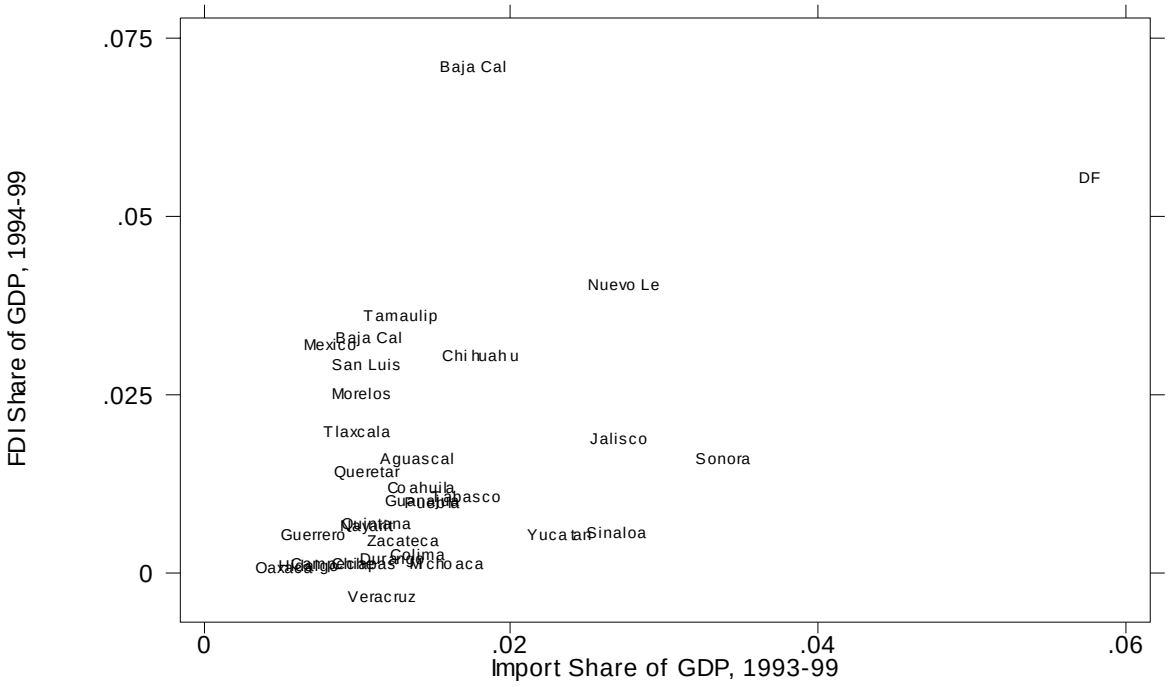


Figure 4


.075
.05
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FDI Share of GDP, 1994-99
Baja Cal
DF
Nuevo Le
Tamaulip
Baja Cal
Mexico
Chihuahu
San Luis
Morelos
Tlaxcala
Jalisco
Aguascal
Sonora
Queretar
Coahuila
Tabasco
Guerrero
Zacateca
Yucatan
Sinaloa
Colima
Michoaca
Veracruz
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Import Share of GDP, 1993-99

Figure 5

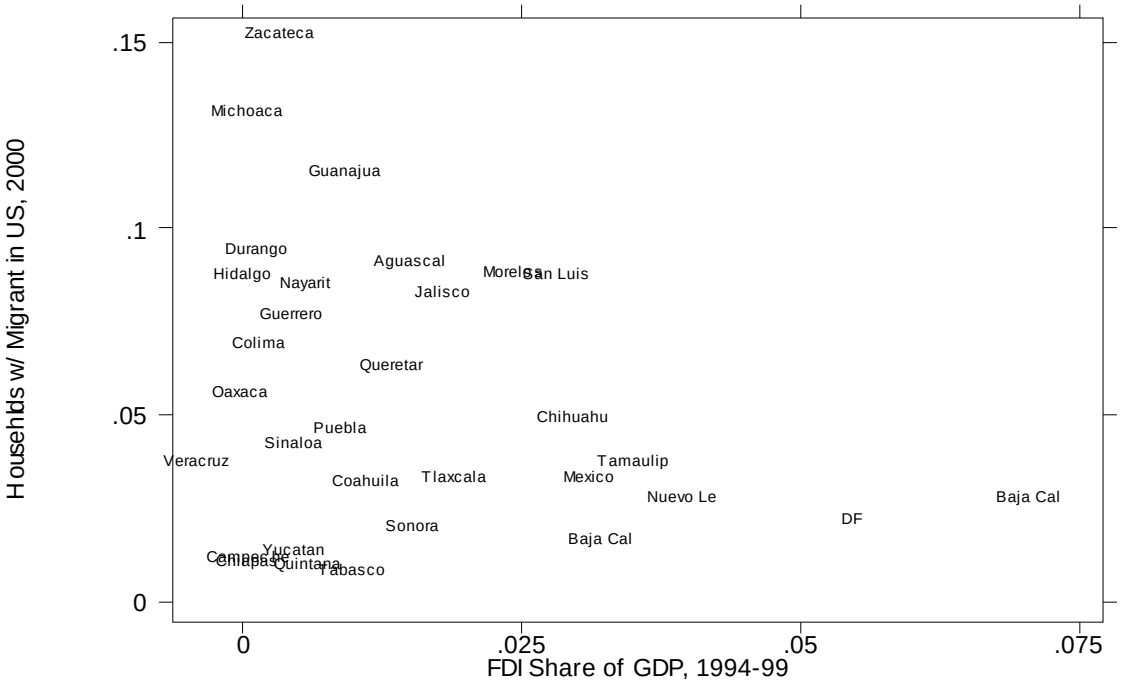


Figure 6

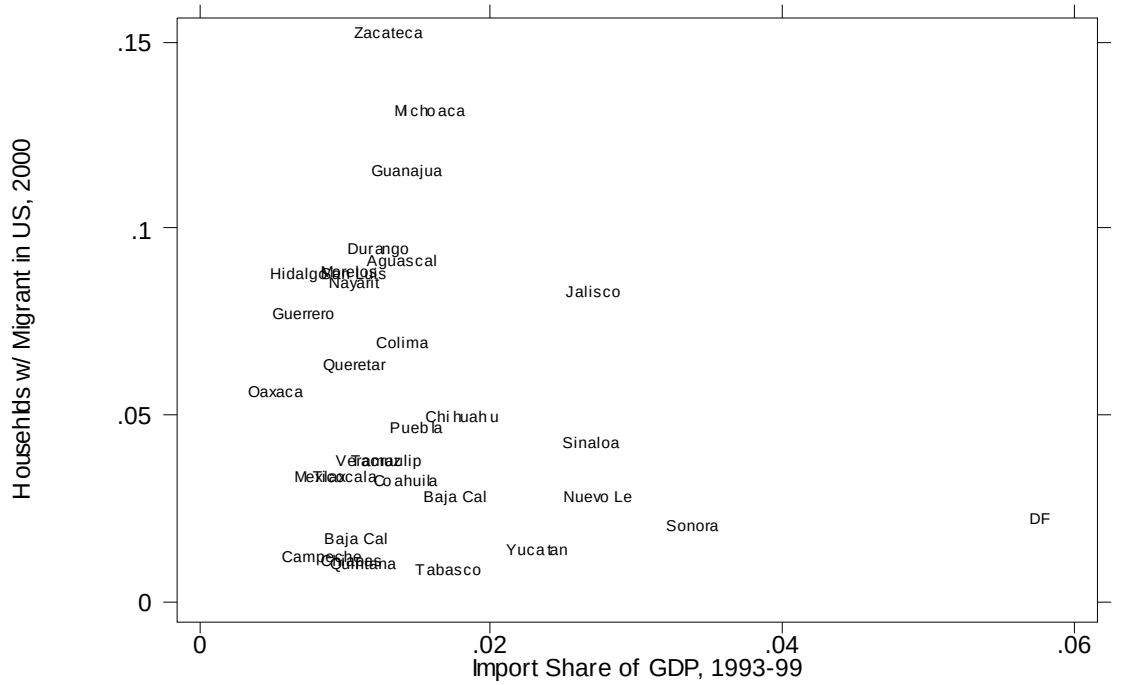
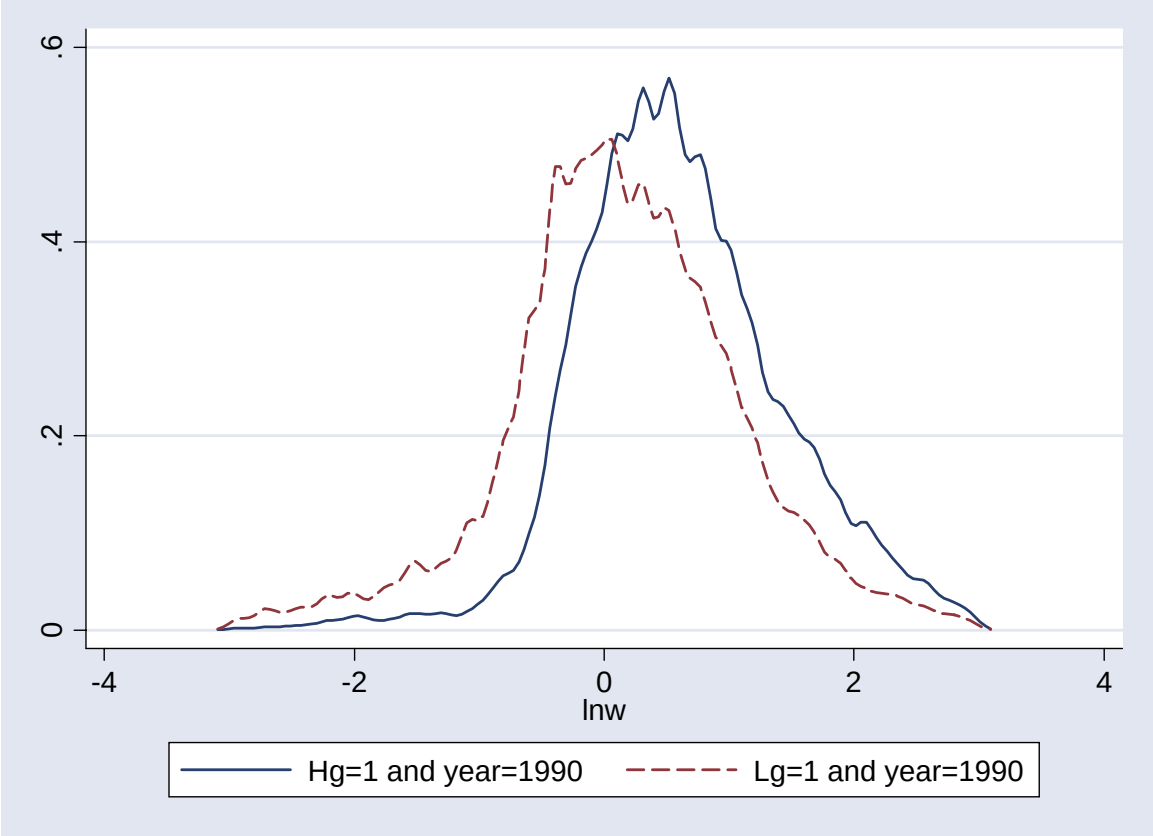


Figure 7

Figure 8: Density of Hourly Labor Income in States with High Exposure and Low Exposure to Globalization, 1990 and 2000



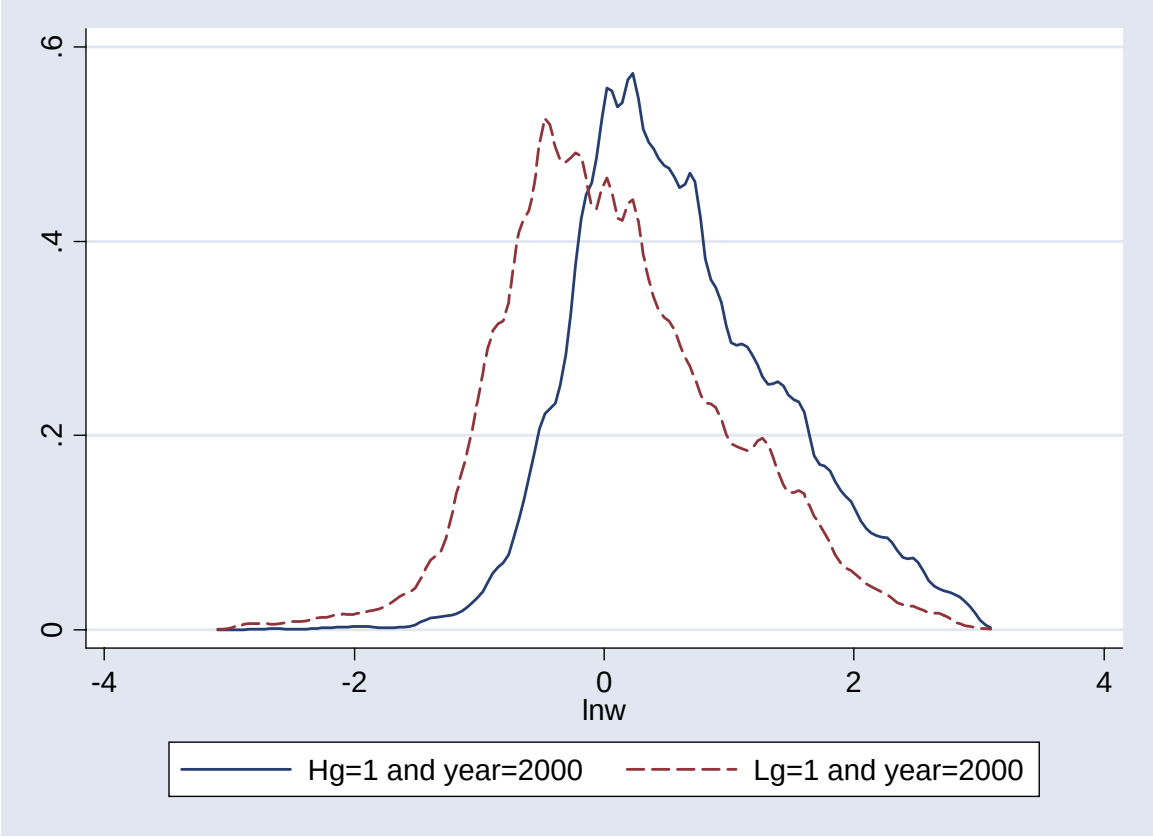


Figure 9a: Counterfactual Income Densities, High and Low-Exposure States in 1990

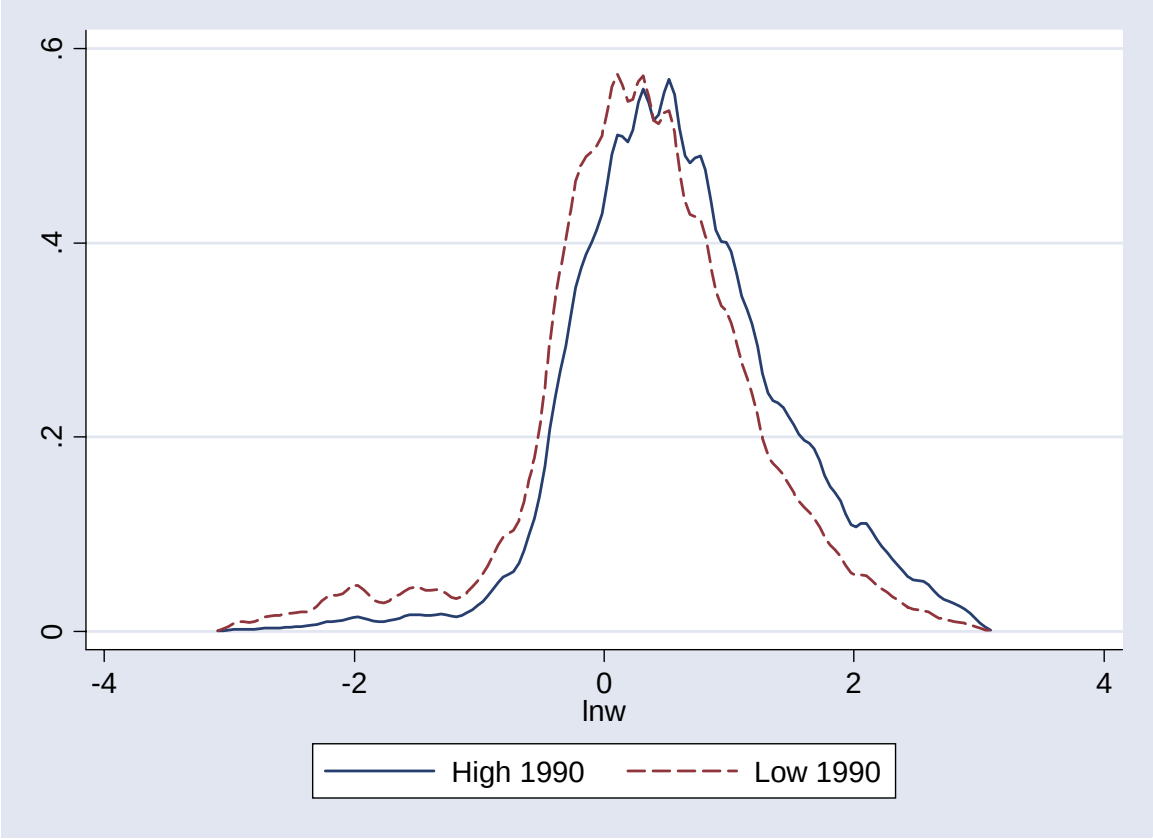


Figure 9b: Counterfactual Income Densities, High and Low-Exposure States in 2000

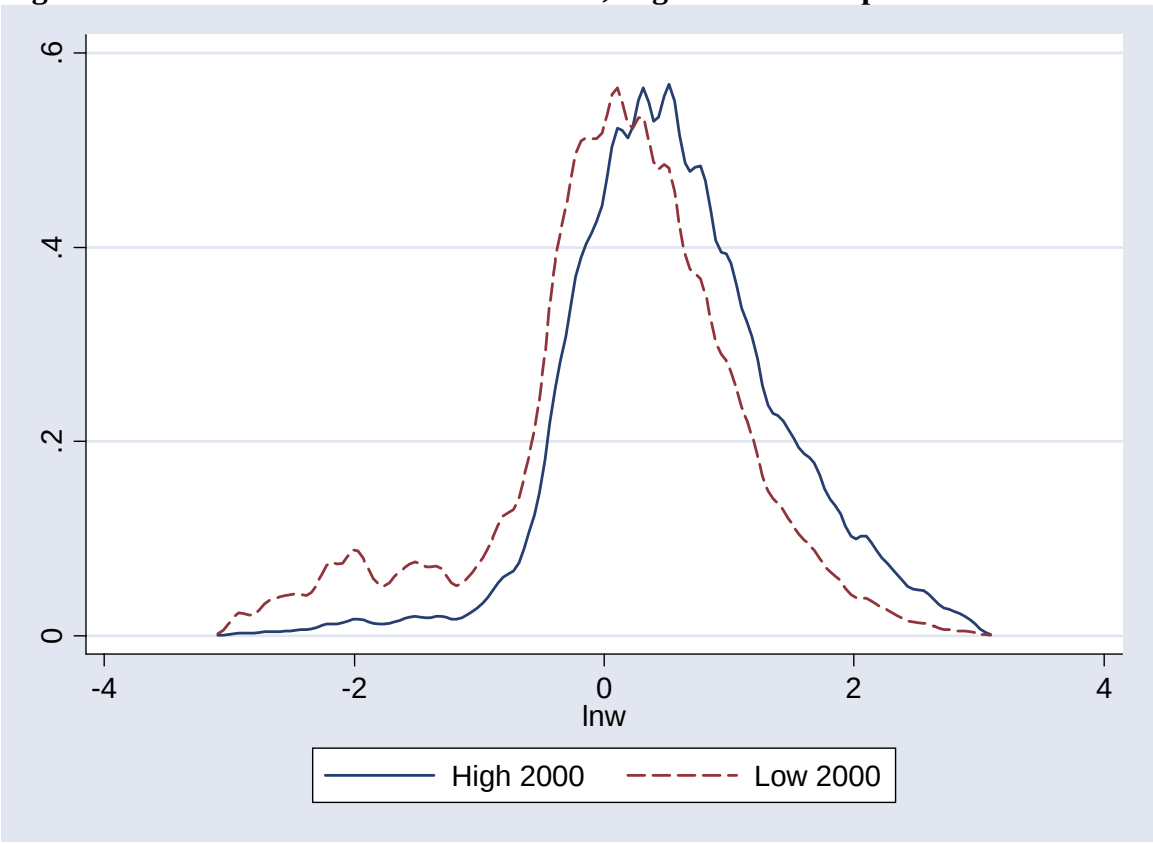


Figure 10: Estimated Change in Labor Income Densities, 1990 to 2000

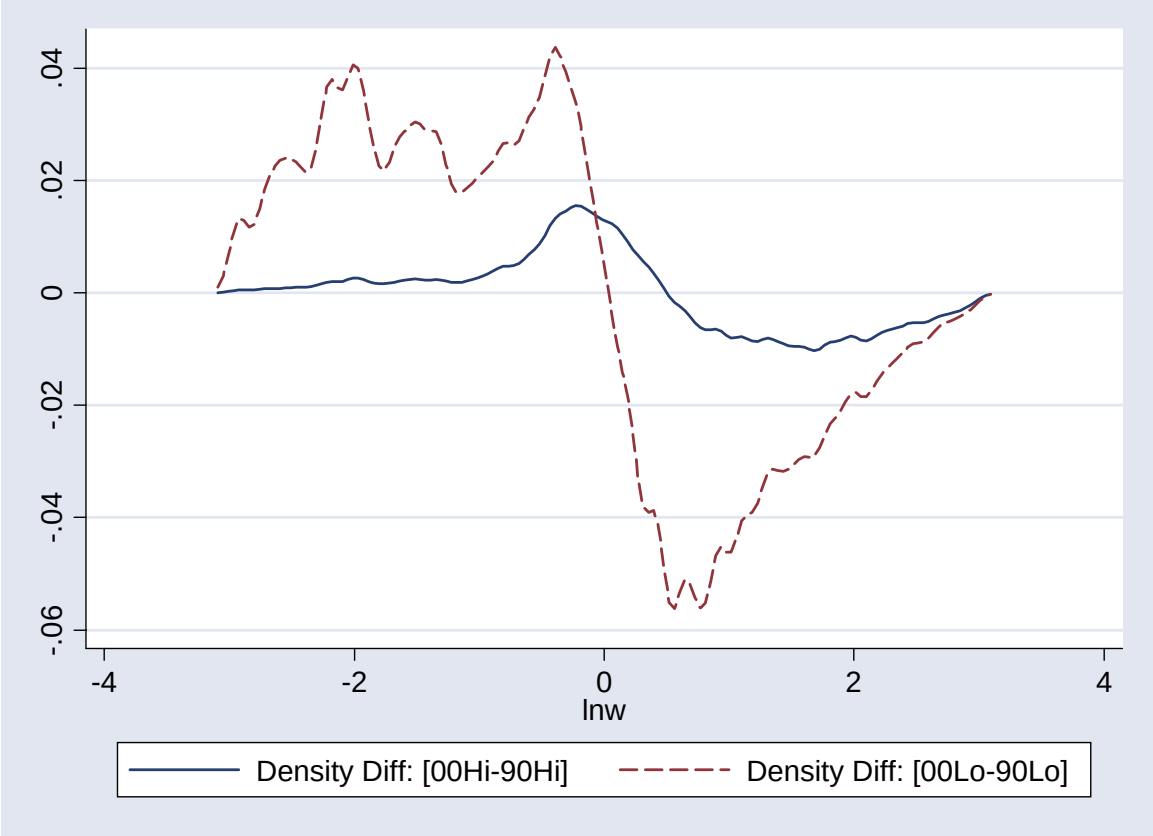


Figure 11: Double Difference in Labor Income Densities

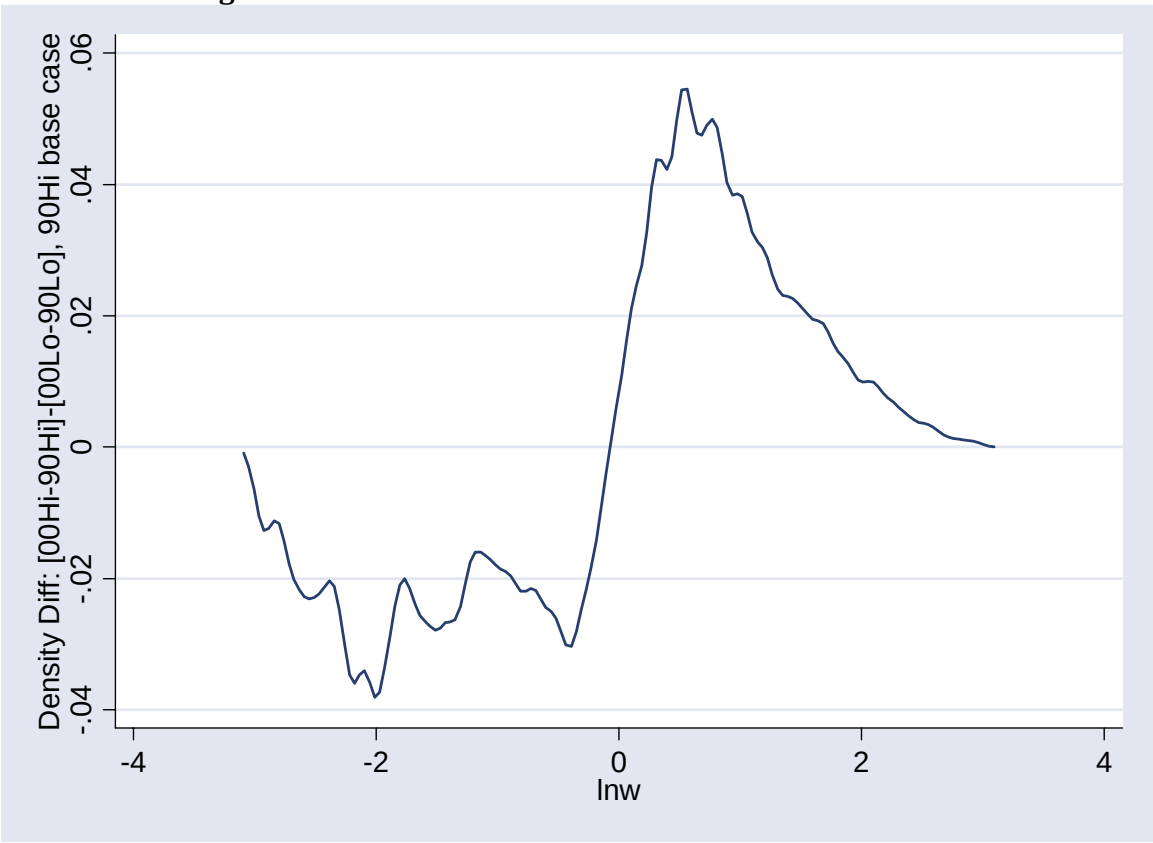


Figure 12: Double Difference in Labor Income Densities (Alternative Base Case)

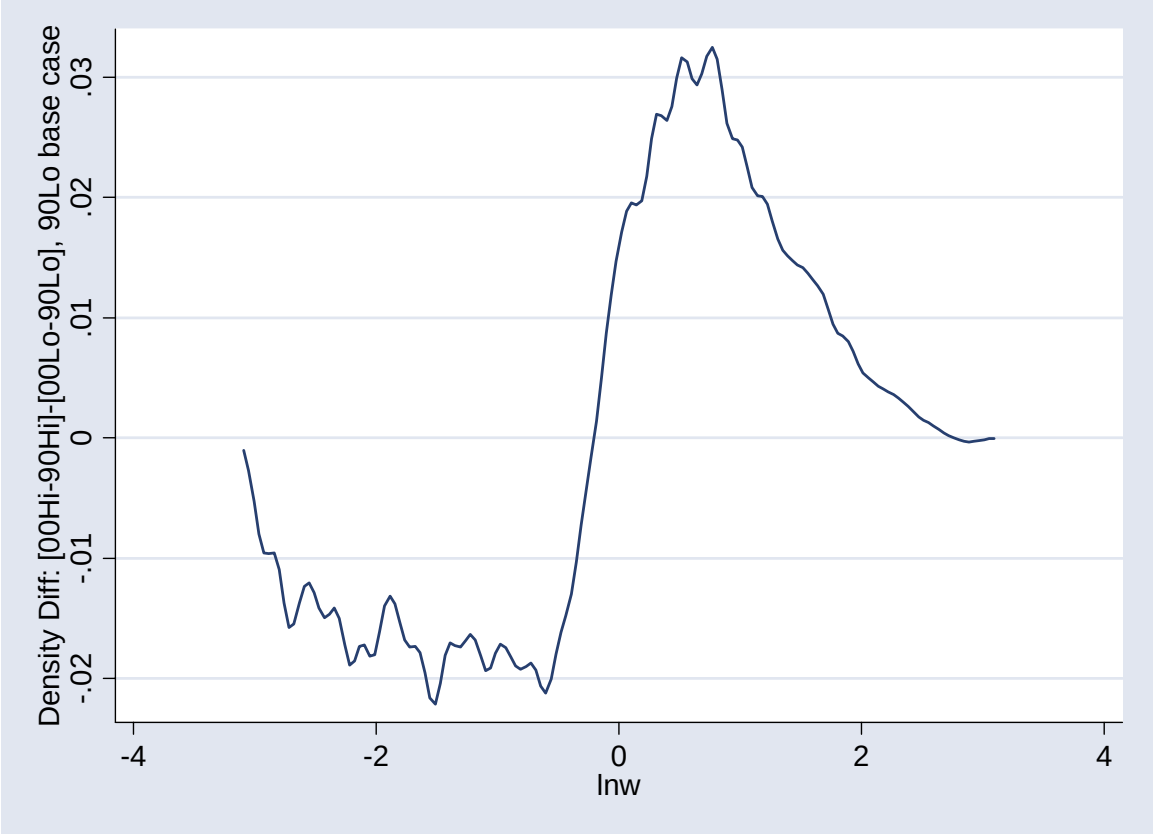


Figure 13: Double Difference in Total Labor Income Densities