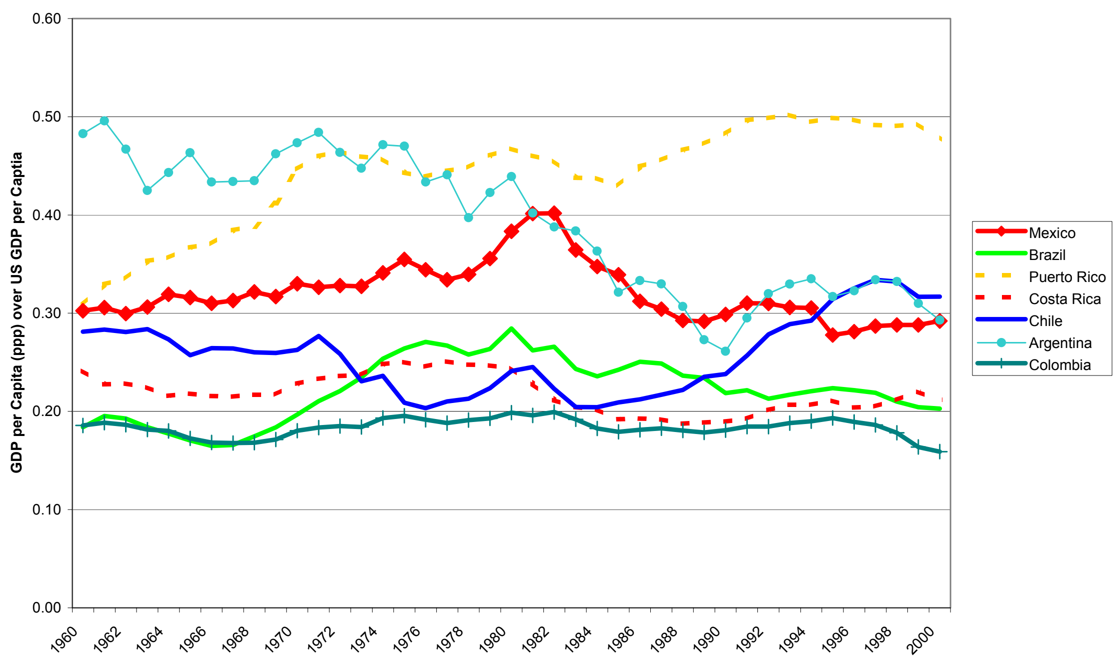
# Chapter 1

# NAFTA and Convergence in North America: High Expectations, Big Events, Little Time

## 1.1 Introduction and related literature

The North American Free Trade Agreement (NAFTA) was formally implemented on January 1, 1994 by the United States, Canada, and Mexico. This treaty instantly gained global notoriety since the formal negotiations started in 1991 mainly because the initiative would become not only one of the most comprehensive trade agreements in history, but also because it seemed to be a breakthrough by leading to free trade in goods and services among developed countries and a developing country. The high expectations were that trade liberalization would help Mexico catch-up with its Northern neighbors. As shown in Figure 1, the ratio of Mexican GDP per capita to the U.S. did increase after unilateral trade reforms were implemented in 1986 and also after the implementation of NAFTA in the aftermath of the so-called Tequila crisis. However, it is noteworthy that other Latin American economies also grew faster than the U.S. economy since the mid-1980s, especially Chile and to a lesser extent Costa Rica. Thus it is not obvious that NAFTA was particularly important in helping Mexico catch-up with the United States. Yet the experience of Puerto Rico is also interesting, given that it is an economy that started with a similar level of development as Mexico in the late 1950s, but achieved an unprecedented level of economic and institutional integration with the U.S. in 1952, and subsequently experienced the fastest rates of economic growth in the developing Latin American economies. This paper attempts to assess the extent to which these high expectations seem to be materializing. It examines trends and determinants of income and productivity gaps observed in North America, both across countries as well as within Mexico.

**Figure 1. GDP per Capita Relative to the U.S., Selected Economies, 1960-2001**




Source: Loayza et al. (2002), World Penn Tables 5.0, and World Development Indicators.

### *1.1.1 High expectations*

The high expectations for NAFTA were supported by neoclassical growth and trade theories. The seminal work of Solow (1956) states that capital-poor countries grow faster than rich countries due to the law of diminishing returns, as long as production technologies, population growth, and preferences are the same across countries. Likewise, the neoclassical Hecksher-Ohlin trade models predict that as the prices of goods and services converge, so will factor prices, including real wages. Hence income levels across borders will also tend to converge as prices converge. A key simplifying assumption of neoclassical economics is that all countries use the same production technologies exhibiting either constant or diminishing returns to scale.

There is a lively debate about the evidence concerning the impact of trade liberalization on income convergence across countries (Slaughter 2001; Ben-David 2001, 1996). There is also an extensive literature about economic convergence within countries including Barro and Xala-I-Martin (1995) and Xala-I-Martin (1996). At least since the publication of Barro (1991), the economics profession has been aware that convergence might be conditioned by convergence in certain fundamentals that are believed to cause economic growth. While there is admittedly much uncertainty about what these fundamentals are (Doppelhofer et al. 2000), the evidence of conditional convergence can be interpreted as evidence in favor of the neoclassical growth model or as evidence that there are fundamental differences that prevent income convergence.

### *1.1.2 Technology and divergence: The "big" story*

For Easterly and Levine (2001) and Pritchett (2000), the "big story" in international income comparisons is that the rich have gotten richer while the poor got poorer. Some studies focusing on cross-country differences in the *levels* of income per capita (or GDP per worker) argue that these differences are largely explained by institutional factors (Hall and Jones 1999; Acemoglu, Johnson, and Robinson 2001). However, there are other factors, besides different fundamentals that might impede economic convergence among geographic areas even if there is free trade.

More recent theories of growth with increasing returns and/or technological differences across regions, such as the pioneering work of Romer (1986, 1990), Lucas (1988), and Grossman and Helpman (1991), predict divergence in income levels and growth rates across regions. Trade flows might help international technology diffusion when technical knowledge is embodied in goods and services, and theories of technology diffusion via trade have been the subject of a fast-growing literature (Eaton and Kortum 1999, Keller 2001). A related literature focuses on the barriers that impede technological adoption, which explain differences in the levels of income per capita (Parente and Prescott 1996). Thus, even when production technologies are different across countries, convergence can be aided through the liberalization of trade. But this would tend to be detected in convergence (divergence) of TFP levels within industries across countries (Bernard and Jones 1996). But even if trade liberalization allows poor countries to import production technologies from advanced countries, if the factor endowments are different, productivity levels might not converge due to the mismatch between labor skills available in poor countries and the sophisticated technologies imported from the rich countries. Hence productivity gaps within industries across countries might persist even if trade facilitates technological convergence (Acemoglu and Zillibotti 2001).

### *1.1.3 Geography and divergence: The "big" story*

The recently resurgent literature on economic geography, transport costs, economies of scale, and knowledge spillovers is less optimistic about the impact of trade liberalization on economic convergence (Krugman 1991; Fujita, Krugman and Venables 1999). For example, transport costs will remain as barriers to trade and economic integration even if all policy distortions are removed (Eaton and Kortum 2002). In addition, if learning and innovation depend on trade, then geography will also be an impediment to convergence via technological diffusion (Keller 2002; Eaton and Kortum 2002). These factors might hamper income convergence across countries (Redding and Venables 2001). Moreover, economies of scale and knowledge spillovers might make some geographic regions more prosperous than others simply because of the cumulative effects of initial conditions such as the density of economic activity (Ciccone and Hall 1996).

### 1.1.4 *Life after NAFTA: Big events, little time*

On the day of NAFTA's implementation, the Zapatista rebels took up arms in Mexico's southern state of Chiapas. Later that year, in December 1994, Mexico was forced to float the Peso, which was followed by a deep banking crisis and severe recession. Beginning in late 1995, after a sharp deterioration and subsequent recovery of domestic investment, the Mexican economy was recovering by 1996 (Lederman et al. 2003). These were big events that coincided with the implementation of NAFTA. Moreover, from a long-run perspective, the post-NAFTA period is still short. These big events, combined with little time after NAFTA increase the difficulty of empirically identifying the impact of the agreement on income and productivity gaps in North America. Nevertheless, we try various methodologies to assess how income and productivity differences were affected by NAFTA.

The rest of the paper is organized as follows. Section II uses times series techniques to identify the impact of NAFTA on the income gap between Mexico and the U.S. To deal with the big-events-little-time problem, we apply various time-series methods. First, we follow Harvey (2002) and conduct a structural time series exercise that might be able to separate transitory effects (e.g., the Tequila crisis) from the long-term effects expected from NAFTA. Second, we provide estimates of the impact of NAFTA on the rate of convergence between Mexico's and the U.S. GDP per capita. Third, we follow Fuss (1999) in applying cointegration analysis to see whether there is an observable process of income convergence between the U.S. and Mexico. We do this recursively to test whether there was a structural change in the equilibrium condition between U.S. and Mexican GDP using quarterly data from 1960-2001. We find that the debt crisis in the early 1980s and the Tequila crisis temporarily interrupted a process of economic convergence (perhaps toward absolute convergence), which resumed after 1995. Convergence after Mexico's trade liberalization in the late 1980s and after NAFTA might have been faster than prior to the debt crisis. However, given that other Latin American economies also seem to have grown quickly during this time period, we also provide econometric annual estimates of the differences between Mexico-specific and Latin American income effects. These results indicate that Mexico's performance between 1986 and 1993 was not that different from the average Latin American economy, but it was significantly more positive after NAFTA, with the obvious exception of 1995. The estimates of the rate of convergence suggest that Mexico's GDP per capita by the end of 2002 would have been about 4-5% lower without NAFTA.

Section III looks at the income per capita differentials across countries in 2000 and estimates the extent to which institutional differences explain observed income differences. This exercise follows Acemoglu, Johnson, and Robinson (2001) in using settlers' mortality rates from colonial times as instruments for currently observed differences in institutional quality, based on data from Kaufmann and Kray (2002a). We find that the income gap between the U.S. and Mexico can be largely explained by the institutional gap plus geographic variables. In addition, we examine the evolution of the institutional gap with respect to the U.S. in Mexico by, again, comparing annual estimates of Mexico effects to the average Latin American effect, and conclude that there is not evidence that Mexico's institutions improved more than others from Latin America in the post NAFTA period. Thus, to accelerate convergence a major effort will be required to improve Mexico's institutions—NAFTA is not enough.

Section IV studies the impact of NAFTA on TFP differentials within manufacturing industries across the U.S. and Mexico. Based on a panel estimation of the rate of convergence across 28 manufacturing industries, we find that the post-NAFTA period was characterized by a substantially faster rate of productivity convergence than in previous years. However, at this time we cannot say whether the productivity-convergence result was due to increased imports of intermediate goods from the U.S. (as argued by Schiff and Wang 2002), due to competitive pressures and preferential access to the U.S. market (as argued by López-Córdova 2002), or by increased Mexican innovation that might have been caused by a variety of factors, including increased domestic R&D efforts and patenting aided by the enhanced protection of intellectual property rights contained in the NAFTA (Lederman and Maloney 2003).

Section V looks at the impact of NAFTA on economic convergence across Mexican states. This issue is of particular interest to many Latin American economies who are looking forward to the proposed Free Trade Area of the Americas (FTAA), because this hemispheric economic integration would theoretically lead to the establishment of free trade, and, in some cases such as in Central America and perhaps Mercosur, to deeper forms of economic integration among countries, which would resemble a single economic entity. Thus different economic performance of Mexican states under NAFTA might be a prelude of differential effects that might be brought by the FTAA or other proposed arrangements, such as the Central America-U.S. Free Trade Agreement (CAFTA). We test the conditional convergence hypothesis across Mexican states, but focus exclusively on initial conditions that might explain why some Mexican states grew faster than others during 1990-2000. We find suggestive evidence that the initial level of skills of the population and telephone density played an important role. We interpret these results as evidence that trade liberalization might indirectly induce divergence within countries, even if it induces convergence across countries. Section V summarizes the main findings and proposes a research agenda focusing mainly on the questions raised by our findings related to TFP convergence in manufacturing.

## 1.2 Time series evidence

### *1.2.1 Structural time series modeling*

A simple way to gain insight into the convergence process is to separate trends and cycles from the relative output gap between the United States and Mexico, whereby a decreasing trend in the output gap indicates convergence. The Hodrick-Prescott filter can create serious distortions, however, as can the Baxter-King band pass filter.[3] We therefore follow Harvey and Trimbur and, in a later work, Harvey, who argue that trends and cycles are best estimated by structural time series models.[4] We estimate a bivariate structural time series model, in which convergence between two economies is captured through a similar-cycle model that allows the disturbances driving the cycles to be correlated across countries.[5] Harvey provides a direct link between cointegration, common factors, and balanced growth models.[6] He also shows that the balanced growth model results as a special case of the similar-cycle model, when a common trend restriction is imposed.[7]

The analysis in this section is based on quarterly data on real GDP per capita for the US and Mexico over the period 1961:4 to 2002:4. To create a quarterly PPP-adjusted data series, we applied the following procedure. Quarterly GDP data were obtained from the OECD and the population series were constructed as quarterly moving averages of annual figures (from the WDI, The World Bank) spread across four quarters. US GDP data was seasonally adjusted by the provider, Mexican GDP data was seasonally adjusted using X-12-ARIMA. We first converted Mexican data into US dollars using quarterly average nominal exchange rates. Both series were then deflated by US CPI to 1995 US dollars. As PPP adjusted figures are only available on an annual frequency, we apply a two step procedure for the PPP adjustment of our quarterly series. In a first step we estimate the exchange rate bias by regressing the annual PPP adjusted GDP figures from Global Development Finance & World Development Indicators [8]

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[3]. On the distortions associated with the Hodrick-Prescott filter and the Baxter-King band pass filter, see references in Harvey (2002).

[4]. Harvey and Trimbur (2001); Harvey (2002).

[5]. Harvey and Koopman (1997).

[6]. Harvey (2002).

[7]. Harvey and Carvalho (2002).

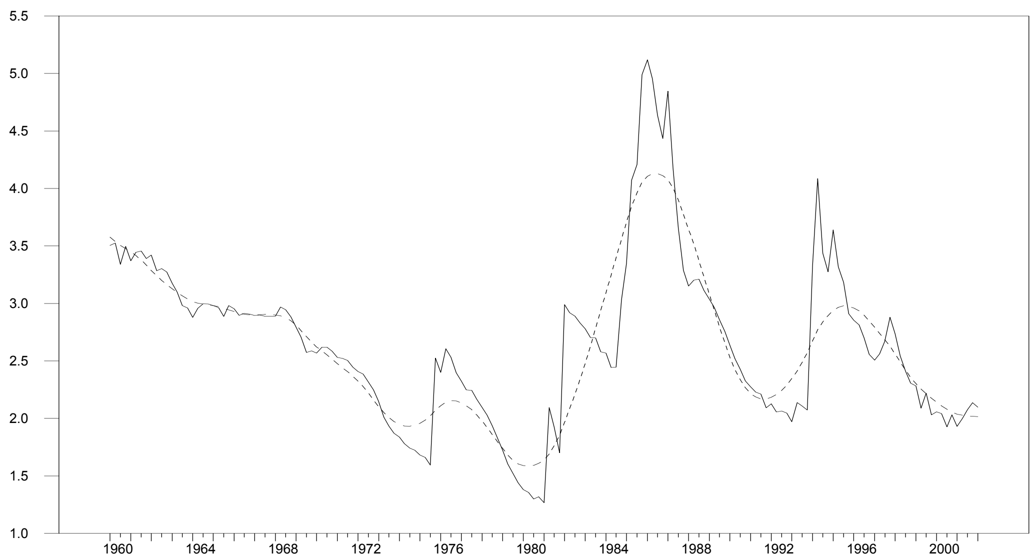
[8] see http://www.worldbank.org/research/growth/GDNdata.htm.

on an annual exchange rate adjusted GDP series from Word Development Indicators. In a second step, we apply the predicted exchange rate bias to our series of quarterly exchange rate-adjusted per capita GDP figures.[9]

We then fit a similar-cycle bivariate model to the logarithms of quarterly per capita GDP in the United States and Mexico.[10] The individual trends and cycles from these bivariate structural time series models are displayed in figure A1 in the appendix. A model with two cycles appears to describe the data well, and the second cycle appears to capture large movements in Mexico around the 1980s.

Figure 2 shows the ratio of the two trends. This PPP-adjusted gap exhibits convergence until the set-back of the 1980s associated with the debt crisis. Convergence resumed around 1987, coinciding with the unilateral liberalization the Mexican economy implemented in 1986. However, this might also reflect the recovery after the recession of 1982-1984. The data also indicate that the Tequila crisis also represented a temporary set-back. Abstracting from the adverse impact of the last crisis, the downward slope of the income gap is steeper than prior to the 1980s, supporting the hypothesis that convergence between Mexico and the U.S. occurred at a faster rate after trade liberalization.[11]

**Figure 2. The U.S.-Mexico GDP per Capita Gap: Similar-Cycle Model with Quarterly PPP Adjusted Data, 1960-2002.**




Note: Solid line is the ratio of the U.S./Mexico trend components of GDP per capita. Dotted line is the observed ratio. Source: Authors' calculations—see text.

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[9] To estimate the exchange rate bias, we regressed log-transformed PPP adjusted GDP ($y_{PPP}$) on exchange rate adjusted GDP ($y_e$). Standard errors are in brackets:

Mexico: $y_{PPP} = -0.2944 + 1.111 * y_e$, $R^2 = 0.987$ , USA: $y_{PPP} = 1.1866 + 0.8482 * y_e$, $R^2 = 0.992$

(0.1608) (0.020) (0.1203) (0.0121)

[10]. Following Harvey (2002).

[11] Since the STAMP algorithm provides only RMSE for the final state vector, we estimate for our quarterly series a structural time series model with three different sample end points: 1987:01, 1994:04 and 2001:03. The resulting final state vectors allow us to gain insight if the different gap estimates are statistically different. This is indeed the case, the respective gaps are as follows: 1987:01: 4.067 (0.226); 1994:04: 3.055 (0.205), 2001:03: 1.951 (0.156), RMSEs are in brackets.

To investigate the speed of convergence further, we estimated the following model:

$$\mathrm{GAP}_t = \underset{(0.045)}{0.059} + \underset{(0.043)^{**}}{0.933}\mathrm{GAP}_{t-1} - \underset{(0.013)^{*}}{0.022}\mathrm{NAFTA\_GAP}_{t-1} + \underset{(0.013)}{0.005}\mathrm{LIB\_GAP}_{t-1} + \underset{(0.080)^{**}}{0.37}\mathrm{TEQUILA}_t ,$$

where $R^2 = 0.90$ and where GAP is the log of the U.S.-Mexico income gap, TEQUILA is a dummy for the 1994 tequila crisis (1994:4–1995:1), and NAFTA_GAP and LIB_GAP are dummies for Mexico's unilateral trade liberalization (1986:1–1993:4) and NAFTA (1994:1–2002:4), interacted with the lagged income gap. Standard errors are in parentheses. We find that NAFTA, but not unilateral trade liberalization, had a significant positive impact on the speed of convergence. With NAFTA, the half-life of a one unit shock to the income gap appears to have fallen from 2.5 to 1.9 years. Alternatively, these results suggest that by the end of 2002, Mexico's GDP per capita would have been around 3.3-4.2% lower without NAFTA, depending on which GDP per capita observation (either the observed or the smoothed gap for 1993Q4 or 1994Q1) one chooses as the pre-NAFTA level. The fact that unilateral liberalization does not appear to be significant for income convergence is interesting. We find a similar result later in the paper, when analyzing the impact of unilateral liberalization and NAFTA on productivity growth.

### *1.2.2 Cointegration analysis*

According to Bernard and Durlauf (1995, 1996) long-run convergence between two or more countries exists if the long-run forecasts of output differences approach zero. In other words, two economies are said to have converged if the difference between them, $y_t$, is stable. Abstracting from initial conditions, stability implies that the difference between two series is stationary. Absolute convergence requires that the mean of $y_t$ is zero, while relative or conditional convergence requires that the difference between the two series has a constant mean. If two series are cointegrated, but with a vector different from [1,-1], the economies are co-moving (i.e. driven by a common trend) but not necessarily converging to identical levels of output. Cointegration between economies alone is therefore a necessary, but not a sufficient condition for absolute convergence. If a constant is introduced into the cointegration space, it is possible to test for absolute and relative convergence by restricting the constant to zero. A zero constant supports absolute convergence.[12] Following Fuss (1999) we intend to interpret evidence of a cointegration vector of the form of [1,-1] at the end of the sample together with a rejection of this vector parameterization in sub-samples as evidence of an ongoing process of convergence.[13]

A cointegration analysis between U.S. and Mexican GDP with a constant and four lags in the cointegration space over the full sample from 1960 to 2001 reveals one significant cointegration vector—see Table 1. As a restriction of the cointegration space according to (1,-1) cannot be rejected

[12] Further, by introducing a trend into the cointegration space it is possible to distinguish between stochastic and deterministic convergence (see Ericsson and Halket, 2002), where a homogeneity (1,-1) restriction on the GDP coefficients with a trend corresponds to stochastic convergence and homogeneity (1,-1) without a trend to deterministic convergence. As we reject stochastic convergence in favor of deterministic convergence in our data, we only report the findings based on a constant in the cointegration space, which we view as a test of deterministic conditional convergence.

[13] Fuss (1999) postulates that if y and x and cointegrated at the end of the period with: y = a +bx+u, then evidence of:

a=0 and b=1 indicates that the series are converging,

a<>0 and b=1 indicates that the two series are converging up to a constant,

a>0 and b<1 implies that x converges towards y,

a<0 and b>1 implies that y converges towards x,

a>0 and b>1 implies divergence (x lags falls y) and

a<0 and b<1 implies divergence (y falls behind z)

($\chi^2(1) = 1.50$, p=0.22) over the full sample, this provides evidence in favor of convergence during 1960-2000[14]:

$$GDP_{us} - GDP_{mx} = 0.720$$
(standard error: 0.082)

The estimate of the constant in the cointegration vector is greater than zero and the standard error for the constant is relatively small. We interpret this as evidence of incomplete convergence in the sense that Mexico is converging towards the U.S. level of income up to a point. That is, the observed process of convergence is unlikely to lead to absolute convergence, but rather to a constant income differential. The estimated constant suggests that Mexico reaches about 40 to 50 percent of the U.S. per capita GDP. Whereas this evidence applies to the whole period, it is possible that this process of conditional convergence holds only for a certain years.

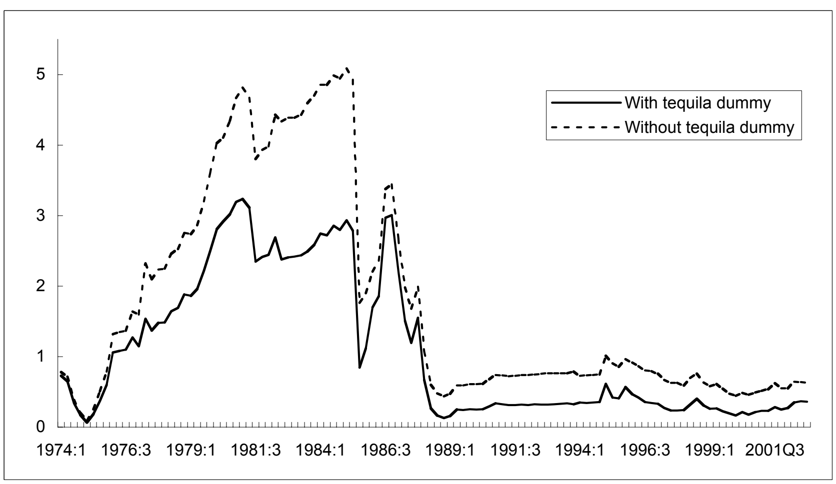
**Table 1. Cointegration Analysis for the United States and Mexico, 1960:4 to 2002:4**

| Eigenvalue | L-max | Trace | H0: r | P – r | L-max90 | Trace90 |
|---|---|---|---|---|---|---|
| 0.1644 | 29.64* | 32.49* | 0 | 2 | 10.29 | 17.79 |
| 0.0171 | 2.85 | 2.85 | 1 | 1 | 7.50 | 7.50 |

Source: Authors'calculations.

Recursive cointegration analysis reveals that the [1,-1] restriction does not hold in all subsamples (see Figure 3). The graph in figure 3 is scaled in such a way that unity represent the 5% level of significance. As such, a test statistic below one indicates that the hypothesis of convergence cannot be rejected. In particular, we find strong evidence for divergence during the 1980s (debt crisis), in spite of the fact that we estimated the cointegration vector with dummies that properly identify the key first and fourth quarters of 1982.[15]

**Figure 3. Trace Tests for Cointegration between U.S. and Mexico (Log) Quarterly GDP, 1960Q4-2002Q4 (recursive estimates)**




Source: Authors' calculations—see text.

[14] A similar result is obtained for annual data: $GDP_{us} - GDP_{mx} = 0.881$.
(standard error: 0.044)

[15] The relevant model specification tests showed that other dummy variables for the debt crisis tended to bias the estimates of the cointegration rank and coefficient restrictions.

To assess the impact of the 1994/1994 Tequila crisis on the convergence process, we perform a recursive cointegration analysis with and without a dummy for the Tequila crisis. As can be seen in Figure 3, which plots the cointegration trace test over time, the Tequila crisis had an impact on the convergence process. Once we include a crisis dummy, we find evidence of a resumed convergence process from 1987/88 onwards. Without the Tequila dummy, the convergence hypothesis is rejected around the time of the crisis. This suggests that the Tequila crisis temporarily interrupted an ongoing convergence process which started at the beginning of the 1990s.

The evidence from time series analyses can be summarizes as follows. Structural time series modeling and recursive cointegration analysis both identify periods of convergence and divergence between Mexico and the U.S. during 1960-2000. Both econometric techniques find evidence that the Tequila crisis only temporarily interrupted a convergence process which started in the late 1980s. But this process seems to have a limit. The time series perspective on convergence has allowed us to recover interesting stylized facts about the underlying dynamics of the U.S.-Mexican convergence process, but as highlighted by Figure 1, it is possible that other economies grew just or even faster than Mexico relative to the U.S. since the late 1980s. Therefore, to better identify the Mexico-specific process of convergence towards the U.S. level of development, we now examine Mexico's performance relative to other regional economies.

### *1.2.3 How did Mexico perform relative to other Latin American countries?*

In order to know how Mexico performed in closing the income per capita gap relative to the U.S. in comparison to other Latin American countries that did not enjoy the benefits of NAFTA but also reformed their economic policies, we tested whether there was a significant statistical difference between the year effects for a group of Latin American countries and the year effects specific to Mexico. The dependant variable was the (log) ratio of GDP per capita of the countries relative to the United States. The test was conducted with two samples of Latin American countries that include Mexico, one that consisted of 22 countries and another of 9 countries. The list of countries appears in Table 5A in the Appendix.

The results are shown in Figure 4.[16] Mexico's year effects are statistically significantly different from the group of 21 countries at a level of 10% of confidence since 1982. In words, the annual observations shown in Figure 4 are significantly different from zero only after 1982. With respect to the smaller comparator group, Mexico's annual effects are also different during 1982-1994 and 1999-2001.[17] However, these differences simply reflect that Mexico tended to be significantly richer than other regional economies during these years. The real question is whether Mexico grew significantly richer than other Latin economies during these years, which should be reflected in upward movements of the country-effects differentials shown in Figure 4. This only occurs after 1995 with respect to both comparator groups. For the larger group of Latin American and Caribbean economies, this might have also occurred during 1986-1993.

The fact that Mexico did not catch-up to the U.S. significantly faster than other middle-income countries (the eight included in the small comparator group) sheds some doubts about the possibility that Mexico's unilateral reforms spurred convergence with respect to the U.S. to a greater extent than reforms in country's such as Chile or Costa Rica. In contrast, the post-NAFTA period is characterized by an declining Mexico-U.S. income gap, which declined faster than for the average Latin economies included in both samples. Following the analysis of the dynamics of convergence process, the next sections try to identify the underlying constraints of the U.S.-Mexico convergence process.

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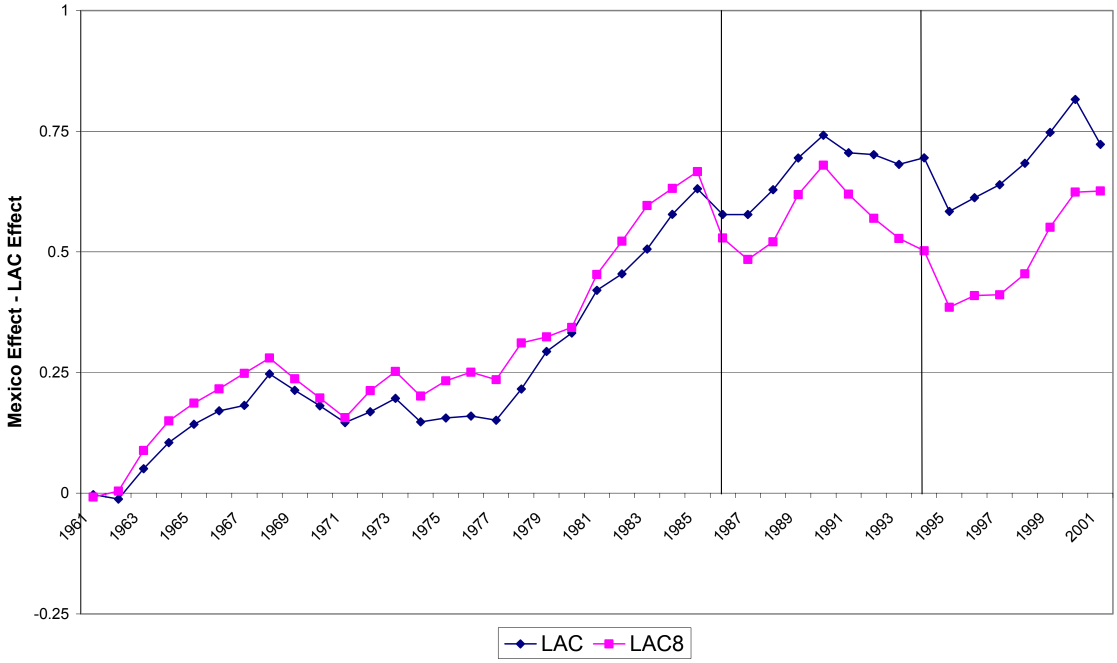
[16] The estimated model was: $y_{c,t} = c + \beta_t \bullet D_t + \beta_{t,Mex} D_t \bullet D_{Mex}$, where y is the log of the GDP per capita ratio with respect to the U.S., $D_t$ is a year dummy, and $D_{Mex}$ is a Mexico dummy. Figure 4 plots $\beta_{t,Mex} - \beta_t$.

[17] Wald tests for significance of the difference between Mexico and average LAC effects are not reported.

**Figure 4. Mexico Year Effect Minus LAC Year Effect, Log (GDP pc/U.S. GDP pc)(PPP)**



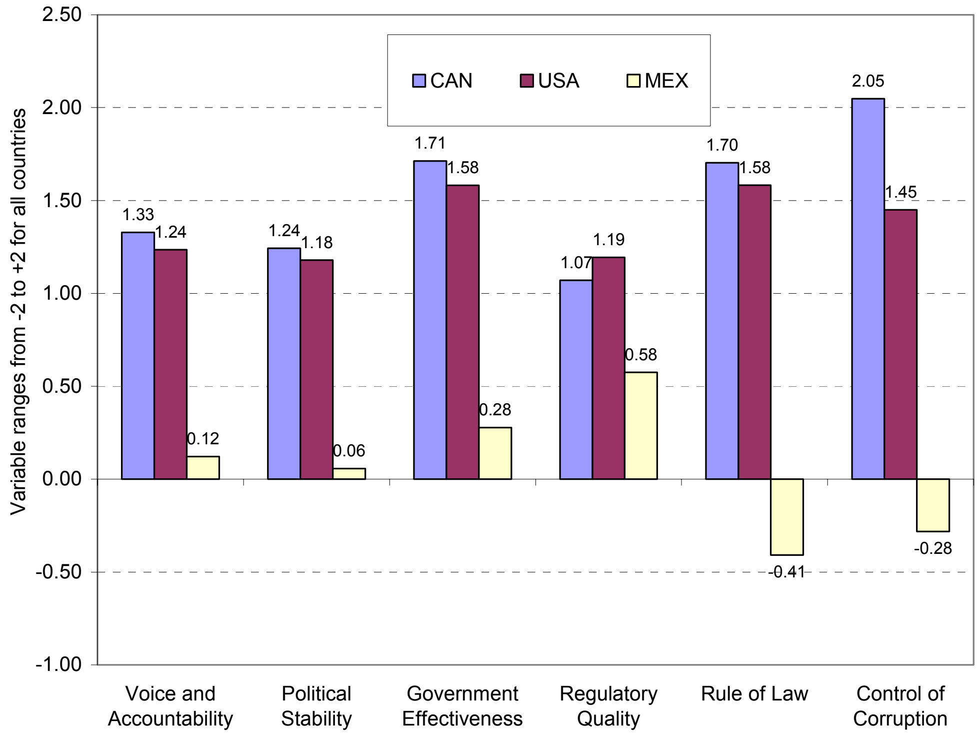

Note: 1960 is the excluded year. Source: Authors' calculations—see text.

## 1.3 Income gaps and institutional gaps

As discussed in the introduction, there is a substantial literature that highlights the role of institutional differences in producing cross-country differences in income per capita (Hall and Jones 1999, Acemoglu et al. 2001). In spite of trade liberalization and the institutional harmonization requirements imposed by NAFTA (e.g., intellectual property rights, investor protection, environmental standards), there are obvious remaining institutional gaps between the U.S. and Mexico. Based on data from Kaufmann and Kraay (2002a), Figure 5 shows the gaps along six dimensions. It is clear that in 2000/01 Mexico lagged behind its North American partners, in all institutional dimensions, especially in corruption and rule of law. If these institutional differences persist, it is likely that absolute income convergence, as predicted by neoclassical economics, will never materialize even if trade is completely liberalized. These types of impediments to convergence are difficult to identify with time series analyzes, such as those presented in the previous section, mainly because institutional gaps can be rooted in history and tend to vary little over time.

The experience of Puerto Rico (recall Figure 1) can provide a useful medium-term perspective on how institutional convergence might affect convergence. Since Puerto Rico became a Commonwealth Territory of the United States in 1952, it gained not only free trade in goods and factors of production, but also in practice the island gained some of the political and regulatory institutions available in the United States. In addition, firms gained tax incentives for setting up operations in the island. Hence it is not surprising that the income gap between mainland U.S. and Puerto Rico narrowed significantly in the last 50 years, especially when compared to the income gaps with respect to Mexico and other Latin American. In what follows, we attempt to estimate the role of institutional gaps in maintaining long-run income gaps.

**Figure 5. Institutional Gaps in North America, 2000/01**




Source: Kaufmann and Kraay (2002a).

### *1.3.1 Data and methodology*

To investigate the impact of institutional gaps, we follow the methodology of Acemoglu et al. (2001). In a nutshell, we use a set of exogenous variables related to geographic characteristics (regional dummy variables, landlocked-country dummy, latitude, dummies for oil and commodity exporters), a constructed trade share indicator that takes into consideration countries' size and geographic factors (from Frankel and Romer 1999), an indicator of ethno-linguistic fractionalization, and a composite index of the Kaufmann-Kraay indicators of institutional quality from 2000/01 as explanatory variables of income per capita (US$ on a PPP basis) as of the year 2000.[18] Table A3 contains the summary statistics for our data set. Our methodology is TSLS.

Since the indicators of institutions and the corresponding composite index can be endogenous to the level of development, we need to find instruments for this variable. Also, the institutional variables are measured with error, as explained by Kaufmann and Kraay and Acemoglu et al. A priori, it is difficult to say which effect will predominate, as the endogeneity problem could bias the estimates upwards if income improves institutions, whereas the measurement error problem could produce an attenuation bias.

Acemoglu and his coauthors showed that the (log) mortality rates of settlers can be a good instrument for current institutions. These authors relied on a long historical literature linking the importation of political and economic institutions to the extent to which colonies were settled by their European colonizers, as opposed to becoming sources for the extraction of high-priced commodities. Where Europeans settled, they imported "good" institutions. However, Europeans had incentives not to settle in places where the climate and other historical factors reduced life expectancy. Consequently it

[18] The composite index is the average of the six individual components.

seems logical to use settler mortality rates in the 18th and 19th Centuries as instruments for institutions in the present.

### *1.3.2 Results*

Table 2 contains a set of results. Panel A contains the estimated effects of the key variables on the (log) income per capita on a PPP basis as of 2000. Panel B shows the first stage regressions, where the composite index of institutional quality is the dependent variable. Panel C shows the corresponding OLS regressions, which depend on the assumption that institutions are exogenous.

In the five specifications shown in Table 2, the instrumented composite index of institutions is positively and significantly correlated with income. In fact, across the four models the relevant coefficient is quite stable, ranging from 1.35 to 1.94. The only other "robust" explanatory variable is the dummy for oil exporters, which appears consistently with positive and significant coefficients. Interestingly, the Frankel-Romer trade openness indicator is not a significant determinant of income per capita. Virtually identical results were obtained when we used the Sachs-Warner (Sachs and Warner 1995) policy openness index average for 1965-1990 instead of the Frankel-Romer constructed trade share. These results can be interpreted as an indication that the long-run level of development of countries is mainly determined by the quality of domestic institutions or that the correlation between the instruments used by Frankel and Romer to estimate the exogenous portion of the trade to GDP ratios (the so-called geographic "gravity" variables) and the settlers' mortality rates are so high that it is quite difficult to really identify the marginal effects of institutions and trade separately (Dollar and Kraay 2003).

The results for the first-stage OLS regressions show that the (log) settlers' mortality rates are good predictors of institutional quality in 2000. The mortality variable is always statistically significant and with the expected negative sign. The comparison of the OLS and TSLS estimates of the institutional coefficient shows that the OLS estimates are significantly lower. These results suggest that OLS estimates suffer from attenuation bias due to measurement errors afflicting the institutional variable.

Figure 6 illustrates how these econometric results shed light on the income gap observed between the U.S. and Mexico. The last bar on the right is the income gap (the difference in the log of GDP per capita on a PPP basis) as of 2000, which is approximately 1.2. The penultimate bar shows the model's (column one of Table 2) estimated income gap. The other bars show the marginal effects of the statistically significant variables on the (log of) of the U.S.-Mexico income gap. Mexico's status of a net exporter of oil tends to reduce the income gap by about 0.88. In contrast, the first six bars on the left of the graph show the contribution of each institutional dimension. The sum of the individual institutional contributions is about 2.5, but gaps in rule of law and corruption seem to be a bit more important than the other institutions, although the measurement errors in each category probably make this last observation less meaningful since we cannot be sure that these institutional gaps are significantly different from the others. In any case, the large income gap observed between the U.S. and Mexico is readily explained by institutional features. Moreover, if Mexico were not an oil exporter it would probably be poorer than it actually is. Finally, the full model predicts a log ratio of U.S. over Mexican GDP per capita of about 0.62, which translates into a 0.54 ratio of Mexican GDP per capita over the U.S. GDP per capita. It is perhaps a coincidence that this is more or less the limit to the convergence process estimated with the cointegration analysis discussed in section II above.

So institutional gaps might hamper convergence in North America. However, this does not mean that trade reforms and NAFTA in particular did not have an effect on institutional convergence. We have already seen that time series analyses suggest that convergence was in fact present after NAFTA. Was this due to institutional convergence?

**Table 2. Regressions of Log GDP per Capita 2000 (robust standard errors in parentheses)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Panel A: Two-Stage Least Squares** | | | | | |
| Institutional Index | 1.94 (0.53) *** | 1.35 (0.19)*** | 1.39 (0.20)*** | 1.40 (0.20)*** | 1.37 (0.25)*** |
| Net Oil Exporters | 0.87 (0.30) *** | 0.69 (0.18)*** | 0.72 (0.21)*** | 0.73 (0.20)*** | 0.71 (0.21)*** |
| Net Commodity Exporters | -0.22 (0.18) | -0.16 (0.13) | -0.16 (0.16) | -0.16 (0.16) | -0.16 (0.16) |
| Africa | 0.22 (0.59) | -0.21 (0.35) | -0.12 (0.38) | -0.10 (0.38) | -0.14 (0.42) |
| South Asia | 0.98 (0.73) | 0.45 (0.38) | 0.59 (0.43) | 0.60 (0.43) | 0.55 (0.48) |
| East Asia & the Pacific | 0.70 (0.53) | 0.53 (0.30)* | 0.61 (0.33)* | 0.62 (0.33)* | 0.59 (0.38) |
| Americas | 0.43 (0.43) | 0.26 (0.24) | 0.27 (0.27) | 0.28 (0.27) | 0.26 (0.30) |
| Log Constructed Trade Share (Frankel-Romer) | -0.04 (0.12) | 0.02 (0.09) | 0.00 (0.10) | | |
| Eth-Ling Fractionalization | | | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| Landlocked | 0.26 (0.39) | | | | -0.05 (0.28) |
| Latitude | -0.02 (0.01) | | | | |
| R squared | 0.72 | 0.84 | 0.84 | 0.83 | 0.84 |
| **Panel B: First Stage Regression for Institutional Index** | | | | | |
| Log Mortality | -0.17 (0.07)** | -0.17 (0.07)** | -0.18 (0.08)** | -0.18 (0.08)** | -0.18 (0.08)** |
| Oil Production Dummy | -0.37 (0.18)** | -0.37 (0.18)** | -0.42 (0.20)** | -0.45 (0.18)** | -0.45 (0.18)** |
| Commodity Dummy | 0.04 (0.16) | 0.04 (0.16) | 0.03 (0.20) | 0.00 (0.18) | 0.00 (0.18) |
| Africa | -0.65 (0.30)** | -0.65 (0.30)** | -0.69 (0.34)** | -0.69 (0.34)** | -0.69 (0.34)** |
| South Asia | -1.00 (0.34)*** | -1.00 (0.34)*** | -1.07 (0.41)** | -1.12 (0.39)*** | -1.12 (0.39)*** |
| East Asia & the Pacific | -0.52 (0.33) | -0.52 (0.33) | -0.45 (0.45) | -0.48 (0.44) | -0.48 (0.44) |
| Americas | -0.35 (0.24) | -0.35 (0.24) | -0.35 (0.26) | -0.36 (0.26) | -0.36 (0.26) |
| Log Constructed Trade Share (Frankel-Romer) | 0.04 (0.11) | 0.04 (0.11) | 0.05 (0.12) | | |
| Eth-Ling Fractionalization | | | 0.00 (0.00) | | 0.00 (0.00) |
| Landlock | -0.43 (0.20)** | -0.43 (0.20)** | -0.43 (0.22)* | -0.45 (0.22)** | -0.45 (0.22)** |
| Latitude | 0.02 (0.01)** | 0.02 (0.01)** | 0.02 (0.01)** | 0.02 (0.01)** | 0.02 (0.01)** |
| R squared | 0.62 | 0.62 | 0.63 | 0.63 | 0.63 |

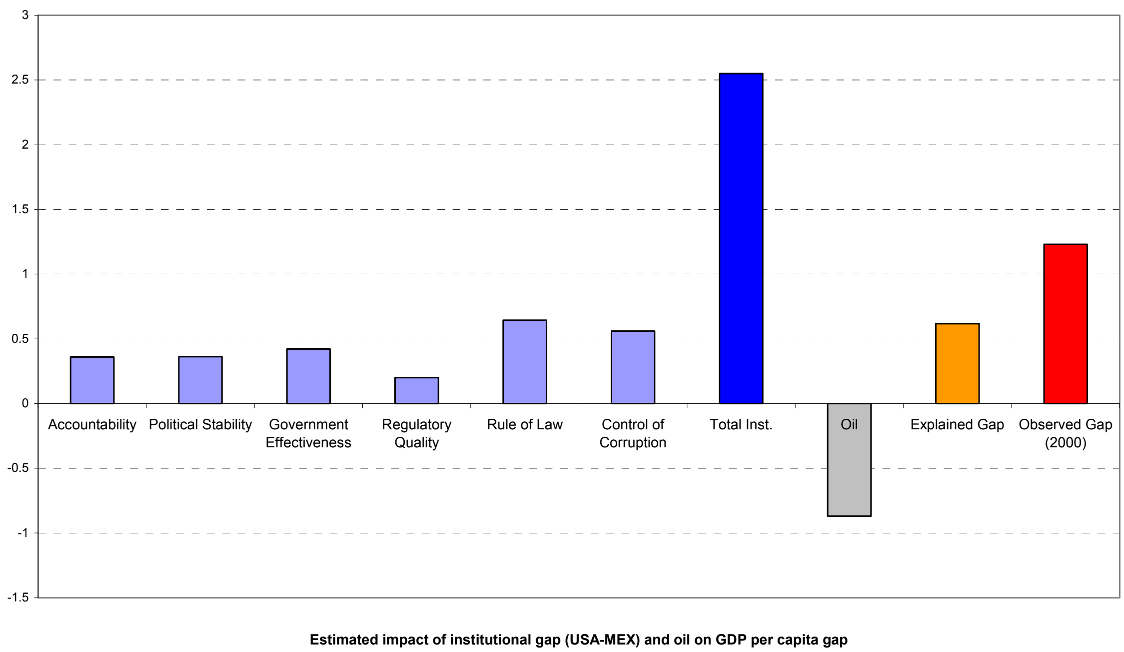
**Table 2 *(continued)***

| Panel C: OLS Estimates | | | | | |
|---|---|---|---|---|---|
| Institutional Index | 1.10 (0.11)*** | 1.11 (0.11)*** | 1.11 (0.11)*** | 1.11 (0.11)*** | 1.08 (0.11)*** |
| Oil Production Dummy | 0.51 (0.16)*** | 0.58 (0.16)*** | 0.59 (0.20)*** | 0.60 (0.17)*** | 0.57 (0.17)*** |
| Commodity Dummy | -0.17 (0.13) | -0.15 (0.13) | -0.14 (0.16) | -0.14 (0.16) | -0.12 (0.15) |
| Africa | -0.65 (0.29)** | -0.57 (0.28)** | -0.56 (0.29)* | -0.56 (0.30)* | -0.57 (0.30)* |
| South Asia | 0.00 (0.33) | 0.12 (0.32) | 0.18 (0.38) | 0.19 (0.36) | 0.12 (0.36) |
| East Asia & the Pacific | 0.16 (0.24) | 0.25 (0.22) | 0.29 (0.24) | 0.29 (0.24) | 0.24 (0.24) |
| Americas | -0.02 (0.20) | 0.05 (0.21) | 0.03 (0.22) | 0.02 (0.22) | 0.01 (0.22) |
| Log Constructed Trade Share (Frankel-Romer) | -0.03 (0.09) | 0.01 (0.09) | -0.01 (0.10) | | |
| Eth-Ling Fractionalization | | | 0.00 (0.00) | 0.00 (0.00) | 0.00 (0.00) |
| Landlock | -0.18 (0.17) | | | | -0.20 (0.19) |
| Latitude | -0.01 (0.00) | | | | |
| Observations | 68 | 68 | 61 | 61 | 61 |

*** =significant at 1%, **=5%, *=10%.

Source: Authors' calculations—see text.

**Figure 6. The Contribution of Institutional Gaps to the U.S.-Mexico Income Gap**



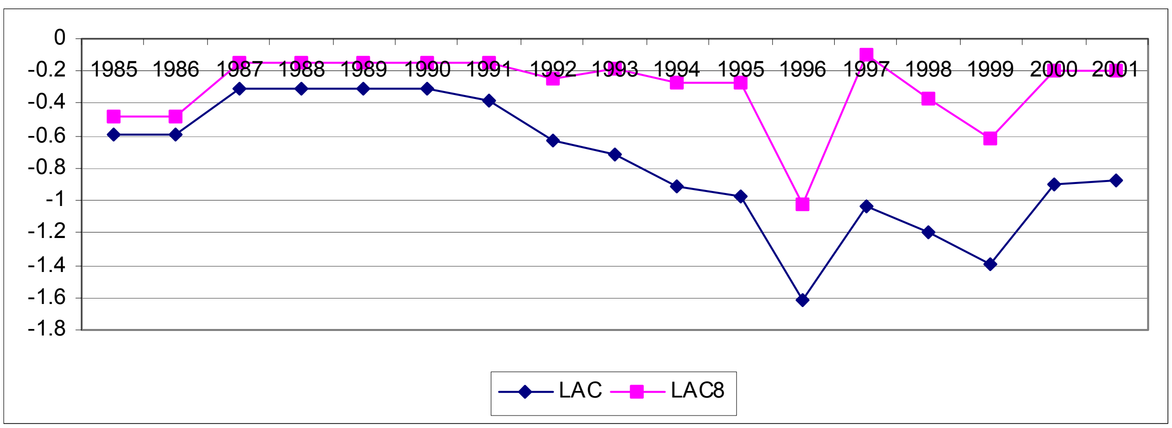

Source: Authors' calculations—see text.

*1.3.3 Institutional performance in Mexico versus the rest of Latin America and the Caribbean*

Since NAFTA was implemented, it was expected that the agreement would put direct and indirect pressures on Mexico to improve its institutions. The direct pressures came from specific elements of the trade agreements, including those related to investor protection, intellectual property rights, and the labor and environmental trade side-agreements, which explicitly focus on Mexico's enforcement of its own laws. The indirect pressure could have emanated from the political debate in the U.S. regarding Mexico's ability to implement its commitments.

In order to test whether this has happened we estimated regressions similar to those concerning the income gaps presented in Figure 4 above. The dependant variable was the difference between the country's composite institutional indicator composed of three indexes of institutional quality provided by the International Country Risk Guide (ICRG) and the U.S. value of this index. The index was constructed using factor analysis of ICRG's absence of corruption, law and order, and bureaucratic quality variables. These data cover 1984-2001. Again, for the comparisons we used two samples consisting of 23 and 9 comparator countries (see Table 5A in the Appendix). Figure 7 shows the results. With respect to the first group of Latin American countries, Mexico's year effects were not statistically different, but they were statistically different from the average for the group of 22 countries since 1994, but Mexico seems to have under-performed relative to the regional average during this period, which is reflected a declining or stable negative difference between the Mexico and the average LAC effects.

**Figure 7. Mexico Year Effects relative to LAC Year Effects, Institutional Index (ICRG)**




Note: 1984 is the excluded year. Source: Authors' calculations—see text.

However, even though Mexico has improved its institutions relative to the United States in the post NAFTA period, the results in Figure 7 are due to the fact that other countries from the region also improved their institutions without benefiting from NAFTA. Table 3 shows the changes in the gap with respect to the U.S. of the composite institutional index before and after 1994. The countries that improved their institutional gap the most after 1994 were Chile and Central America, whereas Mexico's improvement was rather the norm for the whole region. Moreover, Mexico's big improvement took place after 1999 and thus it was probably related to the political transition, as was the case in Chile and Central America. These data are consistent with the findings of Lederman, Loayza, and Soares (2002) who find that political democratization has a positive effect in terms of reducing corruption in a large sample of countries. Thus NAFTA alone is unlikely to contribute to the institutional development of Mexico outside the specific areas covered by the agreement. Consequently, Mexico's policy efforts to combat corruption and improve general institutions need to be pursued further.

**Table 3. Institutional Changes in Latin America**

| COUNTRY / GROUP | BEFORE-NAFTA 1984-93 | AFTER-NAFTA 1994-2001 | CHANGE AFTER minus BEFORE |
|---|---|---|---|
| MEXICO | -1.80 | -1.46 | 0.34 |
| ARGENTINA | -1.49 | -1.05 | 0.43 |
| BRAZIL | -1.00 | -1.57 | -0.57 |
| CHILE | -1.55 | -0.73 | 0.82 |
| COLOMBIA | -1.80 | -1.91 | -0.11 |
| SOUTH AMERICA | -1.68 | -1.59 | 0.09 |
| CENTRAL AMERICA | -2.51 | -1.61 | 0.90 |
| ANDINE COUNTRIES | -1.98 | -1.60 | 0.39 |
| LATIN AMERICAN COUNTRIES | -1.83 | -1.53 | 0.30 |

Source: Authors' calculations, based on data from ICRG—see text.

## 1.4 Productivity gaps within industries, across the U.S. and Mexico

We have already mentioned that if NAFTA trade liberalization helped technological adoption and modernization in Mexico we should observe an acceleration in the rate of TFP convergence between the U.S. and Mexico within industries. To examine this channel of convergence we calculated TFP differentials between the U.S. and Mexico in manufacturing sectors. The following paragraphs discuss the data, methodologies, and econometric results concerning the impact of NAFTA on TFP convergence.

### *1.4.1 Data and TFP estimates*

To measure differences in total factor productivity (TFP) we follow the approach suggested by Caves et al. (1982), which has been utilized in the cross-country context by Keller (2002). They calculate a multilateral (bilateral in our present case) and flexible TFP index of the following form:

$$(1) \qquad \ln TFP_{cit} = (\ln Y_{cit} - \overline{\ln Y_{it}}) - \overline{\sigma_{cit}}(\ln L_{cit} - \overline{\ln L_{it}}) - (1 - \overline{\sigma}_{cit})(\ln K_{cit} - \overline{\ln K_{it}}) \ ,$$

where $c$ is the country index (Mexico and the U.S.), $i$ represents industries, and t is time. $Y$ is total output, $L$ is labor, and $K$ is capital stock. $\sigma$ is the cost-based labor share of output. The Caves et al. approach entails de-meaning of the log output, labor and capital series, using the geometric averages of both countries. The resulting TFP index in each country and industry is based on a vector of outputs and inputs that are common to both countries. Intuitively, this index tells us what is the productivity level in each country and industry if they had the same outputs and inputs.

Data on production and factor shares come from the OECD and UNIDO and cover 28 manufacturing industries at the 3-digit ISIC code.[19] The output data were deflated using the U.S. industry deflators from Bartelsman et al. (2000), because there is not existing series of PPP-adjusted sectoral output data for Mexico. The capital stock data were constructed using the permanent inventory method, assuming a 5% depreciation rate per year, based on fixed investment, and were deflated using the PPP

[19] We got our data from UNIDO but they received the Mexico and U.S. data directly from the OECD.

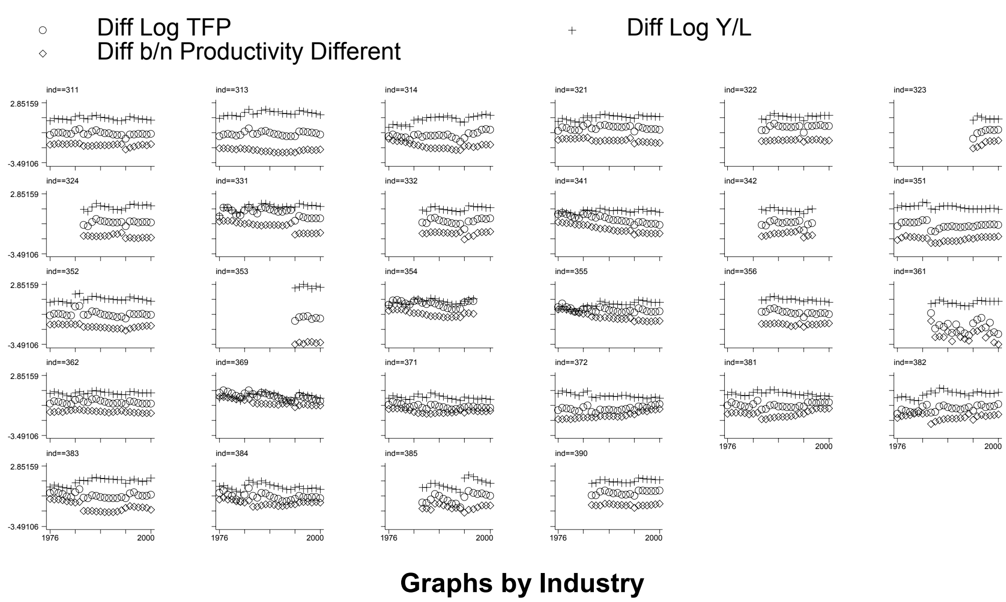
investment price levels from the Penn World Tables 6.0.[20] The Appendix contains summary statistics for the industry-level data for the U.S. and Mexico.

Figure 8 shows the resulting log-TFP differentials between the U.S. and Mexico for all 28 manufacturing industries, as well as the log-differences of output per worker. (The Appendix contains a table with the list of industry codes.) The comparison of both series is interesting as it sheds light on the contribution of capital accumulation to output per worker as opposed to technological differences. Thus the graphs also show the differences between the two series.

The evidence indicates that in some industries, capital accumulation over time has been an important source of differences in labor productivity. This is the case, for example, in 314 (tobacco), 341 (paper and products), 355 (rubber products), and 372 (non-ferrous metals). These industries show a notable trend in the difference between labor and TF productivity. Only in 372 (non-ferrous metals) Mexican capital accumulation seems to have risen slower than in the U.S., which was reflected in a combination of stable differences in labor productivity and declining differences in TFP. In the other examples, labor productivity differences declined while TFP differences increased.

In other industries, especially processed foods and labor-intensive manufacturing such as 311 (food products), 313 (beverages), 321 (textiles), 322 (apparel), 362 (glass), and 390 (other manufactures), the difference between labor and TFP are quite constant over time, suggesting that TFP and labor productivity differences moved together. Hence we cannot draw any firm generalization about the contribution of capital to labor productivity differentials in manufacturing, due to the heterogeneity observed in the data.

**Figure 8. Evolution of U.S.-Mexico Productivity Differentials by Industry, 1976-2000**




Source: Authors' calculations, based on data from OECD/UNIDO—see text.

[20] Output and capital inputs were expressed in constant prices of 1987. The investment PPP deflator series from the Penn World Tables and the industry deflators from Bartelsman et al (2000) end in 1996. We applied the average growth rate of the investment PPP deflator for the available years to the rest of our sample ending in 2000.

### *1.4.2 Estimation strategy*

To assess how the rate of (log)TFP convergence changed after the implementation of NAFTA, we estimated an autoregressive model with structural change in the autoregressive coefficient with industry fixed effects:

$$(2) \qquad y_{i,t} = \alpha_i + \beta y_{i,t-1} + \lambda D_{FTA} y_{i,t-1} + \delta D_{FTA} + \varepsilon_{i,t}\ ,\ i = 1,2,...,N\ ;\ t = 1,2,...,T$$

As mentioned, the number of industries N=28, and the maximum number of years is T=25. In the context of the fixed-effects (FE) estimator, designed to control for industry-specific effects, $\alpha_i$, by de-meaning both the left- and right-hand side variables, the estimated coefficients could be biased due to the correlation between the lagged mean of y and the contemporaneous error, $\varepsilon_{i,t}$. The bias is inversely proportional to T (Anderson and Hsiao 1981). Also, as mentioned, there is no good data on Mexico's PPP-adjusted unit prices for industry-level output, and thus the use of the U.S. deflator might have introduced a measurement error that is endogenous to (i.e., it is affected by) the trade liberalization efforts. This is a concern because trade reforms reduced the output price differences between the U.S. and Mexico and thus the TFP estimates for Mexico could be systematically biased after liberalization. Finally, it is possible that trade reforms themselves (including the sector-specific tariff phase out periods) were implemented when industrial productivity was rising, thus producing another source of biases in our proposed exercise. For these reasons, we used the Arellano-Bond (1991) differences estimator to estimate model (2). This estimator helps reduce the influence of the endogeneity biases discussed above by using lagged levels of the TFP differentials to instrument the changes in these differentials. Hence we also control for unobserved industry-specific effects.

In (2), the AR coefficient, $\beta$, provides an indication of the speed of convergence. When this coefficient is less than 1, it can be interpreted as evidence of convergence in TFP levels between the U.S. and Mexico. If NAFTA was associated with an acceleration of TFP convergence, then the estimated coefficient of the corresponding interactive variable should be negative, which entails an increase in the speed with which productivity improvements in the U.S. are diffused into Mexican manufacturing.

### *1.4.3 Results*

Table 4 reports the results from the Arellano-Bond differences estimator applied to the model suggested by equation 2 plus additional controls for the potential effect that Mexico's unilateral liberalization (from 1985) might have had on TFP convergence. The second model focuses on the gap in labor productivity for comparisons, since these data are not affected by the lack of a Mexican fixed investment deflator for the twenty-eight manufacturing industries. In both cases, the models pass the specification tests, indicating that the instrument set is adequate and there is no serial correlation. This suggests that the coefficients are not biased owing to measurement error in the output series. Also, in both cases, NAFTA was associated with a faster rate of manufacturing productivity convergence, as indicated by the highly significant and negative coefficients of the NAFTA dummy variable interacted with the lagged productivity differential. The TFP results (column 1, table 4) imply that the half life of a unit shock to the TFP gap fell from 1.6 prior to NAFTA to 0.7 years afterwards. The corresponding change for labor productivity (column 2, table 6) was from 2.5 to 1.7 years. These results are consistent with the estimates of the change in the degree of persistence of the U.S.-Mexico income gap discussed above.

In sum, the econometric results strongly suggest that the NAFTA period was associated with a significantly faster convergence in manufacturing TFP levels. Hence we are tempted to postulate that the trade agreement had an important positive effect on Mexican manufacturing TFP. These results are

**Table 4. Did NAFTA Accelerate Manufacturing TFP Convergence? Arellano-Bond GMM Differences Regression Results for data from 1980-2000**

| **Dependent Variable** | **Log TFP Differential (U.S.-Mex)** | **Log Output per Worker Differential (U.S.-Mex)** |
|---|---|---|
| **Explanatory Variables** | **(1)** | **(2)** |
| Log Productivity Diff (t-1) | 0.65*** | 0.76*** |
| NAFTA x Log Productivity Diff (t-1) | –0.28*** | –0.09*** |
| Lib x Log Productivity Diff (t-1) | –0.03 | 0.04 |
| Obs/Industries | 462/28 | 482/28 |
| Sargan over-id test (p-value) | 0.25 | 0.39 |
| 2nd Order serial correlation test (p-values) | 0.32 | 0.87 |

Notes: These are the first-step estimates. ** = significant at 1% level. Year dummies not reported
Source: Authors'calculations.

consistent with firm-level evidence provided by Lopez-Cordova (2002) and industry-level data presented by Schiff and Wang (2002). However, the former study argues that this effect was related to preferential market access to the U.S. and import competition, but not due to imports of intermediate goods. In contrast, the study by Schiff and Wang argued Mexico benefited from imported intermediate goods from the U.S., depending on the extent of R&D effort in the U.S. Our results seem to indicate that NAFTA brought something to the table that was not necessarily accomplished by unilateral liberalization, but we have not speculated about the exact channels of influence. In our view, this issue remains an open question for future research.

Having reviewed the times-series evidence concerning income convergence and the panel evidence concerning TFP convergence between the U.S. and Mexico, we now turn to the impact of NAFTA within Mexico. If geography and initial conditions play an important role in economic convergence, then NAFTA might have had a notable impact on income differentials across Mexican states.

## 1.5 Initial conditions and divergence within Mexico[21]

It is standard practice in the analytical work on economic growth to examine potential determinants of growth in a set of geographic entities using econometric techniques (see the textbook by Barro and Sala-I-Martin 1995). This approach was previously applied to the case of Mexico by Esquivel (1999) and Messmacher (2000). Here we use the same standard approach but we attempt to focus on a small set of policy-related variables that determined initial conditions in each Mexican state. In the following paragraphs we describe the data and methods used to address these questions.

### *1.5.1 Data and methodologies*

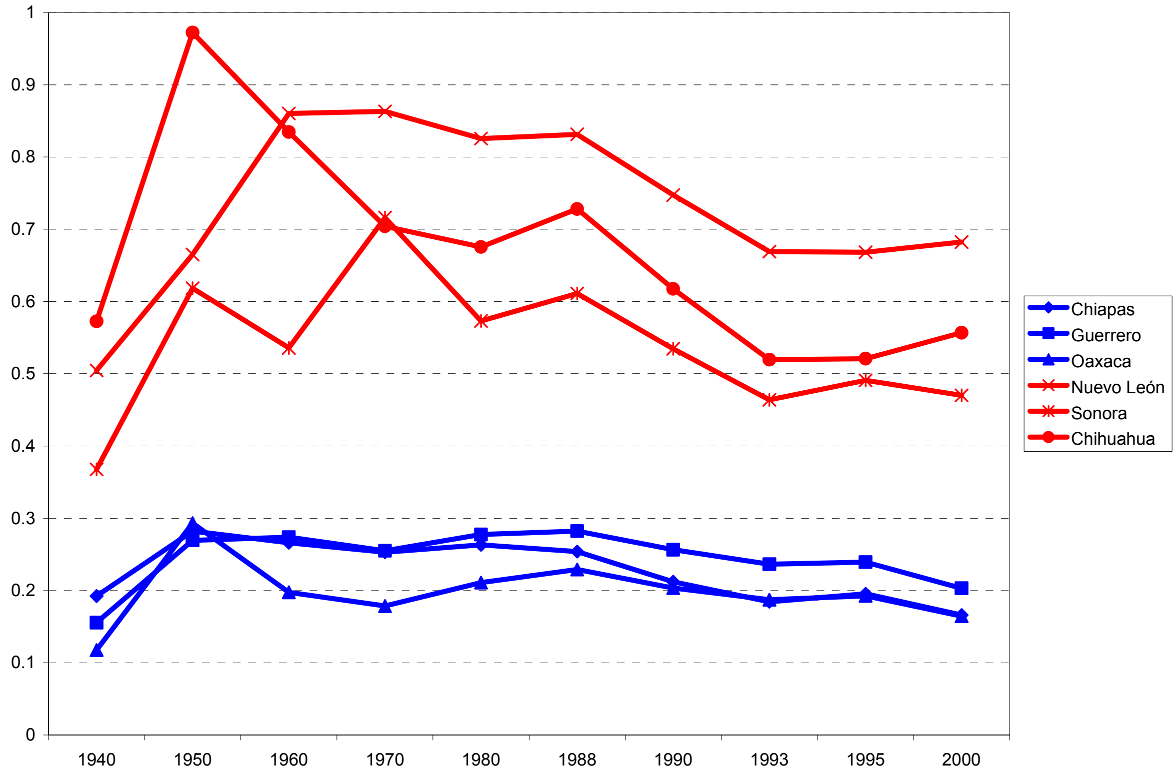
Hence we want to explain the rate of growth of state GDP per capita during 1990-2000 (at constant prices of 1993).[22] As mentioned, this is the period when trade liberalization and NAFTA must have been felt. Also, it is a period that is sufficiently long so that the cumulative growth rate during this

[21] This section is based on Esquivel et al. (2002).

[22] The data were graciously provided by Gerardo Esquivel from El Colegio de México, Mexico City. The GDP series were adjusted for the allocation of oil revenues, which in the original series (from INEGI, the national statistical agency) had been periodically allocated to different states, although in practice they are probably allocated according to population shares.

whole period could reflect medium-term phenomena, rather than just short-lived conditions such as the economic crisis of 1995. Figure 9 shows the evolution of the ratio of GDP per capita in a selection of Northern and Southern states relative to the Distrito Federal (D.F.), the capital of the Republic, since 1940. The big story is, again, that the D.F. was richer and stayed richer for the last 60 years or so. In fact, it is difficult to argue that any of these states managed to significantly catch up in absolute terms, in spite of the fact that free trade within Mexico has existed for a long time. Also, it looks like the 1990s were characterized by a slight catch-up by the Northern states and continuing divergence of the Southern states relative to the D.F.

**Figure 9. Ratio of State GDP per Capita Relative to the Distrito Federal, 1940-2000**




What are some factors that might help explain why some states grew more than others? Given the issues raised by the literature concerning the role of geography and transport or coordination costs in hampering convergence, one set of key explanatory variables are indicators of transport and communications infrastructure, which we measured by the kilometers of paved highways per worker and telephone density.[23] We also used the distance from the U.S. border as an additional explanation of economic growth to assess the argument that being far from the U.S. was an impediment to growth.[24]

It is conventional wisdom that the level of education of the adult population might be related to the rate of growth. Hence we also examine the impact of educational attainment in the year 1990 as an

[23] The coverage of paved roads could be measured with respect to the surface area of each state. However, this measure might also be imprecise due to the fact that we would need to know the surface area of economically meaningful territory. In any case, when we used the ratio of paved roads or highways over surface area of each state, the results are virtually identical to the ones discussed herein.

[24] The distance from the U.S. border was measured in two alternative ways: (1) by the distance from the major city in each state to the closest major city near the border, plus the distance of the latter to the border itself; and (2) by the geographic distance from the capital city of each state to the closest major U.S. city.

explanation of growth rates during the subsequent period 1990-2000. In this way we can be sure that growth did not cause the level of education. We also experimented with literacy rates of the adult population instead of the years of schooling.

It is often argued that poor states grow slower because they receive insufficient public resources to finance their growth. It could be argued, for example, that private capital markets do not provide sufficient financing for the development of lagging regions due to various types of obstacles to private financing related to insufficient information about the capacity to payback loans by firms operating in those areas. However, it is also possible that large public sectors can be a drain on economic growth by distorting the local labor markets (e.g., raising wages above what private enterprises can pay) or by raising the costs of capital that would otherwise have gone to the private sector (i.e., the so-called "crowding-out" effect of public expenditures). To assess these alternative arguments we look at the impact of the size of the public sector, measured as the share of public employment in total employment, on the growth rates of Mexican states.

In order to assess whether the really poor states—Guerrero, Oaxaca, and Chiapas (GOC)—had other characteristics that hampered their prospects for development, we also included a dummy variable that identifies these states. Finally, we included the initial level of GDP per capita to test the conditional convergence hypothesis.

### *1.5.2 Results*

Table 5 reports some of our results, based on standard statistical techniques. The first two columns report results based on Ordinary Least Squares (OLS), and the third and fourth columns report results from an alternative technique, Median Regressions, which are less sensitive to "outliers". It shows evidence of conditional convergence; the initial GDP per capita has a negative and statistically significant coefficient in the four exercises. Hence it seems that poor states do grow faster if they have similar policies to the rich states.

The other explanatory variables, except the variable that identifies the Southern States (Chiapas, Oaxaca, and Guerrero), also seem to be important for growth, and are generally statistically significant. As expected, telephone density has a positive effect on growth. However, estimates using paved roads and paved roads with two lanes per worker (or over surface area) revealed that these variables were negatively correlated with growth during the period.[25] Hence there is no evidence suggesting that building more roads will lead to higher growth in the future. This result might be due to the existence of economically unnecessary infrastructure that does not serve a useful purpose for existing economic activity.

The results concerning the role of distance from the U.S. border (not reported here) indicate that this variable was not a statistically significant impediment to economic growth in most exercises, although the coefficient is always negative.[26] However, when the distance variables were introduced, the

[25] These OLS results did not change when the Distrito Federal, which has low paved roads per worker due to high population density and had relatively high rates of growth, was removed from the sample.

[26] We estimated four models with the two distance variables discussed above in footnote 8. Two regressions were estimated via OLS and two via Median Regressions. In only one of these four models the distance variable was significant at the 10% level. However, several of the other explanatory variables were also not significant in these specifications. These results are due to the correlation between the distance variables and the other explanatory variables.

**Table 5. Potential Determinants of Growth of GSP per Capita, 1990-2000**

| Explanatory variables | Estimated impact: The effect of 1% increase in the corresponding variable on the cumulative GSP growth rate per capita, 1990-2000 | | | |
|---|---|---|---|---|
| | (1) OLS | (2) OLS | (3) Median Reg. | (4) Median Reg. |
| Initial GDP per Capita, 1990 (in natural logarithm) | -0.15** (-2.35) | -0.15** (-2.32) | -0.14** (-3.95) | -0.12** (-2.09) |
| Initial education (years of schooling of population over 15 years of age), 1990 | 0.24 (1.38) | 0.22 (1.09) | 0.27** (3.40) | 0.27* (1.86) |
| Telephone density, 1990 | 0.08* (1.93) | 0.08* (1.91) | 0.05** (2.86) | 0.05 (1.39) |
| Public employment (log of share of total employment), 1990 | -0.12** (-2.13) | -0.12* (-1.98) | -0.07* (-1.97) | -0.09 (-1.54) |
| States of Oaxaca, Guerrero, and Chiapas (dummy variable) | Not included | -0.01 (-0.02) | Not included | -0.021 (-0.33) |
| Number of observations | 32 | 32 | 32 | 32 |
| Adjusted R-squared (OLS) / Pseudo R-squared (Median Reg) | 0.31 | 0.28 | 0.21 | 0.21 |

** = significant at 5%; * significant at 10%. T-statistics in parentheses.

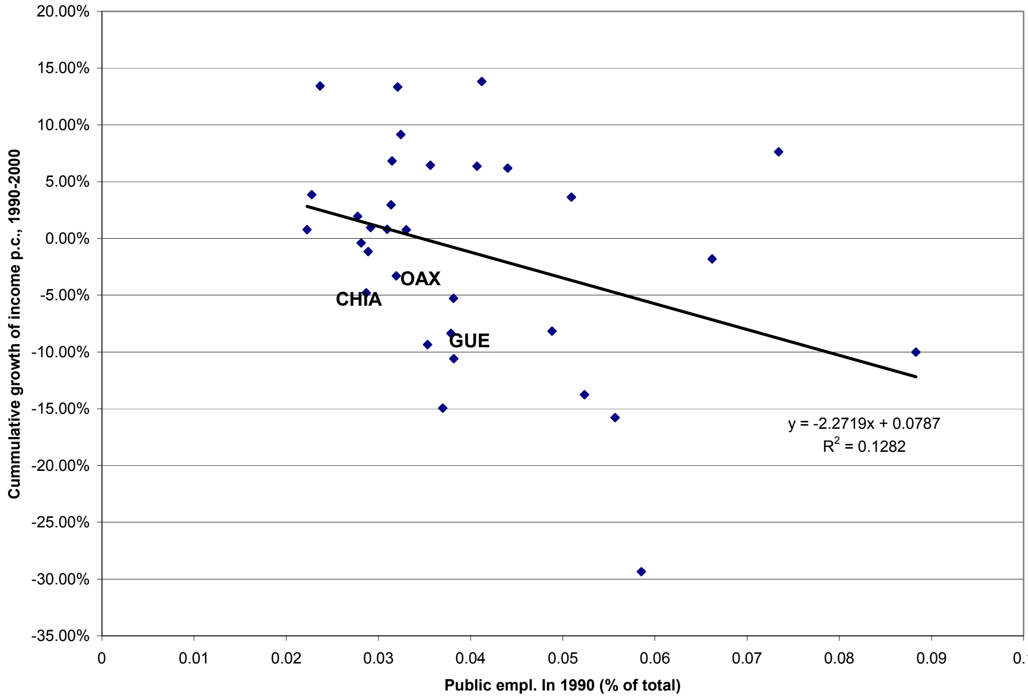
Note: A constant was also included in the regressions, but its coefficients are not reported. Numerous additional specifications in OLS and Median Regressions were estimated using the following explanatory variables: (a) literacy rates instead of years of education; (b) two alternative measures of distance from the United States instead of and in addition to the GOC dummy; (c) paved roads and double-lane highways over surface area or per worker instead of telephone density; (d) with the share of manufacturing GDP over total GDP in 1988; and (e) with urbanization rates. Please see text for a discussion of the alternative results.

statistical significance (but not the direction of the estimated effects) of the other explanatory variables were driven down. This evidence indicates that the states located farther from the United States also suffer from low levels of education and telephone density, which hamper their growth prospects.

The level of education at the beginning of the period has no statistically important impact on growth in the OLS estimates. This result might be due to the fact that human capital can migrate to dynamic regions, and thus this variable does not have any discernable impact on the State in which they were calculated in 1990. However, when literacy rates were used instead of educational attainment, the estimated coefficient was positive and statistically significant. Moreover, the estimates based on Median Regressions forcefully show that educational attainment does matter. It is also possible that the correlation between telephone density, initial GDP per capita, and initial education makes the identification of the impact of education rather difficult.

An interesting result is that the share of public employment had a negative effect on economic activity. Figure 10 shows the simple correlation between these two variables—it is negative. It seems that this negative correlation might be due to some observations that appear to the lower right of the chart. However, the estimates that are less likely to be disproportionately influenced by strange observations, the Median regressions, also show that this variable had a negative effect on economic growth although it not statistically significant in the fourth column of Table 4, after controlling for other unobserved characteristics of the Southern States.

**Figure 10. Relationship between Growth (1990s) and Public Employment in Mexican States: More is not necessarily better.**




To be sure that the aforementioned explanations of the observed differences of growth rates across Mexican states are not misleading, we conducted additional exercises in which we controlled for the share of manufacturing production over total state GDP in 1990. As discussed in Esquivel et al. (2002), the Southern States have never had a high share of manufacturing production, and for the country as a whole some manufacturing industries (and some services) grew quite rapidly during the decade of the 1990s. The performance of manufacturing relative to natural resource or agricultural industries could have been due to changes in relative prices. For example, the international price of coffee began to decline in the late 1980s. In any case, our statistical analyses indicated that the qualitative nature of the OLS results presented in Table 5 are not affected by the inclusion of the manufacturing share of production. However, in the relevant Median Regressions, the inclusion of the share of manufacturing production affected the sign of the education and public employment variables, although none of them were statistically significant. This influence of manufacturing production on the estimated effect of education and public employment could be due to a positive correlation between education and manufacturing production (which is 0.5), and negative correlation with the share of public employment (which is, coincidentally, -0.5). In other words, manufacturing production seems to be concentrated in states with either high levels of education and/or low levels of public employment. It is likely that the high mobility of new capital combined with the relative irreversibility of past investment make capital-intensive activities particularly sensitive to the initial economic environment in a state, and thus manufacturing is implicitly capturing things such as the rule of law, instability, crime or excessive intervention by the state.

Thus far we presented suggestive evidence indicating that hope for the Southern States is not lost; there is some evidence of conditional convergence and some key policy-sensitive variables help explain the patterns of economic growth observed across Mexican states during 1990-2000. In particular, communications infrastructure (measured by telephone density) is more likely to have been positively associated with economic activity than paved roads or highways. Also, there is no evidence in support of the idea that increasing the size of the public sector can be a force for economic convergence. However, the big story remains: initial conditions seem to have had important effects on economic growth within Mexico during the 1990s, and thus states that were initially better prepared to reap the benefits of NAFTA grew faster during this period, while the poor states of the South fell further behind.

## 1.6 Conclusions and final remarks

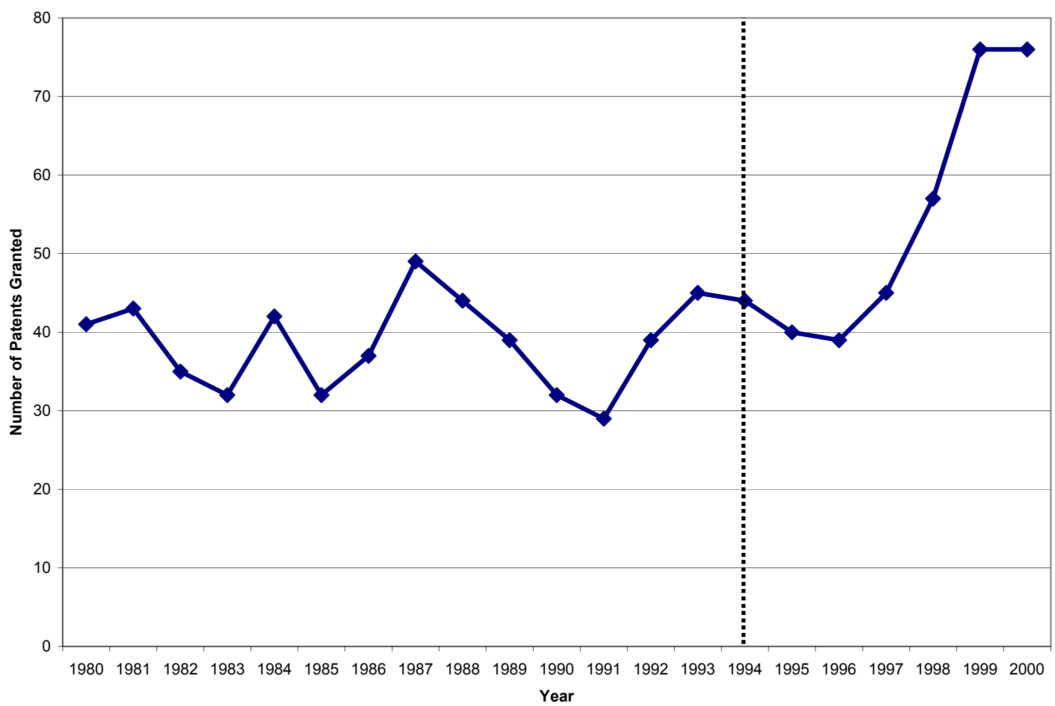
This paper analyzed the dynamics and sources of convergence between Mexico and the U.S. Time series analyses of the convergence process produced interesting stylized facts about the U.S.-Mexican convergence process and identified periods of convergence and divergence. While convergence suffered a major set-back in the 1980s due to the debt crisis, we find that the Tequila crisis only temporarily interrupted a convergence process which started in the late 1980s when Mexico opened its economy. However, we only found evidence of incomplete convergence in the sense that the constant in the cointegration space was greater than zero, indicating that Mexico is converging towards a constant income differential of about 50% of the U.S. GDP per capita. In contrast, the comparison between annual Mexican relative income effects and average Latin American effects indicated that Mexico's convergence towards the U.S. was especially important after 1995. Finally, our estimates of the change in the autoregressive coefficient of the Mexico-U.S. income per capita gap suggest that Mexico's GDP per capita would have been about 4-5% lower by the end of 2002 if NAFTA had not been implemented.

The cross-country evidence showed that differences in institutional features inherited from history play an important role in producing income gaps. Consistent with previous studies (Acemoglu et al. 2001; Kaufmann and Kray 2002b), the TSLS estimates produced much larger estimated effects of institutions on incomes than OLS estimates, thus indicating that measurement error is an important source of attenuation bias in these relationship. The use of historical instruments for current institutional quality is also interesting on its own since it reflects that institutions tend to persist over time and thus might remain a source of income divergence for a long time. However, future research could yield additional practical insights if it focuses on the determinants of institutional quality. In particular, further understanding about the role of political institutions in determining the quality of governance and economic policy could help us understand what types of reforms may help overcome the weight of history. Recent research along these lines has already proven fruitful (Persson 2002; Lederman et al. 2002). Yet our understanding remains quite thin regarding how accountability mechanisms can help improve national institutions. In the case of North America, international economic convergence in the long-run might depend on Mexico's capacity to catch-up to the standards of its neighbors. In fact, the econometric analyses indicated that the model with institutions, geography, and trade predict an income gap of the Mexico-U.S. GDP per capita ratio of about 54%, which is coincidentally similar to the incomplete convergence estimated using cointegration analysis. Furthermore, the quality of Mexican institutions did not improve significantly more than in other Latin American countries during the post-NAFTA period.

The analysis of TFP convergence within manufacturing industries produced more optimistic results concerning the impact of NAFTA. The evidence indicates that NAFTA was associated with improvements in the rate of TFP convergence between the U.S. and Mexico. While these results are broadly consistent with other studies (López-Córdova 2002, Schiff and Wang 2002), the latter contradict each other in terms of the channels through which NAFTA is thought to have improved Mexican manufacturing TFP. Namely, López-Córdova argues that it was preferential access to the U.S. market (e.g., the tariffs faced by Mexican exporters to the U.S.) and import penetration, but not imports of inputs from the U.S. Schiff and Wang argue that TFP improvements were due to the R&D content of imported inputs. In addition, we can think of other alternative hypotheses.

One possibility is that NAFTA, either through its demanded improvement in the protection of intellectual property rights and/or through increased international competition (for import-competing and exporting industries) provided incentives for improvements in private research and development (R&D) effort and patenting. Meza and Mora (2002) and Chapter 5 in this report found that in fact the post-NAFTA period was characterized by significant increases in R&D expenditures. Also, there is evidence that patenting activity by Mexican inventors improved significantly during this period as well—see Figure 11. Yet the existing literature remains silent about this particular force towards convergence. An examination of these issues would require empirical work about the determinants of patenting across countries, with a special focus on the impact of trade policies and innovation policies. Much work remains to be done in this area, although there is an emerging literature (Furman et al. 2002). Lederman and Maloney (2003b)—see Chapter 5—show that in fact IPR protection tends to increase R&D effort relative to GDP in a broad panel of countries and that these expenditures are cyclical in the sense that they tend to rise with improvements in short-term growth. Thus it is very likely that NAFTA helped Mexico improve its innovation through its IPR regime and by helping Mexico recover after the Tequila crisis. On the other hand, Chapter 5 shows that the emerging manufacturing sectors under NAFTA (road vehicles, telecommunications equipment, and appliances) are not yet characterized by significant improvements in patenting activity, thus suggesting that there are significant efficiency problems related to the lack of linkages between R&D performed by the public and higher-education sectors and the productive sector.

**Figure 11. Patents Granted to Mexican Residents by the U.S. PTO, 1980-2000**




The study of growth patterns within Mexico during 1990-2000 showed that initial conditions determined which Mexican states grew faster. We interpret this evidence as showing that trade liberalization might be associated with economic divergence within countries due to differences in initial conditions. In the Mexican case, it seems that telecommunications infrastructure and human capital were especially important. In addition, it is commonly understood that the poor states also suffer from poor public institutions and political instability (Esquivel et al. 2002). If the poor states had been adequately prepared to reap the benefits of free trade, it is possible that they might have grown faster during this period. Thus economic convergence in North America might not materialize under free trade or under any trade regime as long as fundamental differences in initial conditions persist over time. Fortunately, some of these fundamentals should be sensitive to policy changes.

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# Annex

**Figure A1. Quarterly Data Used for Time Series Analyses**

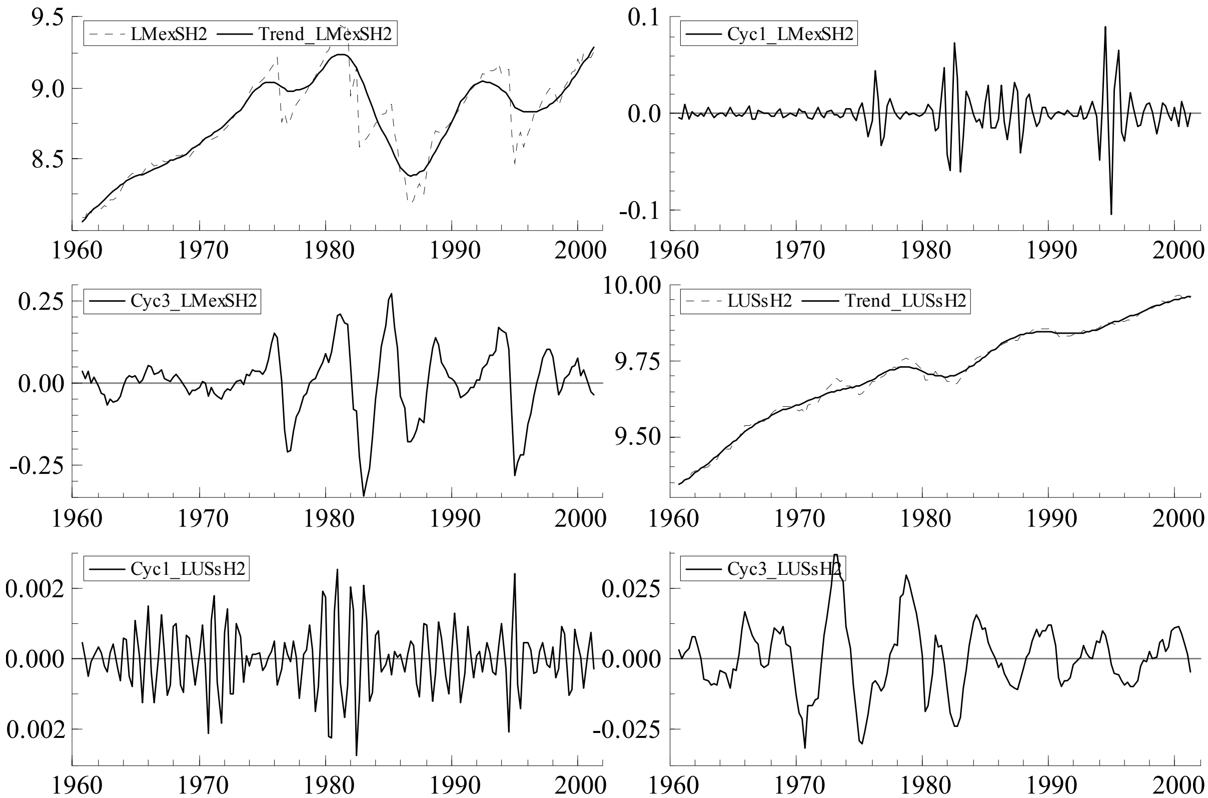

**Table A1. List of Codes and Industries Used in TFP Convergence Analysis**

| ISIC Code | Industry |
|---|---|
| 311 | Food products |
| 313 | Beverages |
| 314 | Tobacco |
| 321 | Textiles |
| 322 | Wearing apparel, except footwear |
| 323 | Leather products |
| 324 | Footwear, except rubber or plastic |
| 331 | Wood products, except furniture |
| 332 | Furniture, except metal |
| 341 | Paper and products |
| 342 | Printing and publishing |
| 351 | Industrial chemicals |
| 352 | Other Chemicals |
| 353 | Petroleum refineries |
| 354 | Miscellaneous petroleum and coal products |
| 355 | Rubber products |
| 356 | Plastic products |
| 361 | Pottery, china, earthenware |
| 362 | Glass and products |
| 369 | Other non-metallic mineral products |
| 371 | Iron and steel |
| 372 | Non-ferrous metals |
| 381 | Fabricated metal products |
| 382 | Machinery, except electrical |
| 383 | Machinery electric |
| 384 | Transport equipment |
| 385 | Professional & Scientific equipment |
| 390 | Other manufactured products |

**Table A2. Summary Statistics of Variables and Data Used for TFP Convergence Analysis, by Country and Industry (standard deviations in parentheses)**

| United States | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Industry Code | (Log)Output | Obs | (Log)Labor | Obs | (Log)Capital | Obs | Labor Share | Obs |
| 311 | 19.47 (0.11) | 25 | 17.06 (0.13) | 25 | 18.08 (0.33) | 25 | 0.09 (0.00) | 25 |
| 313 | 17.50 (0.15) | 25 | 15.19 (0.06) | 25 | 16.74 (0.22) | 25 | 0.10 (0.02) | 25 |
| 314 | 16.85 (0.11) | 25 | 14.03 (0.24) | 25 | 15.37 (0.42) | 25 | 0.06 (0.02) | 25 |
| 321 | 18.14 (0.1) | 25 | 16.45 (0.07) | 25 | 17.21 (0.25) | 25 | 0.18 (0.01) | 25 |
| 322 | 17.64 (0.04) | 25 | 16.12 (0.14) | 25 | 15.86 (0.13) | 25 | 0.22 (0.03) | 25 |
| 323 | 15.35 (0.14) | 25 | 13.66 (0.22) | 25 | 14.11 (0.04) | 25 | 0.19 (0.02) | 25 |
| 324 | 15.32 (0.33) | 25 | 13.81 (0.42) | 25 | 14.72 (0.22) | 25 | 0.22 (0.02) | 25 |
| 331 | 17.64 (0.13) | 25 | 15.92 (0.07) | 25 | 16.79 (0.2) | 25 | 0.18 (0.02) | 25 |
| 332 | 17.27 (0.32) | 25 | 15.86 (0.26) | 25 | 15.61 (0.49) | 25 | 0.24 (0.02) | 25 |
| 341 | 18.46 (0.11) | 25 | 16.58 (0.06) | 25 | 18.15 (0.31) | 25 | 0.15 (0.01) | 25 |
| 342 | 18.57 (0.18) | 25 | 17.21 (0.14) | 21 | 17.47 (0.54) | 25 | 0.26 (0.02) | 21 |
| 351 | 18.67 (0.13) | 25 | 16.36 (0.06) | 25 | 18.54 (0.18) | 25 | 0.10 (0.01) | 25 |
| 352 | 18.46 (0.29) | 25 | 16.37 (0.2) | 25 | 17.34 (0.58) | 25 | 0.12 (0.01) | 25 |
| 353 | 18.62 (0.06) | 25 | 14.86 (0.22) | 25 | 17.90 (0.16) | 25 | 0.02 (0.01) | 25 |
| 354 | 16.58 (0.92) | 25 | 13.88 (0.12) | 21 | 15.12 (0.27) | 25 | 0.10 (0.01) | 21 |
| 355 | 16.99 (0.11) | 25 | 15.45 (0.09) | 25 | 16.20 (0.25) | 25 | 0.21 (0.01) | 25 |
| 356 | 17.95 (0.46) | 25 | 16.32 (0.42) | 25 | 16.93 (0.64) | 25 | 0.19 (0.01) | 25 |
| 361 | 14.72 (0.14) | 25 | 13.56 (0.09) | 25 | 14.03 (0.23) | 25 | 0.32 (0.02) | 25 |
| 362 | 16.64 (0.13) | 25 | 15.14 (0.06) | 25 | 16.15 (0.29) | 25 | 0.23 (0.02) | 25 |
| 369 | 17.62 (0.16) | 25 | 15.97 (0.1) | 25 | 16.92 (0.24) | 25 | 0.19 (0.01) | 25 |
| 371 | 18.09 (0.19) | 25 | 16.43 (0.25) | 25 | 18.15 (0.06) | 25 | 0.19 (0.02) | 25 |
| 372 | 17.73 (0.1) | 25 | 15.69 (0.07) | 25 | 16.97 (0.2) | 25 | 0.13 (0.01) | 25 |
| 381 | 18.73 (0.13) | 25 | 17.25 (0.15) | 25 | 17.62 (0.3) | 25 | 0.23 (0.01) | 25 |
| 382 | 19.31 (0.3) | 25 | 17.78 (0.19) | 25 | 18.21 (0.43) | 25 | 0.22 (0.03) | 25 |
| 383 | 19.15 (0.33) | 25 | 17.60 (0.18) | 25 | 18.07 (0.64) | 25 | 0.22 (0.04) | 25 |
| 384 | 19.66 (0.18) | 25 | 17.88 (0.07) | 25 | 18.43 (0.45) | 25 | 0.17 (0.02) | 25 |
| 385 | 18.21 (0.38) | 25 | 16.80 (0.38) | 25 | 16.98 (0.64) | 25 | 0.25 (0.01) | 25 |
| 390 | 17.25 (0.15) | 25 | 15.71 (0.13) | 25 | 16.10 (0.23) | 25 | 0.21 (0.01) | 25 |

| Mexico | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Industry Code | (Log)Output | Obs | (Log)Labor | Obs | (Log)Capital | Obs | Labor Share | Obs |
| 311 | 15.77 (0.60) | 25 | 12.98 (0.63) | 25 | 13.87 (0.71) | 25 | 0.06 (0.01) | 25 |
| 313 | 15.07 (0.44) | 25 | 12.72 (0.35) | 25 | 13.68 (0.5) | 25 | 0.10 (0.03) | 25 |
| 314 | 13.65 (0.22) | 25 | 10.36 (0.30 | 25 | 11.50 (0.46) | 25 | 0.04 (0.01) | 25 |
| 321 | 14.35 (0.36) | 25 | 12.50 (0.28) | 25 | 13.42 (0.44) | 25 | 0.16 (0.03) | 25 |
| 322 | 13.11 (0.31) | 17 | 11.33 (0.24) | 17 | 11.44 (0.41) | 17 | 0.17 (0.04) | 17 |
| 323 | 12.52 (0.15) | 7 | 10.01 (0.22) | 7 | 10.87 (0.40) | 7 | 0.08 (0.01) | 7 |
| 324 | 12.86 (0.24) | 17 | 11.19 (0.23) | 17 | 11.70 (0.13) | 17 | 0.19 (0.02) | 17 |
| 331 | 11.91 (0.45) | 25 | 9.85 (0.31) | 25 | 11.77 (0.14) | 25 | 0.13 (0.03) | 25 |
| 332 | 12.43 (0.70) | 17 | 10.49 (0.70) | 17 | 10.55 (0.77) | 17 | 0.14 (0.02) | 17 |
| 341 | 14.61 (0.34) | 25 | 12.08 (0.29) | 25 | 14.35 (0.16) | 25 | 0.08 (0.03) | 25 |
| 342 | 13.29 (0.75) | 17 | 11.38 (0.79) | 17 | 11.67 (0.87) | 17 | 0.15 (0.02) | 17 |
| 351 | 14.98 (0.59) | 25 | 12.48 (0.34) | 25 | 14.16 (0.49) | 25 | 0.09 (0.03) | 25 |
| 352 | 15.09 (0.60) | 25 | 12.89 (0.50) | 25 | 13.49 (0.73) | 25 | 0.11 (0.03) | 25 |
| 353 | 13.23 (0.13) | 7 | 10.49 (0.25) | 7 | 11.94 (0.10) | 7 | 0.07 (0.01) | 7 |
| 354 | 12.72 (0.37) | 25 | 9.84 (0.38) | 25 | 12.44 (0.16) | 25 | 0.06 (0.01) | 25 |
| 355 | 13.66 (0.22) | 25 | 11.69 (0.23) | 25 | 12.90 (0.11) | 25 | 0.14 (0.02) | 25 |
| 356 | 14.00 (0.67) | 17 | 11.83 (0.60) | 17 | 12.70 (0.67) | 17 | 0.12 (0.02) | 17 |
| 361 | 12.08 (0.23) | 17 | 10.13 (0.31) | 17 | 9.04 (0.68) | 17 | 0.14 (0.02) | 17 |
| 362 | 13.81 (0.34) | 25 | 11.86 (0.32) | 25 | 13.12 (0.42) | 25 | 0.15 (0.04) | 25 |
| 369 | 14.41 (0.46) | 25 | 12.05 (0.31) | 25 | 14.36 (0.21) | 25 | 0.10 (0.02) | 25 |
| 371 | 15.38 (0.23) | 25 | 12.59 (0.33) | 25 | 14.84 (0.14) | 25 | 0.07 (0.02) | 25 |
| 372 | 14.31 (0.37) | 25 | 11.34 (0.24) | 25 | 12.73 (0.65) | 25 | 0.06 (0.02) | 25 |
| 381 | 14.24 (0.44) | 25 | 12.08 (0.33) | 25 | 12.58 (0.68) | 25 | 0.12 (0.03) | 25 |
| 382 | 14.02 (1.26) | 25 | 11.78 (1.08) | 25 | 11.97 (1.56) | 25 | 0.11 (0.03) | 25 |
| 383 | 14.64 (0.47) | 25 | 12.57 (0.40) | 25 | 13.02 (0.61) | 25 | 0.13 (0.02) | 25 |
| 384 | 15.95 (0.71) | 25 | 13.15 (0.45) | 25 | 14.22 (0.77) | 25 | 0.07 (0.02) | 25 |
| 385 | 12.15 (0.49) | 17 | 9.76 (0.52) | 17 | 10.19 (0.92) | 17 | 0.10 (0.04) | 17 |
| 390 | 12.21 (0.37) | 17 | 10.34 (0.40) | 17 | 10.86 (0.51) | 17 | 0.16 (0.02) | 17 |

Source: UNIDO.

### Table A3. Summary Statistics for Data Used for Analysis of Institutional Gaps and Income Gaps

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Landlock | 68 | 0.1323529 | 0.3413936 | 0 | 1 |
| Openness (Sachs & Warner 95) | 63 | 0.2252768 | 0.3423797 | 0 | 1 |
| Log Constructed Trade Share (Frankel-Romer) | 68 | 2.721456 | 0.7672238 | 0.94 | 4.586 |
| Latitude | 68 | 6.318064 | 19.69103 | -41.81407 | 61.06258 |
| Eth-Ling Fractionalization | 61 | 46.37705 | 29.43024 | 1 | 90 |
| Africa | 68 | 0.3382353 | 0.4766266 | 0 | 1 |
| South Asia | 68 | 0.0588235 | 0.2370435 | 0 | 1 |
| East Asia & the Pacific | 68 | 0.0735294 | 0.2629441 | 0 | 1 |
| Americas | 68 | 0.3970588 | 0.4929263 | 0 | 1 |
| Oil Production Dummy | 68 | 0.2647059 | 0.4444566 | 0 | 1 |
| Commodity Dummy | 68 | 0.6764706 | 0.471301 | 0 | 1 |
| Institutional Index | 68 | -0.1134657 | 0.7704978 | -1.978333 | 1.585833 |
| Log Mortality | 68 | 4.588946 | 1.255075 | 2.145931 | 7.986165 |
| Log GDP per Capita | 68 | 7.794468 | 1.109153 | 5.252923 | 10.0311 |

### Table A4. Summary Statistics for Data Used for Econometric Results Presented in Figures 4 and 7 on Institutional Gaps and Income Gaps

| Sample | Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Latin America (including Mexico plus 22 others). Cuba is not in the GDP sample. | Weighted average of Kraay & Kaufman variables (Corruption, Law & Order, and Bureaucratic Quality) | 414 | -0.4069638 | 0.558766 | -1.75361 | 0.6972296 |
| | Log(country's GDP pc/USA GDP pc) | 923 | -1.715673 | 0.579324 | -3.65967 | -0.3095284 |
| Mexico, Brazil, Argentina, Chile, Colombia, Venezuela, Peru, Costa Rica, and Uruguay | Weighted average of ICRG (Corruption, Law & Order, and Bureaucratic Quality) | 162 | -0.1312372 | 0.4356544 | -1.00386 | 0.6972296 |
| | Log(country's GDP pc/USA GDP pc, ppp) | 378 | -1.328616 | 0.3673385 | -2.19757 | -0.3095284 |

### Table A5. Groups of countries used to calculate GDP and institutional gaps in Figures 4 and 7

| Group 1 | | Group 2 |
|---|---|---|
| ARGENTINA | HAITI | ARGENTINA |
| BOLIVIA | HONDURAS | BRAZIL |
| BRAZIL | JAMAICA | CHILE |
| CHILE | MEXICO | COLOMBIA |
| COLOMBIA | NICARAGUA | COSTA RICA |
| COSTA RICA | PANAMA | MEXICO |
| CUBA* | PARAGUAY | PERU |
| DOMINICAN REPL. | PERU | URUGUAY |
| ECUADOR | TRINIDAD/TOBAGO | VENEZUELA |
| EL SALVADOR | URUGUAY | |
| GUATEMALA | VENEZUELA | |
| GUYANA | | |

* Cuba was not included in the sample to calculate Log of GDP differentials with respect to the USA

**Table A6. Data Used for Analysis of Convergence Across Mexican States during 1990-2000 (all variables are in logs, except the poor states dummy)**

| State | GDP pc 2000 | GDP pc 1990 | Literacy | Yrs. Educ | Pub. Emp. | Manuf. Share | Tel. Dens. | Dist. To U.S. 1 | Dist. to U.S. 2 | High-ways | Poor States |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Aguascalientes | 2.78 | 2.75 | 4.53 | 1.90 | -2.98 | 3.25 | 2.42 | 6.51 | 7.16 | 6.66 | 0 |
| Baja California | 2.86 | 2.97 | 4.56 | 2.01 | -3.27 | 2.93 | 2.52 | 5.13 | 6.91 | 7.95 | 0 |
| Baja California Sur | 2.86 | 2.97 | 4.55 | 2.00 | -2.43 | 1.53 | 2.98 | 6.80 | 7.17 | 7.29 | 0 |
| Campeche | 3.07 | 3.24 | 4.44 | 1.76 | -2.89 | 0.37 | 1.75 | 6.89 | 7.33 | 7.44 | 0 |
| Chiapas | 1.81 | 1.86 | 4.25 | 1.44 | -3.55 | 2.22 | 1.14 | 7.01 | 7.34 | 7.97 | 1 |
| Chihuahua | 2.98 | 2.92 | 4.54 | 1.92 | -3.46 | 3.20 | 2.62 | 5.84 | 7.11 | 8.32 | 0 |
| Coahuila de Zaragoza | 2.96 | 2.83 | 4.55 | 1.99 | -3.44 | 3.51 | 2.64 | 5.78 | 7.08 | 8.12 | 0 |
| Colima | 2.68 | 2.70 | 4.51 | 1.89 | -2.71 | 1.53 | 2.67 | 6.86 | 7.27 | 6.67 | 0 |
| Distrito Federal | 3.59 | 3.51 | 4.56 | 2.17 | -2.61 | 3.11 | 3.59 | 6.59 | 7.22 | 5.08 | 0 |
| Durango | 2.54 | 2.41 | 4.53 | 1.82 | -3.19 | 3.18 | 2.02 | 6.44 | 7.18 | 7.85 | 0 |
| Guanajuato | 2.28 | 2.28 | 4.42 | 1.65 | -3.81 | 3.27 | 1.97 | 6.46 | 7.20 | 7.76 | 0 |
| Guerrero | 2.02 | 2.11 | 4.29 | 1.61 | -3.27 | 1.70 | 1.78 | 6.84 | 7.27 | 7.87 | 1 |
| Hidalgo | 2.21 | 2.22 | 4.37 | 1.70 | -3.54 | 3.36 | 1.62 | 6.43 | 7.19 | 7.68 | 0 |
| Jalisco | 2.66 | 2.66 | 4.51 | 1.87 | -3.57 | 3.22 | 2.69 | 6.72 | 7.20 | 8.42 | 0 |
| Mexico | 2.41 | 2.50 | 4.51 | 1.96 | -3.02 | 3.62 | 1.99 | 6.61 | 7.22 | 8.38 | 0 |
| Michoacan | 2.16 | 2.03 | 4.42 | 1.65 | -3.74 | 2.73 | 1.91 | 6.66 | 7.25 | 8.27 | 0 |
| Morelos | 2.50 | 2.67 | 4.48 | 1.92 | -3.30 | 3.25 | 2.48 | 6.69 | 7.23 | 7.24 | 0 |
| Nayarit | 2.17 | 2.22 | 4.49 | 1.81 | -3.27 | 2.41 | 1.95 | 6.75 | 7.24 | 6.97 | 0 |
| Nuevo Leon | 3.20 | 3.17 | 4.56 | 2.08 | -3.46 | 3.54 | 2.97 | 5.44 | 7.04 | 8.19 | 0 |
| Oaxaca | 1.82 | 1.85 | 4.28 | 1.50 | -3.44 | 2.86 | 1.10 | 6.86 | 7.28 | 8.01 | 1 |
| Puebla | 2.24 | 2.20 | 4.39 | 1.72 | -3.78 | 3.25 | 2.05 | 6.59 | 7.22 | 7.76 | 0 |
| Querétaro de Arteaga | 2.82 | 2.74 | 4.44 | 1.81 | -3.43 | 3.59 | 2.00 | 6.48 | 7.19 | 7.19 | 0 |
| Quintana Roo | 3.06 | 3.40 | 4.47 | 1.84 | -2.84 | 1.39 | 1.96 | 7.05 | 7.36 | 7.47 | 0 |
| San Luis Potosí | 2.33 | 2.32 | 4.44 | 1.76 | -3.54 | 3.39 | 2.03 | 6.23 | 7.12 | 7.94 | 0 |
| Sinaloa | 2.40 | 2.50 | 4.50 | 1.90 | -3.34 | 2.13 | 2.35 | 6.66 | 7.22 | 7.99 | 0 |
| Sonora | 2.87 | 2.81 | 4.55 | 1.99 | -3.12 | 2.78 | 2.68 | 5.86 | 7.06 | 8.60 | 0 |
| Tabasco | 2.14 | 2.29 | 4.47 | 1.77 | -2.95 | 1.79 | 1.79 | 6.92 | 7.31 | 7.79 | 0 |
| Tamaulipas | 2.72 | 2.66 | 4.53 | 1.95 | -3.20 | 3.02 | 2.53 | 5.68 | 7.07 | 8.13 | 0 |
| Tlaxcala | 2.05 | 2.04 | 4.49 | 1.87 | -3.48 | 3.51 | 0.70 | 6.57 | 7.22 | 7.22 | 0 |
| Veracruz-Llave | 2.15 | 2.14 | 4.40 | 1.70 | -3.58 | 3.22 | 2.04 | 6.55 | 7.22 | 8.42 | 0 |
| Yucatán | 2.41 | 2.40 | 4.43 | 1.74 | -3.41 | 2.82 | 2.34 | 6.89 | 7.34 | 8.25 | 0 |
| Zacatecas | 2.09 | 2.03 | 4.50 | 1.69 | -3.33 | 1.25 | 1.41 | 6.42 | 7.14 | 7.66 | 0 |