Trade liberalization and regional income convergence in Mexico: a time-series analysis

Gómez, Manuel and Ventosa-Santaulària, Daniel

Escuela de Economía, Universidad de Guanajuato

2007

Trade liberalization and regional income convergence in Mexico: a time-series analysis

Manuel Gómez*
Daniel Ventosa-Santaulària †

School of Economics
Universidad de Guanajuato

March 13, 2007

Abstract

We study the hypothesis of convergence amongst Mexican regions since 1940 with special interest in the post-trade liberalization period. A standard time-series convergence test shows that per capita income levels between the capital and the rest of the regions tend to narrow over time. Using the concept of deterministic and stochastic convergence, we describe the specific characteristics of the growth pattern for each of the regions. We find evidence that supports the hypothesis that trade reforms reversed the convergence process of some regions, especially those less developed. Results further suggest that trade liberalization did not contribute to per capita income convergence between the U.S. and Mexico border regions.

Keywords: Catching-up, Convergence, Deterministic Trend, and Unit Root.
JEL classification: O10, O40, R1.

1 Introduction

Recent studies assert that Mexico's trade reforms caused an increase in regional income disparities. Chiquiar (2005) and Rodríguez and Sánchez (2002) show that β and σ -convergence throughout Mexican regions was lost after economic liberalization. They determine that a positive relation between the per capita income growth rate and the initial level of income exists after 1985, which is interpreted as evidence of divergence. Moreover, after including additional economic variables (such as average years schooling, the percentage of certain economic activity relative to Gross State Product (GSP), infrastructure indicators,

*Corresponding Author: Escuela de Economía, UCEA-Campus Marfil Fracc. I, El Establo, Guanajuato, Gto. C.P. 36250, México. Phone and Fax (+52) (473) 735-2925 ext. 2925, e-mail: mgomez@quijote.ugto.mx
†Escuela de Economía, Universidad de Guanajuato

state and federal investment, etc.) to allow for the possibility that the regions do not share the same steady state[1], they are able to identify the characteristics that allow rich regions to grow faster than poor ones.
We study the regional growth dynamics from a time-series framework (hereafter τ-convergence). This allows us to reach conclusions that the Barro and Sala-i-Martin methodology precludes. Firstly, the cross-section convergence notion is weaker than that of the τ- convergence; evidence of a negative relationship between growth rates and initial income levels cannot be taken as evidence of income convergence; instead, it merely conveys the idea of catching-up (Andrew and Durlauf 1996). Secondly, it is possible to analyze the regional income pattern over a extended period of time, yet still focus on a specific phase within the original. This offers the opportunity to analyze the growth pattern for the 1940-2003 interval and compare it with the subperiod 1985-2003. Thirdly, this method offers insight into the experience of individual regions, given that this type of test analyzes the difference in per capita income between a pair of economies, so enabling individual characteristics of growth dynamics for each region to be identified.
Results suggest that the difference in per capita income in the period 1940-2003 tends to narrow over time relative to the capital region. Nevertheless, regional development was quantitatively heterogeneous amongst regions. Time-series convergence methodology allows us to define the particularities of each region's growth pattern. In doing so, we find evidence to support the hypothesis that trade reforms negatively affected poor regions; we show that from then on, income differences between the capital and some of the poorest regions in Mexico became more marked. Moreover, there is no evidence that trade reforms contributed to equalize per capita income between the U.S. and the Mexican border regions.
The paper is organized as follows: Section 2 briefly describes the cross-sectional technique for analyzing convergence and presents evidence for Mexican regions for the period 1985-2003. Section 3 explains the methodology used to study the convergence hypothesis using the time-series framework and discusses cases not yet considered by existing literature; it also reports the pairwise time-series test results and, finally, considers their implications for the different Mexican regions. Section 4 analyzes whether trade liberalization contributes to per capita income convergence between the U.S. and Mexico border regions. Section 5 summarizes the main conclusions.

2 Analysis with cross-sectional data

2.1 Methodology

Most empirical tests concerning the convergence hypothesis employ cross-sectional data using the neoclassical growth model as the underlying theoretical framework (Barro and Sala-i-Martin 2004, Cárdenas and Pontón 1995, Chiquiar 2005).

[1]This is done to rule out the possibility of rejecting the convergence hypothesis erroneously.

The neoclassical growth model implies conditional convergence in per capita income: the per capita income growth rate decreases as the economy approaches its steady state. If a group of economies share a common steady state, the model implies absolute convergence in per capita income: poor economies grow faster than rich ones. Barro and Sala-i-Martin (2004) use equation (1) to test for β-convergence; this is derived from the Ramsey model after log-linearizing the differential equations around the steady state.

$$\frac{1}{T} \cdot ln(\frac{y_{i,T}}{y_{i,0}}) = \alpha - \frac{1 - e^{-\beta T}}{T} \cdot ln(y_{i,0}) + u_{i,t} \tag{1}$$

where α is assumed homogeneous across regions and its value dependent on the technological parameters of the model, parameter β measures the speed of convergence towards the common steady state; $y_{i,0}$ denotes the initial level of per capita income of region i, and $y_{i,T}$ represents the final level of per capita income. The estimate of positive (negative) parameter β is evidence of regional convergence (divergence). Equation (1) is estimated using Nonlinear Least Squares (NLS).

2.2 Analysis by state

The per capita income data[2] for 1985, 1988, 1994 and 2003 used in this section was obtained from the BIE[3] provided by INEGI[4].
Figure (1) plots the average growth rate for the 1985-2003 period against the log of the initial level of per capita income. The negative relationship between these two variables suggests absolute convergence amongst Mexican states.
Related studies have mentioned that Campeche and Tabasco may bias the convergence analysis, since a very large portion of their GSP is generated through the exploitation of oil reserves. Their exclusion actually provides a somewhat different insight into the growth process of per capita income after 1985. As shown in Figure (2), there is a positive relationship between observed growth rates and the initial level of income, which is interpreted as evidence of divergence by the Barro and Sala-i-Martin methodology.
Esquivel (1999) finds evidence of per capita income convergence over the period 1940-1995. Nevertheless, the results suggest that the convergence process was not homogeneous: from 1940 to 1960, the estimated rate at which poor states caught up with rich states was one of 2.23% per year; from 1960 to 1980 this fell to 1.4%, whilst from 1980 to 1995, the estimated rate was not significantly different from zero. Figure (2) suggests that the growth state dynamic is reversed, with rich states growing faster than poor.

[2]Data available upon request.
[3]Mexican acronym for the Economic Information Bank.
[4]Mexican acronym for the National Institute of Statistics, Geography and Informatics.

Figure 1: Convergence by state, 1985 – 2003

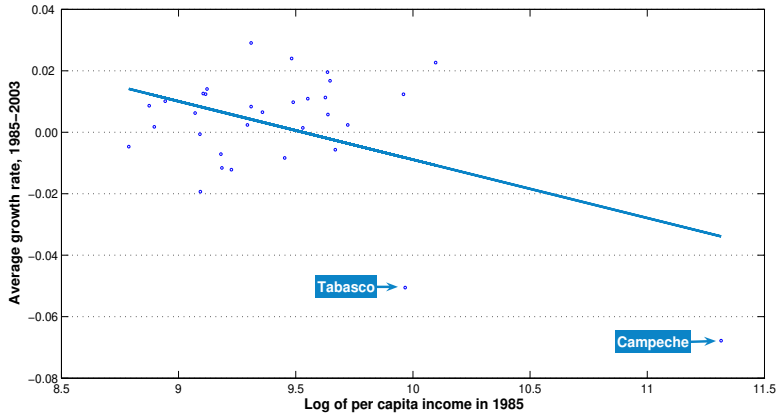
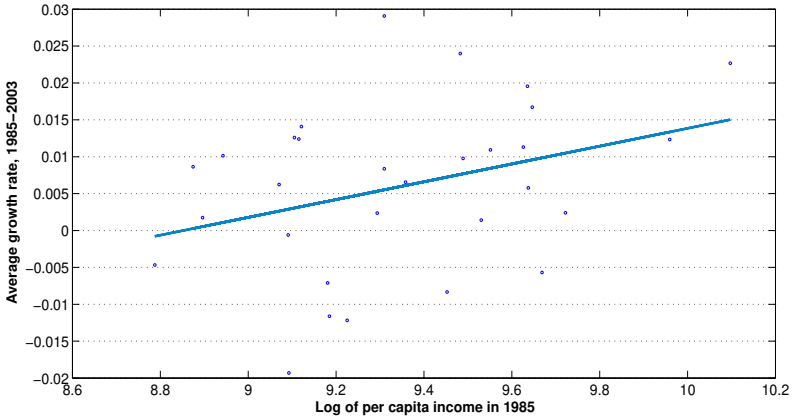


Figure 2: Convergence by state, 1985 – 2003
Excluding Campeche and Tabasco

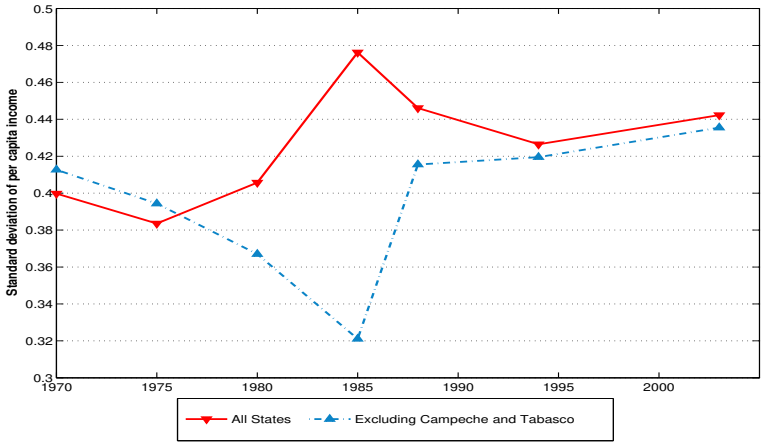


2.2.1 Per capita income dispersion (σ-convergence)

To complete the β-convergence analysis, we compute the per capita income standard deviation. According to Barro and Sala-i-Martin (2004), a low (high) value for this measurement is considered evidence of σ-convergence (divergence). Figure (3) shows that the behavior of income dispersion depends on which states are included in the calculation: when including all states, disparities decrease over the 1985-2003 period; with only 30 states, disparities rapidly increase after 1985, and more slowly after 1988. These facts are consistent with the informa-

tion presented in Figures (1) and (2). From 1994 to 2003, income dispersion behaves similarly, regardless of the sample used.

Figure 3: Income dispersion



2.3 Analysis by region

In this section, the growth process is analyzed based on groups of states. We define these regions as in Esquivel (1999). All states are included in one of the seven regions described in Table (1).

Table 1: Regions

	Region	*State*
1	Capital	DF and Estado de Mexico
2	Center	Hidalgo, Morelos, Puebla and Tlaxcala
3	Northern-center	Aguascalientes, Durango, Guanajuato, Queretaro, SLP and Zacatecas
4	Gulf	Campeche, Quintana Roo, Tabasco, Veracruz and Yucatan
5	Border	Baja California, Chihuahua, Coahuila, Nuevo Leon, Sonora and Tamaulipas
6	Pacific	Baja California Sur, Colima, Jalisco, Nayarit and Sinaloa
7	South	Chiapas, Guerrero, Michoacan and Oaxaca

Figures (4) and (5) plot average growth rate against initial level of income. As in the case of state-by-state analysis, here there is evidence of convergence when all states are included; however, when Campeche and Tabasco are excluded from the Gulf Region, evidence of divergence is found.

Figure 4: Convergence by region, 1985 – 2003

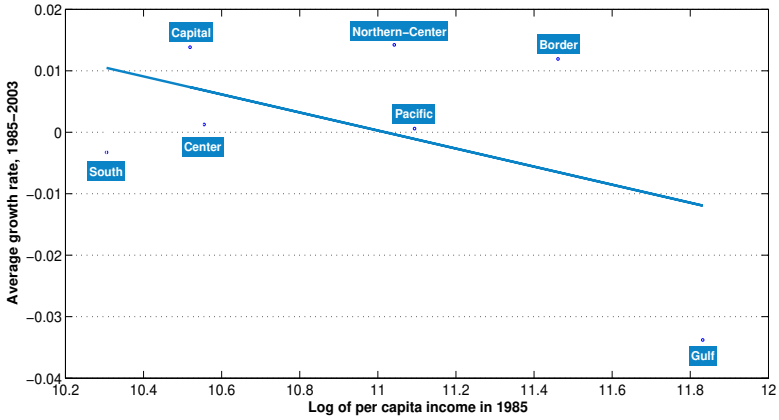
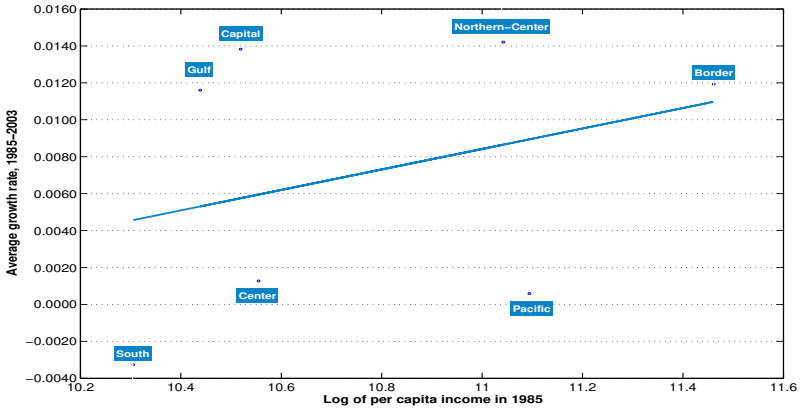


Figure 5: Convergence by region, 1985 – 2003
Excluding Campeche and Tabasco from Gulf Region



2.4 Estimation of the rate of convergence

Table (2) summarizes the NLS estimates of parameter β using equation (1). The conclusions obtained from these results are in line with those obtained from the graphical analysis. The estimated values vary depending upon the sample and the period of time analyzed. Evidence of convergence exists when β is calculated using the whole sample. Panel A shows a positive and statistically significant estimate of parameter β for period 1985-2003 and subperiod 1985-1994. Evidence of divergence is found only when Campeche and Tabasco are

excluded; panel B shows a negative estimate of the rate of convergence for the period 1985-2003 and subperiod 1985-1994.

Table 2: Estimation of the rate of convergence

	Panel A			Panel B		
	Including all states			Excluding Campeche and Tabasco		
	1985-2003	*1985-1994*	*1994-2003*	*1985-2003*	*1985-1994*	*1994-2003*
β	0.0232	0.0438	−0.0021	−0.0109	−0.0207	−0.0022
P-value	(0.028)	(0.019)	(0.580)	(0.043)	(0.025)	(0.580)
R^2	0.21	0.23	0.01	0.12	0.58	0.01
Sample	32	32	32	30	30	30

The estimates for the second subperiod (1994-2003) are similar in both panels: the estimated β appears to be statistically insignificant. The absence of evidence in favor of either convergence or divergence suggests that income disparities remained relatively stable at this stage.
It is unsatisfactory that the inference from previous analysis depends upon the sample used; consequently, any conclusion drawn could be taken as subjective. Nevertheless, we can say that regardless of the convergence or divergence pattern, the process is stronger over the subperiod 1985-1994.

3 Analysis with time series

Time-series specialists claim that τ-convergence analysis is more complete. They argue that the existence of a negative correlation between growth rate and initial level of income—cross-section studies—should not be taken as evidence of convergence; but rather of catching-up (Andrew and Durlauf 1996). Long-run convergence implies that the narrowing of the per capita income disparity between two economies has finished, i.e. income differences are steady over time. This issue can be linked to the well-known statistical property of stationarity.

3.1 Methodology

The basic methodology employed is that of Augmented Dickey-Fuller (ADF) type tests. With these tests, we analyze the stationarity properties of the logarithm differences of real per capita income between two given economies; see for example, Li and Papell (1999), Lee, Lim, and Azali (2005), Oxley and Greasley (1995), amongst others. The convergence hypothesis can be studied using this approach by estimating the following basic model:

$$\Delta(y_{i,t} - y_{j,t}) = \mu + \beta T + \alpha(y_{i,t-1} - y_{j,t-1}) + \sum_{k=1}^{n} \delta_k \Delta(y_{i,t-k} - y_{j,t-k}) + \epsilon_t \quad (2)$$

where the variable $(y_{i,t} - y_{j,t})$ is the logarithmic difference in per capita income between economies i and j in period t, and T is a deterministic trend. The existing literature considers the following results:

- Catching-up (stochastic convergence):
  If $\beta < 0$ and $\alpha < 0$, the series $(y_{i,t} - y_{j,t})$ is stationary around a negative deterministic trend, i.e. there is a tendency for the difference in per capita income to narrow over time.

- Long-run convergence (deterministic convergence):
  If $\beta = 0$ and $\alpha < 0$, the series y_i and y_j are cointegrated, i.e. the reductions in per capita income difference have ended and remain stable over time.

- Divergence:
  If $\beta = 0$ and $\alpha = 0$, income disparity follows a random walk, i.e. per capita income difference is unpredictable.

In addition to these three possible results, we consider a further outcome, not yet considered in existing literature. A somewhat weaker notion of catching-up, *Loose catching-up* suggests that economy j is erratically, but also *inexorably*, catching up with economy i. This conclusion arises if the series contains a negative deterministic and a stochastic trend simultaneously. As is well-known, a deterministic trend always dominates a stochastic one (Hasseler 2000); hence, finding evidence of both indicates an inevitable reduction in income difference over time:

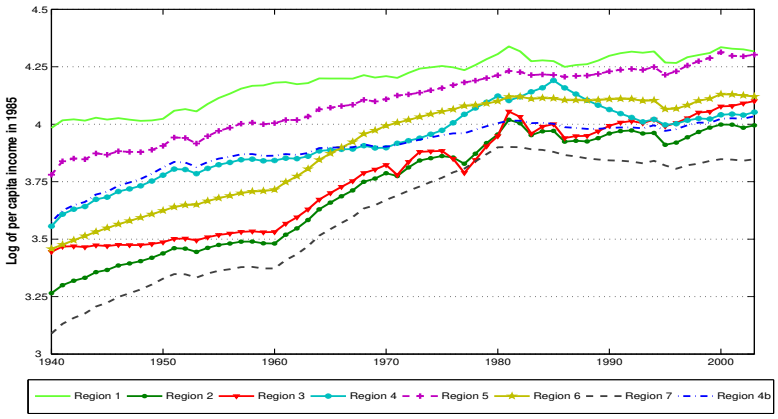
- Loose catching-up:
  If $\beta < 0$ and $\alpha = 0$, the income difference is decreasing but in an erratic way.

3.2 Empirical results of time-series test for convergence

We use the GSPs estimated by German-Soto (2005) for the period 1940-2003. Given that there are 32 states and that the test is performed pairwise, it would be time-consuming to analyze income disparity at a state level. Hence, the τ-convergence analysis is performed using regions. In particular, we compare the growth process between the capital region and the rest of the regions described in Table (1). We use the capital region for our comparison since this is the region with the highest per capita income throughout the whole sample period. Figure (6) shows the evolution of per capita income for the seven different regions; in addition, we include the region denominated 4b (namely, Region 4 with Campeche and Tabasco excluded). In general, we can assert that per capita income has been increasing in all regions; nevertheless, the growth process has not been homogeneous. For example, Regions 2, 3, 6 and 7 had the highest per capita income growth rates from 1960 to 1980, yet are still far behind Regions 1 and 5 in this respect. Furthermore, Region 6's per capita income was lower than that of Regions 4 and 4b at the beginning of the sample, though higher

by 2003. Moreover, it is clear that income dispersion is less severe at the end of the period, which could be interpreted as a reduction in inequality between rich and poor regions.

Figure 6: Per capita income by region, 1940 – 2003



Given the wide array of per capita income patterns relative to that of Region 1, from the figure it is difficult to ascertain the growth dynamic for the last twenty years. For instance, whilst the disparity between Regions 1 and 5 seems to have decreased during this period, the income gap for Regions 1 and 7 appears to have been rising since 1985.

3.2.1 Standard ADF test of convergence

We first apply the conventional ADF to test for unit roots. The rejection of the null hypothesis of nonstationarity is evidence of either catching-up or long-run convergence. As is well-known, there are certain shortcomings associated with the use of this methodology that has resulted in there being little supporting evidence of the convergence hypothesis when using time-series tests. Amongst such limitations, are: (1) its low power and (2) as highlighted by Campbell and Perron (1991), the fact that the misspecification of the model or the existence of structural breaks biases the results of the test towards the nonrejection of the null; this is particularly important when using data referring to an extended period of time.

In the estimation of equation (2), we use the Akaike Information Criterium (AIC) as a model selection guide for determining the value of n. The corresponding results are reported in Table (3). The unit root hypothesis can be rejected at the 5% level for Regions 3, 4b and 5, and at the 10% level for Region 4. On one hand, the joint estimates of $\alpha < 0$ and $\beta < 0$ suggest that per capita

incomes in Regions 3, 4 and 5 have been catching up with that of Region 1 throughout the period. On the other hand, the estimate of a statistically insignificant time trend and the rejection of the unit root hypothesis is evidence of long-run convergence between Regions 1 and 4b, which implies that per capita income difference is invariant over time. Finally, Column 5 shows the number of lags used in the estimation, and Column 6 presents the Q-statistics that indicate that there is not enough evidence to reject the null hypothesis of white noise. We find considerable support against the null hypothesis of nonstationarity in four out of seven cases. This is substantial evidence in favor of stochastic and deterministic convergence, in contrast to what related studies have found previously. We are unable to reject the unit root hypothesis for the poorest regions; this may be due to the fact that trade reforms had an important effect on their growth dynamic, an aspect we have so far ignored.

Table 3: τ-convergence analysis

Region	β^a	$\alpha^{a,b}$	R^2	k	$Q(20)^c$	Conclusion
2	-0.0014***	-0.0843	0.45	3	13.36	Loose catching-up
	(-2.59)	(-2.85)			(0.86)	
3	-0.0033***	-0.2015**	0.34	6	18.67	Catching-up
	(-3.62)	(-3.81)			(0.54)	
4	-0.0007*	-0.1603*	0.37	6	28.58	Catching-up
	(-1.86)	(-3.35)			(0.11)	
4b	0.0001	-0.1507**	0.45	1	25.55	Long-run convergence
	(0.83)	(-3.81)			(0.18)	
5	-0.0018***	-0.3180***	0.35	6	23.29	Catching-up
	(-4.19)	(-4.19)			(0.27)	
6	-0.0009*	-0.0773	0.36	6	13.42	Loose catching-up
	(-1.68)	(-2.20)			(0.85)	
7	-0.0014**	-0.0774	0.41	6	15.91	Loose catching-up
	(-2.05)	(-2.44)			(0.72)	

[a]The number in parenthesis is the t-statistic. *, **, and *** denote statistical significance at the 10%, 5% and 1% level respectively. [b]Critical values are from Mackinnon (1991).
[c]P-values are in parentheses.

3.2.2 ADF test of convergence with a structural break in the deterministic trend

Perron (1989) showed that the effectiveness of the unit root tests decreases significantly in the presence of structural breaks by biasing the results towards the nonrejection of the null hypothesis. Allowing for a structural break in the trend function in the post-trade reform period corrects such a bias by increasing the power of the test, whilst at the same time allowing the process of convergence after liberalization to be described. The break represents the shock that the regional per capita income might have suffered as a consequence of a specific economic policy and removes its influence from the noise function. Specifically, the proposed model is,

$$\Delta(y_{i,t}-y_{j,t}) = \mu+\beta T+\alpha(y_{i,t-1}-y_{j,t-1})+\theta DT_t+\sum_{k=1}^{n}\delta_k\Delta(y_{i,t-k}-y_{j,t-k})+\epsilon_t \quad (3)$$

where DT_t represents the trend dummy variable, $DT_t = t - T_B$ if $t > 1985$ and 0 in any other case, $T_B = 1985$ is the break date. As mentioned, we compare all regions against Region 1, therefore, $j = 2, 3, ..., 7$. If the income gap is increasing after the 1985, we would expect our estimation to result in a θ value greater than zero. Equation (3) is estimated by Ordinary Least Squares and, similarly, we use AIC to select n.

The results in Table (4) show stronger evidence against unit root; it appears that the source of the nonrejection in the previous section is the bias caused by the omission of the structural break. Similar to the previous estimation, we find support to affirm that Regions 3, 4, and 5 are catching up with Region 1; in this case however, the unit root hypothesis is rejected at a higher confidence level. Furthermore, there is now evidence of catching-up for Regions 2, 6 and 7; we believe that the new specification allows us to reject nonstationarity for these regions because their growth pattern suffered a significant change after trade reforms. This implies that the non-inclusion of the break had a major effect on their noise function. This is shown by the highly significant estimates of parameter θ; allowing for a structural change in the post-liberalization period significantly improves the goodness of fit of the model.

The estimates show that per capita income disparities diminished during the period 1940-2003. Nevertheless, this process was abruptly interrupted after 1985, in Regions 2, 6, and 7; the rate at which income disparity is increasing in the post-reform period is similar to the estimated rate at which this difference was decreasing prior to the reforms[5].

Related studies argue that Region 5 especially benefited from the reforms since it includes all the states sharing the border with the U.S.; the results find inconclusive evidence in favor of this claim: whilst our estimate of θ for this region is negative, it is statistically insignificant.

[5] We perform Wald test for the null $\beta + \theta = 0$, and we are unable to reject it for Regions 2, 6 and 7.

Table 4: τ-convergence with a structural break in the deterministic trend

Region	β^a	$\alpha^{a,b}$	θ^a	R^2	k	$Q(20)^c$	Conclusion
2	-0.0035***	-0.1603**	0.0030**	0.49	6	10.02	1. Catching-up
	(-3.34)	(-3.58)	(2.19)			(0.95)	2. Divergence after trade reforms
3	-0.0036***	-0.2059**	0.0007	0.35	6	18.89	1. Catching-up
	(-3.22)	(-3.78)	(0.41)			(0.52)	2. No significant effect after trade reforms
4	-0.0018***	-0.2175**	0.0035*	0.41	6	28.72	1. Catching-up
	(-2.63)	(-3.90)	(1.87)			(0.11)	2. Divergence after trade reforms
4b	0.0003	-0.1456**	-0.0007	0.46	1	26.75	1. Long-run convergence
	(1.25)	(-3.64)	(-0.93)			(0.11)	2. No significant effect after trade reforms
5	-0.0017***	-0.3189***	-0.0002	0.36	6	16.44	1. Catching-up
	(-3.71)	(-4.16)	(-0.27)			(0.68)	2. No significant effect after trade reforms
6	-0.0038***	-0.1945**	0.0049***	0.45	6	12.58	1. Catching-up
	(-3.34)	(-3.67)	(2.82)			(0.89)	2. Divergence after trade reforms
7	-0.0043***	-0.1726**	0.0053***	0.49	6	18.36	1. Catching-up
	(-3.42)	(-3.73)	(2.70)			(0.56)	2. Divergence after trade reforms

[a]The number in parenthesis is the t-statistic. *, **, and *** denote statistical significance at the 10%, 5% and 1% level respectively.
[b]Critical values are from Mackinnon (1991). [c]P-values are in parentheses.

Our estimations suggest evidence in favor of absolute convergence. The rate at which regions have been catching up with Region 1 depends on the initial level of income. The estimated absolute value of the parameter β is greater for the poorest initial regions. Regions 4 and 4b deserve a more detailed examination. The oil wealth of Campeche and Tabasco biases our results towards the conclusion that per capita income of Region 4 is catching up with that of Region 1. Nevertheless, when these two states are excluded, the estimate shows that per capita income in the rest of the states in that region—Quintana Roo, Veracruz and Yucatan—has not changed relative to that of Region 1. This implies that the qualitative results regarding the effect of Campeche and Tabasco are unchanged from Section 2.

4 Convergence between the U.S. and Mexico border regions

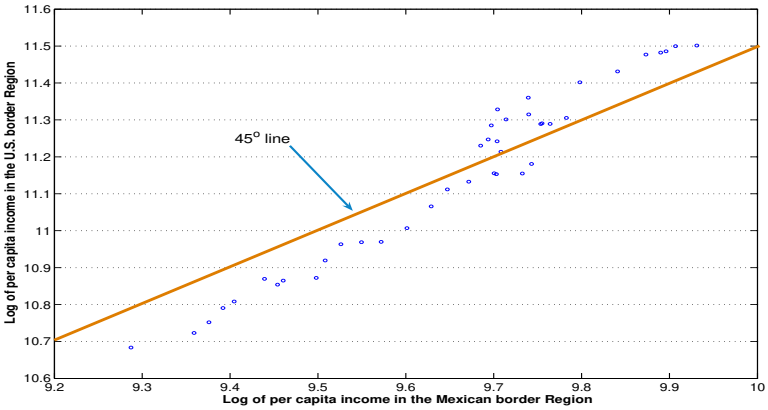
Empirical studies that have analyzed whether trade liberalization contributes to per capita income convergence across countries have produced mixed results. On the one hand, Slaughter (2001) evaluates four examples of important multilateral trade liberalization and finds no evidence of resulting income convergence. In fact, trade actually seems to have caused income divergence. However, Ben-David(1993, 1994 and 1996) finds that the elimination of trade barriers leads to a noticeable reduction in the existing income gap.

Mexico's trade reform is an episode that seems to be a natural laboratory in which to analyze the impact of economic liberalization on per capita income difference. Since the results above suggest that the Mexican border region has especially benefited from economic liberalization, we focus on investigating the properties of the income gap series of the U.S.-Mexico border region.

To perform this analysis we used data[6] for those States that share the border with Mexico. Then, we computed the real Gross Regional Product (GRP) for each region—that of the U.S. side of the border and that of the Mexican. The scatter plot in Figure (7) suggests that the U.S. region grows faster than the Mexican, given that the scatter plot has a slope greater than the 45° line. This pattern of lagging behind remained unaltered after 1985. Thus, the reforms apparently did not break down the dynamic of per capita income that had been observed since 1963.

[6]Annual GSP for the period 1963 – 2003 was retrieved from the Bureau of Economic Analysis. The U.S. border region includes: Arizona, California, New Mexico, and Texas.

Figure 7: Per capita income in border regions, 1963 – 2003



To formally test for convergence, we carry out the same analysis as in Subsections 3.2.1 and 3.2.2. The results can be seen in Table 5.

Table 5: τ-convergence analysis for the U.S.-Mexico border regions

Model	β^a	$\alpha^{a,b}$	θ^a	λ^a	R^2	k	$Q(20)^c$
(2)	0.0030***	-0.4672*			0.24	1	13.77
	(2.96)	(-3.29)					(0.84)
(3)	0.0030**	-0.4645*	-0.0001		0.24	1	13.76
	(2.56)	(-3.18)	(-0.11)				(0.84)

[a]The number in parenthesis is the t-statistic. *, **, and *** denote statistical significance at the 10%, 5% and 1% level respectively. [b]Critical values are from Mackinnon (1991).
[c]P-values are in parentheses.

The null hypothesis of divergence is rejected. Per capita income disparities are increasing over the entire period—the deterministic trend parameter estimate is positive in both models—this implies that the Mexican region is lagging behind with respect to its U.S. counterpart. There is no evidence to support the hypothesis that trade reforms have altered the rate at which the income gap widens—the trend dummy variable estimate is statistically insignificant in model (3).

5 Conclusions

We conduct a τ-convergence analysis for Mexican regions over the period 1940-2003; the results suggest that income disparities were decreasing relative to capital region income. There is evidence in favor of absolute convergence, since the rates at which poor regions reduce income differences depend on their initial level of wealth. Contrary to related studies that analyze the convergence hypothesis with time-series, we find strong evidence against the null hypothesis of unit root; this evidence is even stronger when we include a structural break in the deterministic trend to model any effect that trade reforms may have had. We are able to describe the specific characteristics of the growth pattern for every region, both before and after the economic liberalization.
Our results are consistent with the hypothesis that trade reforms negatively affected some areas of Mexico. We do show that there is evidence from the time-series framework that supports the assertion of an increase in the income gap between the capital region and Regions 2, 6 and 7; and determine quantitatively and qualitatively the relative significant adjustment in regional growth patterns after this event. Results further suggest that trade reforms failed to reverse the trend previously observed in income per capita between the U.S. and Mexican border regions, that is, incomes per capita in the Mexican region lagging behind those of the U.S..

References

Andrew, B., and S. Durlauf (1996): "Interpreting Tests of the Convergence Hypothesis," *Journal Econometrics*, 71, 161–173.

Barro, R., and X. Sala-i-Martin (2004): *Economic Growth*. McGraw Hill.

Ben-David, D. (1993): "Equalizing Exchange: Trade Liberalization and Income Convergence," *The Quarterly Journal of Economics*, 108(3), 653–679.

——— (1994): "Income Disparity Among Countries and the Effects of Freer Trade," *Economic Growth and the Structure of Long Run Development*, pp. 45–64.

——— (1996): "Trade and convergence among countries," *Journal of International Economics*, 40(3/4), 279–298.

Campbell, J., and P. Perron (1991): "What Macroeconomist Should Know about Unit Roots," in *NBER Macroeconomics Annual*, ed. by O. Blanchard, and S. Fisher, pp. 141–201. MIT Press.

Cárdenas, M., and A. Pontón (1995): "Growth and Convergence in Colombia: 1950-1990," *Journal of Development Economies*, 47, 5–37.

Chiquiar, D. (2005): "Why Mexico's Regional Income Convergence Broke Down," *Journal of Development Economies*, 77, 257–275.

Esquivel, G. (1999): "Convergencia Regional en México, 1940-1995," *El Trimestre Económico*, 66, 725–761.

German-Soto, V. (2005): "Generación del Producto Interno Bruto Mexicano por Entidad Federativa, 1940-1992," *El Trimestre Económico*, 72, 617–653.

Hasseler, U. (2000): "Simple Regressions with Linear Time Trends," *Journal of Time Series Analysis*, 21, 27–32.

Lee, H.-A., K. Lim, and M. Azali (2005): "Income Disparity between Japan and ASEAN-5 Economies: Converge, Catching-up or Diverge?," *Economics Bulletin*, 6, 1–20.

Li, Q., and D. Papell (1999): "Convergence of International Output Time Series Evidence for 16 OECD Countries," *International Review of Economics and Finance*, 8, 267–280.

Mackinnon, J. (1991): "Critical Values for Cointegration Test," in *Reading in Cointegration*, ed. by R. Engle, and C. Granger, pp. 267–276. New York: Oxford University Press.

Oxley, L., and D. Greasley (1995): "A Time-Series Perspective on Convergence: Australia, UK and USA since 1870," *Economic Record*, 71, 259–270.

Perron, P. (1989): "The Great Crash, the Oil Price Shock and the Unit Root Hypothesis," *Econometrica*, 57, 1361–1401.

Rodríguez, A., and J. Sánchez (2002): "The Impact of Trade Liberalization on Regional Disparities in Mexico," *Growth and Change*, 33, 72–90.

Slaughter, M. (2001): "Trade Liberalization and Per Capita Income Convergence: A Difference-in-Differences Analysis," *Journal of International Economics*, 55(1), 203–28.