Maquiladoras and Standard of Living in Mexico Before and After NAFTA

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Contents

Abstract

This study assesses the impact across states of for-export, mostly foreign-owned manufacturing plants (commonly known as 'maquiladoras') on various measures of standard of living in Mexico, namely literacy rate, school attendance rates, housing characteristics, life expectancy, infant mortality, and an overall index of human development. The main data set used is from the population and housing censuses of 1980, 1990, and 2000. The study controls for the effect of nonmaquiladora economic activity and prior growth. To remove the endogeneity, maquiladora activity is instrumented with a measure of road transportation time to the nearest major border city in the United States. The resulting IV-TS-OLS and GLS regressions, pooled and with (state and time) fixed effects, are estimated and the results of the respective Hausman specification tests are reported. I conclude that, overall, with the inclusion of state and time effects, maquiladora activity shows no impact on the measures of standard of living analyzed, with one exception: undergraduate schooling rates.

Keywords: Maquiladoras, maquila, Mexico, assembly manufacturing, liberalization, social welfare, standard of living, poverty.

1 Introduction

This study assesses the impact across states of for-export, mostly foreign-owned assembly factories (commonly known as 'maquiladoras') on various measures of standard of living in Mexico, namely literacy rate, school attendance rates, housing characteristics, life expectancy, infant mortality, and the modified index of human development constructed for Mexico by the United Nations Development Program.

The study covers a three-decade period punctuated by momentous changes in Mexico's economy, development strategy, and political system, including – under an evolving legislation – the transformation of the maquiladora sector into an economic powerhouse, initially limited to the border states and then extended to some areas in the interior.

In the late 1970s, buoyed by high oil prices and low interest rates, Mexico leveraged its oil resources in the international capital markets and grew rapidly. In the early 1980s, the drop in oil prices combined with a sharp increase in the interest rates left the country at the brink of default. The economy contracted and stagnated for over half a decade. In the mid and late 1980s, Mexico implemented wide-ranging economic reforms. At first, the focus was on getting the public finances in order and stabilizing the current account. Gradually, the focus shifted towards the privatization of public assets, the dismantling of the import-substitution strategy of industrialization that Mexico had pursued for over thirty years, and the liberalization of foreign trade and ownership, topped by the implementation of a free-trade agreement with the United States and Canada. There was a deliberate attempt to set the country's economic course on a difficult-to-reverse 'market-friendly' or, as the critics call it, 'neoliberal' path.

In 1986, Mexico joined the GATT, reduced its import quotas, and lowered its tariffs. In 1988, it managed to reduce and restructure its foreign debt. In 1993, it reformed its law on foreign investment and ownership. In 1994, it implemented the North-American Free Trade Agreement (NAFTA) with the United States and Canada, followed by a series of minor bilateral trade agreements with other countries. That same year, in the southern and impoverished state of Chiapas, an indigenous rebellion broke out. In the spring and summer, the political system was shaken by the assassination of prominent politicians. By the end of 1994, the peso plunged. In spite of the turbulence, the peso devaluation boosted almost immediately Mexico's trade balance and enhanced the country's appeal to foreign investment.

In the late 1990s, the country experienced a boom in maquiladora manufacturing driven by a dramatic expansion in foreign direct investment.[1] Initially, the maquiladoras were clustered on large northern border towns. Gradually, they expanded towards certain areas in the central states.

Table 1.1 in the Appendix shows the increasing weight of maquiladora activity in Mexico's employment, gross domestic product, and exports in the 1990s, particularly in the late part of the decade. Table 1.2 provides another view of the dynamism in maquiladora activity in the period. Table 1.3 shows the significant and growing contribution of maquiladora activity to Mexico's total manufacturing growth in the period.

The impact of maquiladora activity on the standard of living and social welfare in the developing countries has been the subject of much controversy. Advocates have claimed that maquiladoras enhance social welfare by providing jobs, generating much needed foreign exchange, expanding the tax base and the average income, and providing external benefits like local backward and forward linkages, technology transfer, and skill spillovers. It has been argued that, although initially the effect of maquiladora activity on the environment may be harmful, over time, this tendency is reversed.[2]

In turn, critics have replied that maquiladoras offer low quality jobs, poorly paid, and substandard health-and-safety conditions. It has also been claimed that maquiladoras foster workers' exploitation, sexual and gender oppression, and abuse against migrant workers, pollute the environment, strain the public infrastructure in the areas where they locate, worsen public health, and remain largely isolated economic enclaves with few linkages to the rest of the economy, fragmenting the economic structure and exposing it to the vagaries of the U.S. business cycle. A host of studies show that post-NAFTA economic growth, in which maquiladoras played such a prominent role (see Table 1.3), failed to narrow wage inequality and even increased it.[3]

In a recent study on the dynamics of distribution across states in Mexico, using Markov chain models, García-Verdú (2002) found that average income and non-income measures of standard of living have exhibited different paths

[1] During the 1990s, the average annual growth rate of maquiladora employment was 11.3 per cent. In the 1995-2000 period, the figure was 15.8 per cent. As a result of the peso devaluation in 1994-1995, in gross value added calculated in constant pesos (dollars), the boom was not nearly as spectacular: -4.9 (-0.3) per cent in the 1990s and -2.8 (5.9) per cent in the 1995-2000 period.

[2] See Section 2 below.

[3] See Section 2 below.

of evolution in the last thirty years. While the states tend to converge in literacy rates, there is no evidence of convergence in infant mortality or per-capita income in recent decades. García-Verdú's study highlights the need to study separately different nonincome measures of standard of living.

High infant mortality, low life expectancy, illiteracy, low educational attaintment, and inadequate housing are generally associated with poverty.[4] Consequently, the findings reported here may contribute to the discussion on the causes and mechanisms of poverty in Mexico[5] as well as in like developing countries.

The measures of non-income standard of living used here are taken from the Population and Housing Censuses of 1980, 1990, and 2000 on literacy, schooling, housing characteristics, life expectancy, and infant mortality. The UNDP modified index of human development, an index estimated on the basis of census data as well, is also included in the study. To remove endogeneity, maquiladora activity is instrumented using a measure of road transportation time to major border metropolitan areas in the United States.[6] The latter data are supplied by the Instituto Mexicano del Transporte. To control for the effect of nonmaquiladora activity, I use average earnings also drawn from the census of population and housing.[7] I estimate the resulting IV-TSLS (OLS and GS) regressions with and without fixed effects (both state and time).

When state and/or time effects are not included, the coefficients of instrumented maquiladora activity tend to be statistically significant. But once both state *and* time (fixed) effects are included in the regressions, maquiladora activity exhibits no effect on the measures of standard of living

[4]Sen (1987) views the standard of living as a "constitutive plurality [...] a basket of multiple attributes, even though secondarily that basket may quite possibly be given a numerical representation in the form of an index." The creation of the Human Development Index of the United Nations Development Program has been heavily influenced by these views. See UNDP (2003). For official poverty statistics estimated for Mexico, see Cortés Cáceres et al. (2002) and Comisión de la Pobreza (2003).

[5]See Cortés Cáceres et al. (2001) and Comisión de la Pobreza (2003).

[6]Results of relevant Hausman specification tests are reported in Tables 5.1-5.10 in the Appendix.

[7]Alternatively, for 1990 and 2000 only, I use per-capita real gross domestic product from the Sistema de Cuentas Nacionales de México or the average wage in the manufacturing industry from the industrial censuses. The data sets used, the *.do files with the Stata routines, the detailed outputs, and a whole set of additional statistics and graphs not reported on this paper will be made available by the author upon request.

under examination, with the exception of undergraduate school enrollment rates.[8]

This work fills a vacuum in the literature on the impact of maquiladora activity on local standards of living. Unlike the prevailing discursive and case studies in the literature on maquiladoras, this work uses rigorous and adequate econometric techniques to back up its empirical claims. Unlike any previous work, it exploits census data to ascertain that the net maquiladora effect on nonincome measures of standard of living in Mexico in the periods under study is not statistically significant, with the exception of undergraduate schooling rates. Although the data panel is cross-sectionally dominated, it takes advantage of its time dimension to isolate period effects. In particular, it confronts and provides reasonable solutions to the model-specification, endogeneity, and heteroskedasticity problems of the data panel.

Section 2 reviews the topical literature. Section 3 describes the data in detail. Section 4 discusses the econometric issues involved. Section 5 presents and discusses the main results. Section 6 concludes and suggests avenues for further research.

2 Literature Review

In the 1980s and early 1990s, there was an intense debate on the impact of maquiladora activity on social welfare in Mexico. The debate on maquiladoras intersected, but did not entirely coincide with, the larger controversy on the welfare effects of trade liberalization and overall policy reform in Mexico.[9] Table 2.1 summarizes the economic advantages (A) and disadvantages (D) attributed to maquiladoras by advocates and critics:[10]

I will now use this table as a framework to introduce some of the relevant literature. Note, however, that this study is not a direct test of the plau-

[8]There is no *a-priori* justification to use random-effects estimators. See Greene (2000), p. 623, for criteria for using random effects.

[9]There are several detailed descriptions of the historical evolution of maquiladoras in Mexico. I will not repeat such description here. For a good overview, see Buitelaar and Padilla Pérez (2000), section II.

[10]The items listed are not necessarily mutually exclusive or collectively exhaustive. For each row, the items in columns A and D do not necessarily constitute conflicting claims. For a detailed inventory and discussion of the economic advantages and disadvantages of maquiladoras, see Fatemi (1990), a compilation of articles by several authors.

Table 2.1. Maquiladora's economic advantages and disadvantages

	Advantages	Disadvantages
1	Direct and indirect job creation	Low-paid, exploitive, oppressive jobs
2	Foreign exchange generation	Exposure to U.S. business cycle
3	Linkages and knowledge transfer	Enclave economy
4	Environmental Kuznets curve	Environmental decay
5	Temporary region imbalance	Increasing region imbalance

sibility of the claims in Table 2.1. My goal here is to highlight (explicit or implicit) mechanisms by which maquiladora activity impacts the local standard of living, and how it may do so, and – in that context – invoke the literature and comment on it.[11] At the end, I shall comment briefly on two strands of the literature on Mexico's economic reforms that are related to my study: (1) the relation between NAFTA and the maquiladora boom in the late 1990s and (2) the empirical work on wage dispersion after NAFTA.

Clearly, item (A1) in Table 2.1 implies a mechanism and a positive economic impact. To my knowledge, there are no estimates of the welfare (or, say, GDP) multiplier effects induced by the maquiladoras value added: wages and salaries, purchases of local supplies, and taxes. According to INEGI BIE data, in 1990 only 1.3 per cent of gross output and 5 per cent of value added came from locally-supplied (nonlabor) inputs. In 2000, these figures were 2.3 per cent and 10 per cent respectively. Estimates of the proportion between direct maquiladora jobs and the 'indirect jobs' induced by the maquiladoras vary. For example, Carrillo (1997) estimated that 80 per cent of maquiladora jobs are direct jobs. On the other hand, Guajardo (1992) estimated that indirect jobs in local supplier firms is about 44 per cent of direct jobs, and jobs due to the multiplier effect of maquiladora wages are about 73 per cent of direct jobs.

In a related comparative study using pre-NAFTA data, Aitken, Harrison, and Lipsey (1995) found "no evidence of wage spillovers leading to higher wages for domestic firms" induced by foreign investment in Mexico and Venezuela. The authors provided a host of possible explanations for this phenomenon. It would be interesting to update this study to include the post-NAFTA years. While the migration of some of the benefits across states

[11] Some of the works discussed in this part of the section refer to experiences in maquiladoras outside of Mexico.

cannot be ruled out, the first-order (and perhaps largest) impact is likely to be local. In this regard, the goal of this study is to quantify the effect that direct maquiladora employment has on different nonincome measures of the local standard of living, something that – to my knowledge – has not been done before.

Item (D1) raises a rather complicated argument about the meaning of the concepts 'exploitation' and 'oppression.' Sargent and Matthews (1999) interpreted these charges as meaning that maquiladora jobs are "less attractive" (e.g., offer lower wages and poorer working conditions) than prior jobs held by maquiladora workers (or than alternative available jobs). These authors conducted a simple questionnaire survey on a sample of 59 maquiladora workers in Ciudad Juárez and Chihuahua and concluded that maquiladora jobs are "attractive employment for the economically disadvantaged in Northern Mexico."

Ver Beek (2001) surveyed a "random sample" of 270 maquiladora workers in the Departamento de Cortés, Honduras and compared their responses to those of 149 first-time maquiladora job applicants. The author found that maquiladora workers in the area are significantly better paid and "perceive themselves as politically more powerful and with better household relationships" than the control group. The author also found that workers at the maquiladoras feel that "they may be endangering their health" and "are less likely to be able to form a union." Workers and applicants did not exhibit significant differences in their self-perception of "overtime work," "stress," "mistreatment by supervisors," crime victimization, "ability to find child care and continue their education." The author suggests that, given the demand for maquiladora jobs in that region of Honduras, the workers must assign a larger weight on higher pay and the feeling of empowerment than on health risks in their choosing to search for work at the maquiladoras.

While the former studies (especially Ver Beek's, considerably more careful in its methodology and measured in its claims) are worthy of attention, their authors do not do justice to the subtlety of the critics' argument. For instance, some of the criticism of the social effects of maquiladora activity comes from the Marxist intellectual tradition and, in that tradition, the term 'exploitation' does not necessarily mean an increasing or even a constant level of abuse, underpayment, poor working conditions, or mistreatment of workers, although neither of those events would be ruled out.[12]

[12] A thorough discussion of this issue is beyond the scope of this paper, but suffice it

In the case of item (A2), the local benefits are difficult to identify, since they would be channelled through the strengthening of the country's balance of payments and, thereby, the macroeconomic environment. Item (D2) does not imply that there is no positive impact on the local standard of living. The charge appears to be more subtle: that reliance on maquiladora activity commits the local economy to a certain path that, compared to alternative ones, is unnecessarily volatile. For a given growth rate in the average standard of living, economic volatility has been linked to a more regressive distribution. But, this econometric study cannot directly support or contest this claim, because I cannot allude to any relevant counterfactual.

As for the claim itself, that maquiladoras increase volatility in the local economy, Hanson (2002) has pointed out that "maquiladoras tend to be very sensitive to business cycles in other countries" (mainly the U.S., almost exclusive destination of maquiladora exports) and "are footlose establishments that can easily relocate to another country if local costs rise." The same author adds that maquiladoras "may increase the sensitivity of an economy to global shocks." While this clearly insinuates an extra predictor in each of the regression equations, namely some measure of volatility in maquiladora activity over a relevant prior period, this paper failed to include it. This type of analysis will have to wait for further research.

Item (3) refers to the long-run benefits of a more integrated, dynamic, and balanced economic structure (or the opportunity costs of lacking it). Based on a wide survey of various segments of the pre-NAFTA maquiladora

to say that, in the tradition of Marxism, the notion of 'exploitation' is not incompatible with improving working conditions, real wages, and standards of living for the workers, not to mention an increasing local average standard of living. See, for example, Marx's (1970) description of the mechanism of 'relative surplus value production.' On the other hand, the feminist economic literature does not claim that gender or sexual oppression is incompatible with an improving standard of living for female workers. Thus, the effect of gender or sexual oppression on the local standard of living pointed by the critics is not unambiguous. See, for instance, Fontana, Joekes, and Masika (1998). Salzinger (2003) analyzes the gradual "de-feminization" of the maquiladora labor force, from the socialist feminist perspective (according to INEGI BIE data, in 1990, over 60 per cent of plant workers were female; in 2000, about 55 per cent). The importance of the gender dimension in assessing the social impact of maquiladora activity is undeniable. However, for the discussion on maquiladora workers' exploitation and gender oppression to be directly relevant to this paper, the critics would have to specify unambiguously its implication on the local standard of living, quantitatively (magnitude of change) and/or qualitatively (direction of change). I have no knowledge of such specification and, to that extent, the results presented in this paper can neither validate nor reject their claims.

sector, Wilson (1992) described in detail the nature and limited size of maquiladora linkages. Wilson suggested that, with adequate incentives induced by public policy, locally-owned maquiladoras are more likely to expand their local linkages than foreign-owned assembly plants, particularly those of the newer generation. She added that "If the Mexican government is to turn the maquiladora industry into a catalyst for domestic development, it must develop geographically and sectorally specific policies for increasing the maquiladoras' local linkages."

Following up on early claims made by Blomstrom and Persson (1983) and Blomstrom and Wolff (1994) on the existence of productivity spillovers from foreign ownership, Fairris (2003) conducted a case study of electronics plants in Guadalajara to ascertain the existence of productive knowledge transfer. The author claims to have gained "insights into the multitude ways in which a dynamic foreign presence can lead to knowledge transfer and spillovers via training incentives." However, as noted in Wilson (1992), the maquiladoras in the electronics segment in the region of Guadalajara are known for their comparatively larger linkages, unusual in the rest of the sector. In any case, Fairris' conjectures were not confirmed by his own econometric analysis of 1992-1999 plant-level data, where FDI presence shows no statistically significant influence on job training. The author admits that "significant knowledge transfer through worker training is by no means assured with foreign direct investment. Where foreign firms utilize very low-skilled labor, and there are few forward and backward linkages, and where the product is largely export bound – typical of export processing [maquiladora] zones – the knowledge transfer may be minimal."

Clearly, item (D4) suggests mechanisms of an adverse impact of maquiladoras on the standard of living: environmental decay and health issues are clearly adverse to some of the standard of living measures used in this study. Grossman and Krueger (1991) argued that, although initially the effect of maquiladora activity on the environment may be harmful, over time, this tendency is reversed: a sort of inverted U ('Kuznets') environmental curve. On the critical side, Frumkin et al. (1995) conducted a case study documenting the deterioration of the urban infrastructure and the increasing occupational and environmental hazards caused by maquiladoras on the border zones. The data used is anecdotal and the analysis is purely descriptive. Jones (1999) conducted a household survey and reported measures of association between incidence of infectious and prenatal diseases and exposure to maquiladora pollutants on the Mexican and Texan margins of the Rio

Grande Valley.

The latter two studies, as many from other social sciences on the topic, insistently point out the sociological and environmental drawbacks of maquiladora activity. Although frequently these studies rely on anecdotal evidence, resort to naive statistical analysis, and overreach with conclusions largely unsupported by the empirical evidence supplied, the social and environmental phenomena they call attention to cannot be ignored or dismissed offhand by the economists. Undoubtedly, a detailed description of the institutional characteristics of maquiladoras need to rely on serious ethnographic, anthropological, and sociological work. I must note however, that whatever the theoretical and empirical merits of these claims, I do not engage them directly in this analysis. The difficulty of specifying structural market models for each measure of standard of living examined precludes me from such engagement.

With regards to item (5), as far as I know, the demographic and geographical issues raised by item (D7) have not been duly examined in the empirical literature. The focus of this study on the *local* effects of maquiladora activity should contribute to the examination of the full demographic and geographic dimensions of Mexico's policy reform.[13]

This completes the discussion of literature most closely related to the dispute on the economic advantages and disadvantages of maquiladoras. I now turn to a brief discussion of research on the implications of NAFTA for maquiladoras and the empirical work on post-NAFTA increase in wage inequality.

In the early 1990s, during the debates on NAFTA, the particular implications of the trade agreement for the maquiladora legislation were unclear. On the upside, were NAFTA to be implemented, many analysts predicted a substantial increase in foreign investment following the trade agreement, and – regardless of the impact on its legislation – the maquiladora sector was poised to absorb a substantial portion of the investment flows in the short and medium run. In this sense, part of the welfare effects that NAFTA would induce in Mexico would be channelled through the maquiladoras. On the downside, NAFTA would allow production-sharing operations between the U.S. and Mexico outside of the maquiladora program and the duty free

[13]Selligson (1981) provides an early discussion of the migratory aspects of the early maquiladora program. For a recent study of the geography of economic development in Mexico, see Esquivel (2000).

advantages of maquiladoras would be generalized to nonmaquiladora manufacturing. Some authors pointed that the large amounts of foreign investment expected to flow into Mexico would lead to a rapid appreciation of the peso and an increase in labor costs likely to inhibit maquiladora growth.[14]

After NAFTA was approved in the U.S. Congress, the interest in the economic effects of maquiladoras declined. In the years immediately after NAFTA, the interest shifted towards the distributional effects of the treaty itself and the economic reforms implemented since the mid 1980s. During the NAFTA debate, the advocates of the treaty fomented the expectation that the removal of trade barriers in North America would lead to a reduction in Mexico's inequality as a result of the operation of the Stolper-Samuelson mechanism. Compared to the U.S. and Canada, Mexico was clearly abundant in unskilled labor and scarce in (physical and human) capital. The initial belief was that import substitution policies had artificially propped up heavier industries at the expense of primary activities and light manufacturing.[15] In absence of large shifts in technology's factor bias, if anything like the Stolper-Samuelson mechanism was to operate, freer trade would lead to a reallocation of resources towards unskilled-labor intensive industries and away from capital intensive ones. In turn, this would lead to a decrease in the real and relative return on capital (physical and human) and an increase in the real and relative return on unskilled labor.

The empirical literature did not confirm these expectations. Cragg and Epelbaum (1996) reported an increase in manufacturing wage inequality following the reforms. Their paper was followed by others confirming the basic finding: Feenstra and Hanson (1996), Feliciano (2001), Hanson (2003), among others.[16] Some authors tried to rationalize the findings by arguing

[14]For a sample of the wide range of pre-NAFTA estimates of the welfare impact of NAFTA in Mexico, see Brown, Deardorff, and Stern (1991), Hinojosa-Ojeda and Robinson (1991), Young and Romero (1991), and Kehoe (1992). For two contrasting accounts of the implications of NAFTA for the maquiladora program, see Watkins (1994) and Echeverri-Carroll (1999). For an empirical study claiming that the high growth in maquiladora activity in the late 1990s was related to the peso devaluation of 1994-1995 and not to NAFTA, see Gruben (2001). For a description of the difficulty of disentangling the positive effects of NAFTA on foreign investment and maquiladora trade from those of previous liberalization policies implemented by Mexico in the period, see CBO (2003), p. x.

[15]The canonical criticism of import substitution in Latin America is synthesized in Krueger (1995), where this case is made compellingly.

[16]Recently, Esquivel and Rodríguez-López (2003) reviewed the literature and contributed to it.

that, in fact, before the reforms, Mexico's light manufacturing had been most protected and unionized. The dismantling of import substitution had weakened the bargaining power of workers thus leading to higher wage dispersion. Others (e.g., Hanson, 2003) alluded to the skill bias in the type of technological change induced by foreign investment, particularly in the maquiladora sector. Yet another plausible explanation was entirely neglected: a several-years-long lag in the operation of the Stolper-Samuelson mechanism due to plain friction reinforced by institutional rigidities in Mexico's good and factor markets.[17] The empirical literature has not addressed the impact of the 1990s' increase in wage inequality on the local standard of living.

To my knowledge, no other study has looked at nonincome measures of standard of living, such as literacy rate, schooling rates, housing characteristics, and health indices from the population and housing census data to estimate the local economic impact of maquiladora activity. To that extent, this study is unique.

3 Data

The main data set was provided by Mexico's Instituto Nacional de Estadística, Geografía e Informática (INEGI). The data on earnings of the economically-active occupied population, literacy rate, housing characteris-

[17]The Stolper-Samuelson Theorem assumes that good and factor markets are perfectly competitive and that the adjustment in resource allocation following changes in good and factor prices is instantaneous and costless. Clearly, this a grossly unrealistic assumption. It is unlikely that the kind of sectoral re-allocation of labor and capital implied by the Stolper-Samuelson Theorem, a process that would entail the reversal of long-dated inertias in migratory patterns and long-run investment behavior, could take place in months rather than in decades. To illustrate the argument, consider the case of Mexico's rural economy: In spite of its shrinking share in total GDP, this sector continues to tie about one fourth of the labor force and an even higher share of the pool of unskilled labor in Mexico. Approximately half of the farm land is collectively tenured and, 12 years after a process of land tenure certification and reform (PROCEDE) was initiated to enable legal leasing and property transfer, the results have been slow to show (Zorrilla Ornelas, 2003). In particular, with NAFTA in place, PROCEDE was supposed to attract immediate investment into agriculture. Yet, between 1994 and 2000, only 0.3 per cent of the total foreign direct investment went to agriculture (0.9 per cent went to mining). In contrast, 61 per cent went to manufacturing, mostly maquiladoras, 14 per cent to financial services, and 12 per cent to retail trading (INEGI BIE). Perhaps the ultimate reason why the lag hypothesis has been neglected is that the most reliable data used in the empirical work on income dispersion comes from manufacturing.

tics, and various measures of educational attainment are from the Population and Housing Censuses of 1980, 1990, and 2000. They are available online at the INEGI's Sistema de Bases de Datos Municipales (SIMBAD) web site. The data on life expectancy and infant mortality, as well as migration rates, are also from the Population and Housing Censuses of 1980, 1990, and 2000, but they were provided in a separate file by the Consejo Nacional de Población (CONAPO). The data on infant mortality for 1980 were taken from INEGI (1988).[18] The data on maquiladora activity are available at the INEGI's Banco de Información Económica (BIE). Their ultimate source is the Sistema de Cuentas Nacionales de México.[19]

In its narrower, more operational definition, the Index of Human Development (IHD) is conceptualized as "the set of capabilities to live a long and healthy life, acquire knowledge, and earn income." It is an equally weighted average of indices in the following three 'dimensions': longevity, knowledge, and access to resources. More specifically, the statistical indicators used in constructing the index are: life expectancy at birth (for longevity), literacy rate and elementary, secondary, and high school registration (for knowledge), and GDP per capita (for access to resources). The indicators are calculated using simple averages and normalizing the results against a scale of minimum and maximum values derived from international estimates by the United Nations Development Project (UNDP). The MIHD ranges between 0 (international minimum) and 1 (international maximum).[20]

I instrumented maquiladora activity with data on average road trans-

[18]I also experimented with net inter-state and international migration rates as controls. The rationale is that maquiladora activity attracts migrant workers, the inflow of migrants strains the public infrastructure in the receiving states and has a direct negative impact on the standard of living, which might lead to an underestimation of the true (positive) effects of maquiladora activity on the standard of living. Although the instrumentation of maquiladora activity may remove some of the simultaneity with the migration variables (Hausman tests fail to suggest significant feedback between migration and maquiladora activity), I included net migration rates as explicit controls. The estimates are available upon request.

[19]The estimates reported use maquiladora total payroll employment as measure of maquiladora activity, the independent variable of interest. Similar results are obtained using maquiladora gross value added. These estimates are also available upon request.

[20]Detailed information on the evolution of the concept and method of calculation of the IHD is available online at http://www.undp.org.mx/desarrollohumano/informefr.html. The data used in this study is on the Modified Index of Human Development (MIHD). I thank Gerardo Esquivel (Colegio de México and UNDP-Mexico) for kindly making it available to me.

portation times from the capital of each state to major U.S. border metropolitan areas, as estimated by the Instituto Mexicano del Transporte of the Secretaría de Comunicaciones y Transportes.[21]

The panel dimension is 32 states by 3 years (1980, 1990, 2000) for a total of 96 data points.

4 Econometric Issues

I begin the discussion by stating the general econometric specification. Then I turn to the issues raised by the model's specification, endogeneity, fixed effects, and heteroskedasticity, as well as the solutions proposed to deal with each of the issues.

4.1 General Specification

Let the following variables be indexed by state i and year t for $i = 1, \ldots, n$ and $t = 1, \ldots, T$:
Y: a non-income measure of standard of living,
M: a measure of maquiladora activity (per capita),
τ: road transportation time from the state capital to a major border U.S. city,
$\mathbf{D}^t$: a $(T-1)$ row vector of two year dummies,
$\mathbf{D}^i$: a $(n-1)$ row vector of state dummies, and
$\mathbf{X}$: a vector of control variables.

Maquiladora activity is instrumented as follows:

$$\ln M_{it} = \alpha_0 + \alpha_1 \tau_{it} + \epsilon_{it} \tag{1}$$

The TS pool regression model is:

$$\ln Y_{it} = \beta_0 + \beta_1 \ln \hat{M}_{it} + \mathbf{X}_{it}\mathbf{B} + \varepsilon_{it} \tag{2}$$

where $\ln \hat{M}$ is predicted $\ln M$ from equation (1).

[21] Similar results were obtained instrumenting maquiladora activity with a widely-used seven-region classification of Mexico's states. For more on this regional classification, see Esquivel (2000). The alternate estimates are available upon request.

The IV-DV-TS regression model is:

$$\ln Y_{it} = \gamma_0 + \gamma_1 \ln \hat{M}_{it} + \mathbf{X}_{it}\mathbf{\Gamma} + \mathbf{D}^t\mathbf{\Gamma}^t + \mathbf{D}^i\mathbf{\Gamma}^i + \xi_{it} \tag{3}$$

where $\mathbf{\Gamma}^t$ is a $(T-1)$ column vector of year dummy coefficients and $\mathbf{\Gamma}^i$ is a $(n-1)$ column vector of state dummy coefficients.

These models were estimated using OLS and GLS. Under the assumption of equal slope coefficients by year and state, no correlation between the regressors and the error term, and zero expected value of errors, OLS is an unbiased although inefficient estimator. GLS is both an unbiased and efficient estimator.

Summarizing, estimation statistics for the following models are presented in Tables 5.1-5.10 in Appendix I (the estimator is indicated in parenthesis):

1. $Y_{it} = \alpha_0 + \alpha_1 M_{it} + \epsilon_{it}$ (OLS),
2. $\ln Y_{it} = \beta_0 + \beta_1 \ln \hat{M}_{it} + \varepsilon_{it}$ (OLS),
3. $\ln Y_{it} = \gamma_0 + \gamma_1 \ln \hat{M}_{it} + \gamma_2 \ln w_{it} + \gamma_3 g_{it} + \zeta_{it}$ (OLS),
4. $\ln Y_{it} = \delta_0 + \delta_1 \ln \hat{M}_{it} + \delta_2 \ln w_{it} + \delta_3 g_{it} + \mathbf{D}^t\mathbf{\Delta}^t + \xi_{it}$ (OLS),
5. $\ln Y_{it} = \eta_0 + \eta_1 \ln \hat{M}_{it} + \eta_2 \ln w_{it} + \eta_3 g_{it} + \mathbf{D}^i\mathbf{\Gamma}^i + \varphi_{it}$ (OLS),
6. $\ln Y_{it} = \theta_0 + \theta_1 \ln \hat{M}_{it} + \theta_2 \ln w_{it} + \theta_3 g_{it} + \mathbf{D}^t\mathbf{\Theta}^t + \mathbf{D}^i\mathbf{\Theta}^i + \psi_{it}$ (OLS),
7. $\ln Y_{it} = \iota_0 + \iota_1 \ln \hat{M}_{it} + \iota_2 \ln w_{it} + \iota_3 g_{it} + \mathbf{D}^t\mathbf{\Phi}^t + \mathbf{D}^i\mathbf{\Phi}^i + \mu_{it}$ (GLS),
8. Same specification as model 6 but including only years 1990 and 2000,[22]
9. Same specification as model 7 but including only years 1990 and 2000,[23] and

[22]The scattergrams suggest that the data of several dependent variables (especially health-related variables) are much more dispersed for 1980 than for 1990 or 2000. The effect of a structural break after 1980 (such that maquiladora activity was not significant prior to the break but became significant after the break) can be isolated with differential time and group slopes, but – as noted in footnote 25 – these slope coefficients are unaffordable with this sample size. Removing 1980 from the sample is a 'butcher's way' to separate this effect.

[23]See the previous footnote.

10. $\ln Y_{it} = \theta_0 + \theta_1 \ln \hat{M}_{it} + \theta_2 \ln w_{it} + \theta_3 g_{it} + \mathbf{D}^t\mathbf{\Theta}^t + \mathbf{D}^i\mathbf{\Theta}^i + \theta_1 \ln \hat{M}_{it} d^{90} + \theta_1 \ln \hat{M}_{it} d^{00} + \theta_1 \ln w_{it} d^{90} + \theta_1 \ln w_{it} d^{00} + \psi_{it}$ (OLS).

where w is average (or per-capita) earnings, g is the growth rate of per-capita GDP in the prior 5 years, and d^s is the year dummy variable taking a value of 1 if $t = s$ and 0 otherwise. The Greek letters denote the parameters of the model.

4.2 Model Form and Endogeneity

I have eschewed the stipulation of structural equations to model the markets for each of the goods involved: literacy, schooling, adequate housing, and health. Given the inherent complexity of the goods and the diverse institutional characteristics of the markets involved, identifying each market's structural parameters is too daunting a task with the data at hand. Simply, this analysis cannot identify those parameters.

That said, to the extent the market characteristics involved are local, the state fixed effects will pick them up. To the extent they are common to all states, they will be picked up by the intercept. To the extent they are varying over time, they will be picked up by the year fixed effects. And to the extent they are neither, they will be picked up by the error term (under the restriction that the expected value of all the influences bundled in the error term is zero). So, by humbling necessity if not by conviction, I am sympathetic to Liu's (1969) classical argument that all simultaneous-equations models of the economy are truly unidentified and only reduced forms can be estimated.

On the other hand, the relations between maquiladora and nonmaquiladora manufacturing or between maquiladoras and the rest of the economy are likely to be fairly complex. Thus, the first task of this study is to separate the 'pure' maquiladora effect from other effects resulting from nonmaquiladora activity. Two stories may illustrate the potential endogeneity involved:

Other things equal, investment in modern maquiladora manufacturing is likely to be attracted to areas with a pre-existing basic infrastructure in public services and a relatively educated and healthy labor force. In other words, whatever the effect of maquiladora activity on the standard of living, other things constant, maquiladora activity is likely to flow toward areas with a higher initial standard of living.

On the other hand, at least during their first stages of evolution, maquiladoras were invited to the northern border towns as a response to local joblessness, which was causing a rapid deterioration in the standard of living, and immigration flows, which were overwhelming the local capacity of schools, housing infrastructure, and health services. In other words, other things equal, maquiladora activity is likely to flow toward areas with a lower initial standard of living.

Of course, both scenarios may coexist, in which case either one of them dominates or they exactly cancel each other out. In any case, the mere visual inspection of the data cannot settle the issue. I conducted Hausman specification tests on regressions with no fixed effects.[24]. The results of the Hausman tests are reported for each dependent variable.

Under the presumption of simultaneity bias in the standard OLS estimator, I used the IV-TSLS estimator. To instrument maquiladora activity, I used road transportation time from the capital of each state to the nearest major metropolitan area on the U.S. border. On the data, this variable is highly correlated to maquiladora activity and largely uncorrelated to the error term of the models.

4.3 Fixed Effects and Heteroskedasticity

The assumption of the pooled models – namely, that the coefficients are fixed across states and years – is too restrictive to be plausible. Thus, another key issue in isolating the 'pure' maquiladora effect was the existence of time-invariant factors characteristic of each state (i.e., the 'state effects') and factors that vary over time but are roughly common to all states.[25]

[24]With more regressors, in this case fixed effects, the Hausman χ^2 statistic increases monotonically and the null hypothesis of equal coefficients in the inefficient and efficient estimators is more easily rejected.

[25]It may seem plausible that the changes in the policy and regulatory environment in Mexico that took place in the late 1980s and early 1990s, affected the states differently. For instance, changes in relative prices induced by trade liberalization, which presumably led to switching of resources from lower to higher profitability ventures, could have had a different impact on each region. These effects could be captured including interactive or 'differential' state and year slopes in the regression models. I did implement interactive year slopes. See column (10) in Tables 5.1-5.10 in the Appendix. But in this panel, sparse and cross-sectionally dominated, I did not have enough degrees of freedom to afford interactive group slopes. In further research, I plan to implement regional interactive slopes.

Instances of the former are geography, climate, natural resource endowments, demographics, local institutions, laws and regulations, hardwired cultural traits, and long-standing capital infrastructure. One of these time-invariant variables is the distance to the border, which is highly correlated to road transportation time or, more generally transportation costs, and thus to maquiladora investment and activity.

Since I use road transportation time to instrument maquiladora activity, I implicitly assume that the only way in which this variable affects the standard of living is via its effect on maquiladora activity. In other words, I assume that the state dummies and the instrument are orthogonal. While this may seem contradictory with what I have noted above, it is not necessarily so. Another way to frame this is to say that the other time-invariant factors bundled in the state effects dominate the geographic distance element. The data bears this assumption reasonably well. In any case, this assumption seems to be a reasonable restriction to impose given the advantages of using road transportation time in the IV-TSLS estimation.[26]

Instances of state-invariant, time-variant effects are changes in national patterns of consumption, external shocks, and changes in national policy and the regulatory environment. Precisely, the three-decade period under analysis was punctuated by inflections in oil prices and interest rates in the international markets that shook Mexico's economy. To mention a few highly consequential instances: In 1982, with oil as Mexico's main export, its price in the international market fell sharply. Starting in the mid 1980s, Mexico's development strategy, roughly based on the import-substitution industrialization policies of the postwar, was thoroughly revised and replaced by a 'market-friendly,' 'export-led,' or – as the critics call it – 'neoliberal' strategy.[27]

If the assumption of state- and time-invariant coefficients is not warranted, the estimated coefficients in the pool models are biased in an unknown direction. I used the IV-DV-TSLS estimator (fixed state and year

[26] A similar problem arises if I use Esquivel's (2000) regional classification to instrument maquiladora activity.

[27] To this one may add the impact of the sudden increase in the interest rates in the early 1980s. Stiglitz (2002) has speculated that, even if the governments and the government-owned companies in Latin America had been financially healthy and corruption had not been an issue at the time (which was certainly not the case in Mexico), the sharp increase in the rate driven by the Federal Reserve under Paul Volcker's management might have been sufficient to send the highly indebted Latin-American countries into bankruptcy.

effects), which is unbiased under the assumption of different state and year intercepts. There was no *a priori* rationale to specify random effects.[28]

Finally, cross-sectionally dominated panel estimates are likely to be plagued by heteroskedasticity, which leads to inefficiency in the (IV-DV-TS) OLS estimator. In this case, the GLS estimator is efficient. The issue of efficiency is important to uphold the null hypothesis in these regressions, i.e., the maquiladora effect on each non-income measures of standard of living analyzed (except the undergraduate schooling rate) is not statistically significantly different from zero. An inefficient estimator (e.g., OLS) may be an unduly strict test on the maquiladora coefficients' significance.[29]

5 Results and discussion

Tables 5.1 (a) and 5.1 (b) in the Appendix summarize the descriptive statistics for the variables involved (by state). Tables 5.2-5.12 show the estimation results. Overall, maquiladora activity was not a statistically significant predictor of the measures of standard of living examined once (1) controls (per-capita earnings and prior growth rate in per-capita GDP) and (2) year and state fixed effects were included. A robust exception was the undergraduate school attendance rate.

[28] Greene (2000) states that: "The fixed effects model is a reasonable approach when I can be confident that the differences between units can be viewed as parametric shifts of the regression function. This model might be viewed as applying only to the cross-sectional units in the study, not to additional ones outside the sample. [...] In other settings, it might be more appropriate to view individual specific constant terms as randomly distributed across cross-sectional units" (p. 623). The former seems to be the case in this study. The 'units' included in the sample are all the 32 states of Mexico. There are no "additional ones outside the sample."

[29] A note on the Stata algorithms used: Stata has a GLS algorithm to estimate fixed effects (xtreg, fe), but it can only handle time or group fixed effects per regression, not both. It has the convenience of reporting pseudo R^2s (within and between groups). However, since the algorithm cannot include both kinds of fixed effects, I implemented the dummies 'manually' and ran the regressions with the standard GLS regression algorithm (xtgls). Had Stata's xtreg allowed both kinds of fixed effects, the coefficients and the z-values would be identically to those I obtained by direct GLS estimation.

5.1 Education

5.1.1 Literacy

Without year or state fixed effects, without and with the controls (average earnings and per-capita GDP growth rates), the maquiladora coefficients are significant – although the model with state effects makes the maquiladora coefficient significant only at the 0.1 level (see columns 1-5 in Table 5.1 in Appendix I). However, the introduction of both year and state fixed effects takes away the statistical significance of the maquiladora coefficient. In all the models that include it as a control (3-10), average earnings is significant at the 0.01 level. Growth rates of per-capita GDP are not significant predictors. Slopes interacting year with average earnings and year and per-capita GDP growth rates are not statistically significant. The exclusion of 1980 in model (9), with GLS, returns the significance of the maquiladora coefficient at the 0.05 level. The R^2's remain low (below 0.5).[30]

5.1.2 Elementary Schooling

The inclusion of year fixed effects takes away the statistical significance of the maquiladora coefficient. State fixed effects alone does not take away the significance of the maquiladora coefficient; it is both fixed effects that make the maquiladora coefficient insignificant. Average earnings remains the dominant predictor, although its coefficient is only significant at the 0.05 level when 1980 is excluded under the OLS model (with GLS, it is again significant at the 0.01 level). Growth rates of per-capita GDP are not significant. The interactive year-average earnings and year-growth are not significant. Finally, like in the literacy model, excluding 1980 in the model with GLS estimation makes the maquiladora coefficient significant at the 0.05 level. The R^2's without controls and fixed effects are very small, but they become larger than 0.6 when the controls are included.[31]

5.1.3 Secondary Schooling

The inclusion of either or both fixed effects takes away the statistical significance of the maquiladora coefficient. The exclusion of 1980 does not help the maquiladora coefficient gain significance. Finally, the exclusion of 1980 in the

[30] See Table 5.2 in the Appendix.
[31] See Table 5.3 in the Appendix.

model with GLS estimation does not return significance to the maquiladora coefficient. Also in this case, average earnings is the dominant predictor, although its coefficient becomes insignificant when 1980 is excluded (both under OLS and GLS) and also when year-average earnings interactive slopes are included. The latter are statistically significant under model (10). The value of these interactive coefficients (shifting the intercept that reflects the 1980 benchmark) indicates that after 1980, secondary schooling was positively impacted by average earnings while after 1990, there was a decrease in this impact, although still significantly different from 1980. In the 1980s, Mexico implemented a thorough decentralization of its educational system, which may have given states with higher levels of per-capita income greater leverage in the allocation of federal educational funds. These results are consistent with anecdotal reports that the decentralization had its larger impact on secondary and high school education. However, the authenticity of these claims could not be verified (see below the notes on high schooling and undergraduate schooling). Growth rate of per-capita GDP is significant at the 0.05 level in model (3), with controls but without fixed effects. Otherwise, it is not significant. The R^2's without controls and fixed effects are very small, but they become larger than 0.5 when the controls are included.[32]

5.1.4 High Schooling

The inclusion of controls takes away the statistical significance of the maquiladora coefficient. The exclusion of 1980 does not help the maquiladora coefficient gain significance. Finally, the exclusion of 1980 in the model with GLS estimation does not return significance to the maquiladora coefficient. Again, average earnings is the dominant predictor, although its coefficient becomes insignificant when 1980 is excluded (both under OLS and GLS). Average earnings remain significant when year-average earnings interactive slopes are included. The year-average earnings interactive slope coefficients are statistically significant under model (10). Like in the secondary schooling model, the value of the coefficients indicates that after 1980, high schooling was positively impacted by average earnings while after 1990, there was a decrease in this impact, although it still kept it significantly different from 1980 (see the notes on secondary schooling and undergraduate schooling). The difference with secondary schooling model (10) is that in high schooling, average

[32]See Table 5.4 in the Appendix.

earnings remains significant in the presence of interactive the year-average earnings slopes. Growth rate of per-capita GDP is significant at the 0.05 level in model (6), with controls and both fixed effects under OLS and at the 0.1 level in model (7) with controls and both fixed effects under GLS. Otherwise, it is not significant. The R^2's without controls and fixed effects are very small. They remain below 0.5 until both year and state fixed effects are included, when the adjusted $R^2 = 0.67$. The high R^2 in the model that excludes 1980 under OLS suggests that 1980 introduces much variation that the models fail to explain.[33]

5.1.5 Undergraduate Schooling

Unlike all other models estimated, the maquiladora coefficient remains significant in all models, except in model (4), with year but not state fixed effects, and in the models where 1980 is excluded (8-9). This suggests that higher education was the most (and only) variable sensitive to the the expansion in maquiladora activity. This raises the question of whether this result is consistent with the growth in FDI-driven demand for skilled labor that some authors associate with the increased dispersion in wage rates found for the 1990s. As in the previous cases, average earnings is the dominant predictor, although its coefficient becomes insignificant when 1980 is excluded (both under OLS and GLS) and it remains significant when year-average earnings interactive slopes are introduced. The year-average earnings interactive slope for 2000 in model (10) is significant at the 0.01 level. Also note that the year-average earnings interactive slope for 2000 was significant and of negative sign. This suggests that the expansion of undergraduate schooling was less responsive to per-capita average earnings in 2000 than it had been in the previous years. The reason for this shift is unclear. Undergraduate schooling chased after maquiladora activity, which is largely uncorrelated to average earnings, and this is particularly true in 2000. The R^2's without controls and fixed effects are very small. They increase to over 0.8 when controls are included and over 0.9 when fixed effects are included. The exclusion of 1980 does not lower the adjusted R^2 below 0.9.[34]

[33] See Table 5.5 in the Appendix.

[34] See Table 5.6 in the Appendix.

5.2 Housing

5.2.1 House with Tap Water

With year fixed effects, the maquiladora coefficient is significant. When state fixed effects and both state and year fixed effects are included, the maquiladora coefficient is no longer significant. The exclusion of 1980 does not make the maquiladora coefficient significant either. Average earnings is significant, except when both year and state fixed effects are included. Even with both fixed effects, average earnings is significant when 1980 is excluded. The year-average earnings interactive slope coefficient for 2000 is statistically significant and positive under model (10). My interpretation is that in 2000, the responsiveness of housing with tap water to average earnings increased with respect to 1980 (and 1990). Growth rate of per-capita GDP is not significant. The R^2's without controls and fixed effects are very small. They remain below 0.2 until the controls are included. With both controls and fixed effects, the R^2's stay above 0.8. The exclusion of 1980 does not lower much the adjusted R^2.[35]

5.2.2 House with Electric Power

With state fixed effects, the maquiladora coefficient is significant at the 0.05 level. When both state and year fixed effects are included, the maquiladora coefficient is no longer significant. The exclusion of 1980 does not make the maquiladora coefficient significant either. Average earnings is significant, except when 1980 is excluded. The year-average earnings interactive slope coefficients for 1990 and 2000 are significant and negative under model (10). My interpretation is that in 1990, the responsiveness of housing with electric power to average earnings decreased with respect to 1980. It then increased slightly in 2000 (with respect to 1990, although still significantly lower than in 1980). Growth rate of per-capita GDP is significant with year fixed effects and with both year and state fixed effects. Note that the sign of the coefficient is negative. I do not have independent information that may explain the negativity and significance of this coefficient. The R^2's without controls and fixed effects are very small. They remain below 0.1 until the controls are included. With controls, the R^2's increase above 0.9. The exclusion of 1980 increases the adjusted R^2.[36]

[35] See Table 5.7 in the Appendix.

[36] See Table 5.8 in the Appendix.

5.2.3 House with Drainage

Like in housing with electric power, with state fixed effects, the maquiladora coefficient is significant (in this case at the 0.01 level). When year fixed effects and both state and year fixed effects are included, the maquiladora coefficient is no longer significant. The exclusion of 1980 makes the maquiladora coefficient significant at the 0.1 level under model (9), i.e., with GLS. Average earnings is significant, except when 1980 is excluded. The year-average earnings interactive slope coefficient for 2000 is significant and negative under model (10). Growth rate of per-capita GDP is significant without fixed effects, with state fixed effects, and with both state and year fixed effects, except when 1980 is excluded and when interactive slopes are included. However, the sign of the coefficient switches from positive (with no fixed effects and with state but not year fixed effects) to negative (with both fixed effects). I have no conjectural explanation for this result. The R^2's without controls and fixed effects are very small. They remain below 0.1 until the controls are included. With controls, the R^2's increase above 0.8. The exclusion of 1980 increases the adjusted R^2.[37]

Significance in the maquiladora coefficient in the face of state effects but not with year effects means that the larger change came from changes in time invariant variables across states.

5.3 Health

5.3.1 Life Expectancy

The maquiladora coefficient is not significant once controls are included, except when 1980 is removed (under GLS). Average earnings is significant throughout. The year-average earnings interactive slope coefficient for 2000 is significant and negative. Growth rate of per-capita GDP is not significant, except when both types of fixed effects are included, under GLS (at the 0.1 level). The R^2's without controls and fixed effects are very small, around 0.1. They increase to just over 0.7 with controls and over 0.8 with controls and fixed effects. The exclusion of 1980 largely increases the adjusted R^2.[38]

[37] See Table 5.9 in the Appendix.

[38] See Table 5.10 in the Appendix.

5.3.2 Infant Mortality

As a warning note, this is the variable that exhibits a much greater dispersion in 1980, than in 1990 and 2000.[39] The maquiladora coefficient is not significant once controls are included. Average earnings is significant, except when both types of fixed effects are included, 1980 is excluded, and interactive slopes are included. The inclusion of fixed effects, the exclusion of 1980, and the inclusion of interactive slopes does not change that. The year-average earnings interactive slope coefficients are not significant. Growth rate of per-capita GDP is significant and negative with no fixed effects, only state effects, and both types of fixed effects under GLS. The R^2's without controls and fixed effects are very small – below 0.1. They increase to just over 0.4 with controls and fixed effects. The exclusion of 1980 largely increases the adjusted R^2.[40]

5.3.3 Modified Index of Human Development

The maquiladora coefficient is significant at the 10 per cent level with controls and fixed effects. When both state and year fixed effects are included, the significance disappears. When 1980 is removed (under GLS), maquiladora activity becomes significant. Average earnings is significant, except when the 1980 data are removed. The year-average earnings interactive slope coefficient for 1990 and 2000 are significant at the 10 per cent level, and negative. Growth rate of per-capita GDP is significant when fixed effects are included. The R^2's without controls and fixed effects are seizable, about 0.64. They increase to over 0.9 with controls and fixed effects. The exclusion of 1980 increases the adjusted R^2.[41]

[39] I double-checked the data on infant mortality, which appears at odds with the 1990 and 2000 data. INEGI stands by these figures. No explanation, from either of the INEGI or CONAPO representatives I contacted, was given for the reversal in the infant mortality ranking of several states (e.g., Guerrero was among the five lowest infant mortality states in 1980 while it was among the five highest in 1990 and 2000; Guanajuato was among the five highest infant mortality states in 1980 and among the ten lowest in 1990 and 2000, etc.).

[40] See Table 5.11 in the Appendix.

[41] See Table 5.12 in the Appendix.

6 Final Remarks

This study concludes that, overall, with the inclusion of controls (per-capita earnings and prior growth rate of per-capita GDP) as well as state and time effects, maquiladora activity has no impact on the measures of standard of living under examination, with the exception of undergraduate schooling rates.

This work is unique in the literature on the impact of maquiladora activity on local standards of living. Unlike the discursive and case studies that prevailed in the literature, this work uses rigorous and adequate econometric techniques to back up its empirical claims. Unlike any previous work, it uses census data to ascertain that the net maquiladora effect on nonincome measures of standard of living in Mexico in the periods under study is not statistically significant, with the exception of undergraduate schooling rates. Although the data panel is cross-sectionally dominated, it takes advantage of its time dimension to isolate period effects. In particular, it confronts and provides reasonable solutions to the model-specification, endogeneity, and heteroskedasticity problems of the data panel.

That said, cross-sectional econometric analysis is limited by the availability of disaggregated and compatible data. The data from the Households' Income and Spending National Surveys (ENIGHs), which offers more direct measures of social welfare, are not disaggregated by municipality or even state. They are only representative at the urban-rural and male-female level of disaggregation. A similar problem arises with the National Employment Surveys (ENEs and ENEUs). However, the ENEs' and ENEUs' data could be fruitfully used in combination with the data from the industrial censuses.

A strong limitation of this study is that the census data panel used only includes three years, with a 10 year gap between points (1980, 1990, and 2000). There are only usable census socio-demographic data for those three years, which makes it impossible to extend the panel data. Another limitation is the aggregation by state. The maquiladora data by municipality is restricted to municipalities with a large maquiladora activity, even though there are other municipalities with significant maquiladora activity not included in the tables. In spite of this restriction, it should be possible to test the relation between maquiladora activity and social welfare with more disaggregated data by municipality available at the INEGI's web site. That is to be pursued in the future.

More work is required to elucidate the specific mechanisms by which

maquiladora activity leads to changes in social welfare, both on the theoretical and empirical sides. In future research, I plan to study the impact of the volatility of maquiladora activity (dependence on U.S. business cycle) on these measures of standard of living by state.

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Appendix