Polarization of Income under Structural Changes: Winners and Losers of Regional Growth in Mexico

Eduardo Rodríguez-Oreggia
Inter-American Conference on Social Security

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Center of Border Economic Studies
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INTRODUCTION

The work of Barro and Sala-i-Martin [1991; 1992; 1995] on the neoclassical convergence of per capita GDP among countries and regions started a stream of works investigating the speed at which economies tend to close or increase disparities. Although criticized [Quah, 1993; 1996], this approach to the evolution of disparities has developed two main measures of long-term growth analysis through the beta and sigma coefficients. To some extent the process of convergence is associated, in general, with recession periods while the divergence is found in economic booms periods [Chatterji and Dewhurst, 1996]. From this, some regions are winning, while other regions are losing.

The case of Mexico offers an interesting example in the analysis of regional disparities evolution in developing countries under economic liberalization and reforms. Since the beginning of the 1970s Mexico has experienced changes in its economic model: until 1985 promoting import substitution with strong state intervention in the economy, and after starting a period of economic reform and openness. Before 1985 Mexico experienced higher rates of growth, and disparities among regions were closing. However, the recurrent economic crises and the transition to economic reform and liberalization have brought new problems. Among these problems is the widening gap in per capita GDP among regions. In spite of this, Mexico still suffers from a lack of well-defined and coordinated regional policy as such. Regional policy has been limited to the spatial impact of national policies, which have tended to increase concentration of industry and population in some areas [OECD, 1997; Palacios, 1989].

The purpose of this paper is to focus on aspects derived from convergence and divergence among regions in Mexico since the 1970s, identifying the winners and loser through the structural change processes suffered in the economy. The paper is organized as follows. The second section describes the data to use in the paper. The third part analyses the evolution of disparities through beta convergence. The fourth section analyses sigma convergence. The fifth section considers the migration effect. Finally some conclusions are drawn.

DESCRIPTION OF THE DATA

Regional economic disparities are traditionally measured in terms of per capita GDP. This measure is said to be ambiguous given that just one part of a region's GDP, composed of the sum of the total of its value added, goes to the income of the inhabitants in such region. Additionally, in a country like Mexico with a wide income polarization, per capita GDP is at risk of not being a representative of measurement of inequalities.

In addition, some analysts [OECD, 1997] have pointed out the existence of a type of statistical fallacy in the case of Mexico using per capita GDP as indicator. This fallacy derives from the fact that oil and petrochemicals have a strong weight in the total GDP, while at the same time these sectors are highly localized (mainly in the states of Campeche and Tabasco), massive generators of value added, and with small impact in the economic development of the region in which they are located. The rate of growth during the 1970s for the states of Tabasco and the 1980s for Campeche were very high, and in both cases rate of growth decreases in periods after.

There are no official data of GDP per state before the 1970s[1], and only since 1993 the data is annual. The database of state's GDP to be used in this paper is from the National Institute for Statistics, Geography and Information (INEGI) available at www.inegi.gob.mx. The methodology to calculate the GDP was based on the national input-output matrix for 1970 and 1980. In 1998 INEGI changed its methodology to measure state's GDP, updating the figures to a 1993 base. The reasons argued for such a change are the progress in technology and demand structure as some of the factors affecting the rise or extinction of economic activities [Banamex, 1999]. To a certain extent, the so-called statistical fallacy was brushed away from the data.

The change in methodology brought three groups of variations in state's GDP [Banamex, 1999]. In the first group there is an increase in the participation of Northern states or states with economic activity supported on a foreign market. INEGI argues that this modification mirrors in a more accurate way the effects of trade opening and export dynamic. In the second group the oil states experience a reduction in their weight, mainly due to changes in commercial activities related to this industry. Finally, the third group, including states with a performance highly vulnerable to neighbours market, experiences a drop in their weight.

BETA CONVERGENCE: WINNERS AND LOSERS

Following the work of Barro and Sala-i-Martin [1991, 1992, 1995] on the patterns of growth at regional levels there have been flows of works interested in investigating the

common speed at which economies converge to their own steady state. These ideas were first proposed by Abramovitz [1986] and operationalized by Baumol [1986], and are supported by the neoclassical growth theory under the common assumption of diminishing returns to capital.

The implication behind the latest assumption in neoclassical models is that each addition to capital will generate a more than proportional addition in output when the capital is small, and small addition when the capital is large. Consequently, if the only difference across economies is the initial capital stock, poor regions (with small capital stock) will grow faster than rich regions (with large capital stock), creating a convergence effect.

The literature uses the β coefficient to measure the speed of convergence. There is β convergence if, on average, initially poor regions are growing faster than rich regions. The speed of convergence, or beta coefficient, is estimated through the following equation [Barro and Sala-i-Martin, 1991, 1992, 1995]:

$$\frac{1}{T} In\left(\frac{y_{i,t_0+T}}{y_{i,t_0}}\right) = a - \left(\frac{1-e^{-bT}}{T}\right) In(y_{i,t_0}) + u_{it_0,t_0+T} \qquad (Equation\ \ 1)$$

Where the left side is the average annual rate of growth of per capita GDP, and the right side the initial level of per capita GDP of a set of regions between time t_0 and t_0+T. β coefficient is the absolute β convergence coefficient, without conditioning on any other

characteristic of states. The model can be modified to include some variables, to control for differences in other characteristics, to calculate conditional beta convergence.

Table 1 depicts results for Equation 1 using Non Linear Least Squares. It presents regressions according to 5 periods of time, the period 1970-1999 is the whole sample of time, then we break this period in 2 main sub-periods comprising the period before trade liberalization and economic reform, 1970-1985, and the period after, 1985-1999. These two periods will constitute the axis on which the analysis in this paper will be based, as this breakpoint constitutes a structural change in the economy (e.g. Lächler and Aschauer, *1998,* using national data for found a significant test for structural change in 1985-1986). Table 1 also presents a period before the oil shock, 1970-1980, and a period after the economic crises of the 1980s, 1988-1999.

The oil producing states of Campeche and Tabasco have been excluded from the sample as they experienced very high rates of growth at the end of the 1970s and beginning of the 1980s as a consequence of the boom of the oil prices, then their inclusion in the sample creates distortion in the coefficients and the dispersion, pulling down results for other states[2]. I have also run the regressions including geographical dummies[3]. The logic to include these dummies is the assumption of permanent differences among regions, which could affect the rate of interregional convergence captured by the beta coefficient.

Table 1
Non linear least squares regression of b coefficient in the Mexican states. (Excluding Campeche and Tabasco)

Coefficient/Period	**1970-1999**	**1970-1980**	**1970-1985**	**1985-1999**	**1988-1999**
α	0.0181**	0.0812***	0.0646***	-0.0461**	0.0126
	(0.0073	(0.0130)	(0.0075)	(0.0199)	(0.0147)
β	0.0019	0.0211***	0.0223***	-0.0175***	-0.0038
	(0.0035	(0.0072)	(0.0047	(0.0061)	(0.0055)
Regional dummies	No	No	No	No	No
T_{half}	354	33	31	39^	198^
R^2	0.0116	0.2724	0.5276	0.1876	0.0133
Coefficient/Period	**1970-1999**	**1970-1980**	**1970-1985**	**1985-1999**	**1988-1999**
α	0.0195**	0.0794***	0.0647***	-0.0417*	0.0127
	(0.0087)	(0.0139)	(0.0090)	(0.0235)	(0.0112)
β	0.0017	0.0128	0.0229***	-0.0173**	-0.0074
	(0.0017)	(0.0139)	(0.0063)	(0.0078)	(0.0048)
Regional dummies	Yes	Yes	Yes	Yes	Yes
T_{half}	391	54	30	39^	93^
R^2	0.0294	0.4259	0.5298	0.2127	0.2036
T (years)	29	10	15	14	11
N	30	30	30	30	30

Standard errors in parentheses. ***, ** and * correspond to 1, 5 and 10% significance. Regional dummies coefficients not reported.
^ Correspond to the concept of Tdouble, meaning the number of years that it would take to double the current gap.

Table 1 displays the T_{half}, also called half-life, indicates the number of years that would take to reduce by half the gap between the logarithm of the initial and the steady state GDPs and is calculated according to the formula $T_{half} = In(2)/\beta = 0.69/\beta$.

According to the results, for periods starting in 1970 the β coefficient indicates the existence of absolute convergence in per capita GDP across states. This coefficient is

only 0.19% in the period 1970-1999 (or 0.17% when controlling for regional differences), and the estimator is statistically insignificant. The correspondent T_{half} for this period is of 354 years, or 391 if we consider regional dummies. Nevertheless, during this long period the Mexican economy has suffered from diverse and wide changes, which might have affected the patterns for convergence among regions.

The period before the liberalization of the economy (1970-1985) shows a negative and significant beta coefficient, with the coefficient ranging around 2.2%, which is in tune with the findings of rates of convergence around 2% for different countries in several empirical studies[4]. The result is consistent even controlling for regional differences. The period 1970-1985 shows especially a high R square of 52%. T_{half} for this period is around 30 years. This process might be fuelled at the beginning of the 1980 as the coefficient for the period 1970-1980 is just behind the figure for the 1970-1985 period, but not significant and much smaller if we control for differences among regions.

For the period 1985-1999 the β coefficient in Table 1 is statistically significant. As a consequence, it is possible to find a process of β divergence in the period 1985-1999, the gap between rich and poor regions has tended to widen, opposite to the findings of convergence in the previous period 1970-1985. The T_{half} for this period around 39 years, but here it means the numbers of years to double the current gap.

Figure 1 shows the scatter plot with the average annual rate of growth for the period 1970-1985 and the per capita GDP in 1970, excluding Campeche and Tabasco. The

dotted lines in Figure 1 (and subsequent) mark the average of the variable in the axis in such a way that we can identify four categories according to the economic growth and the initial per capita GDP[5]. The scatter plot shows a negative relation, the lower income regions at the beginning of the period having a higher rate of growth in the period. What it is interesting from this scatter plot is that most of the regions fall in the "catching-up" or "falling-behind" categories.

Figure 1

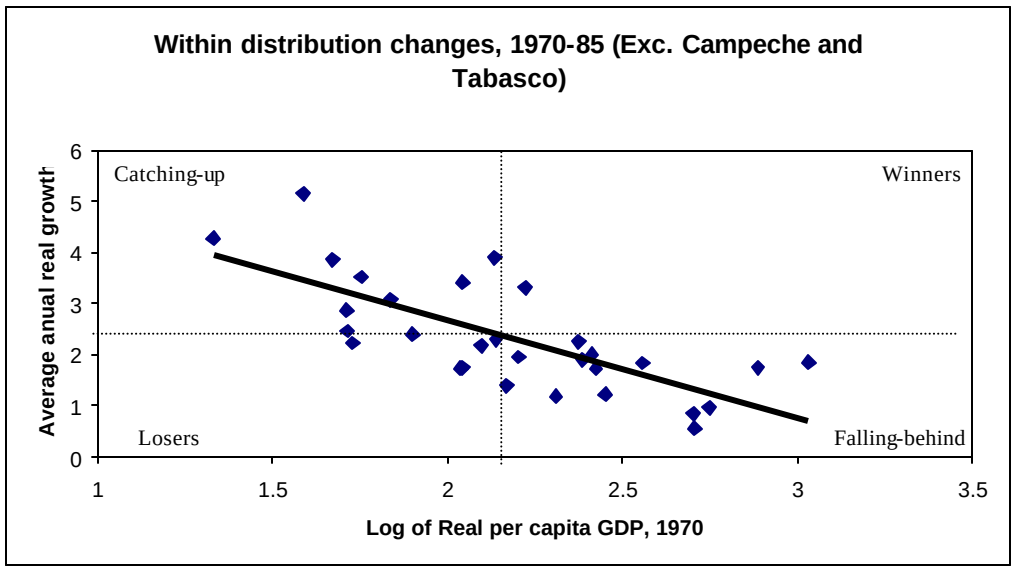
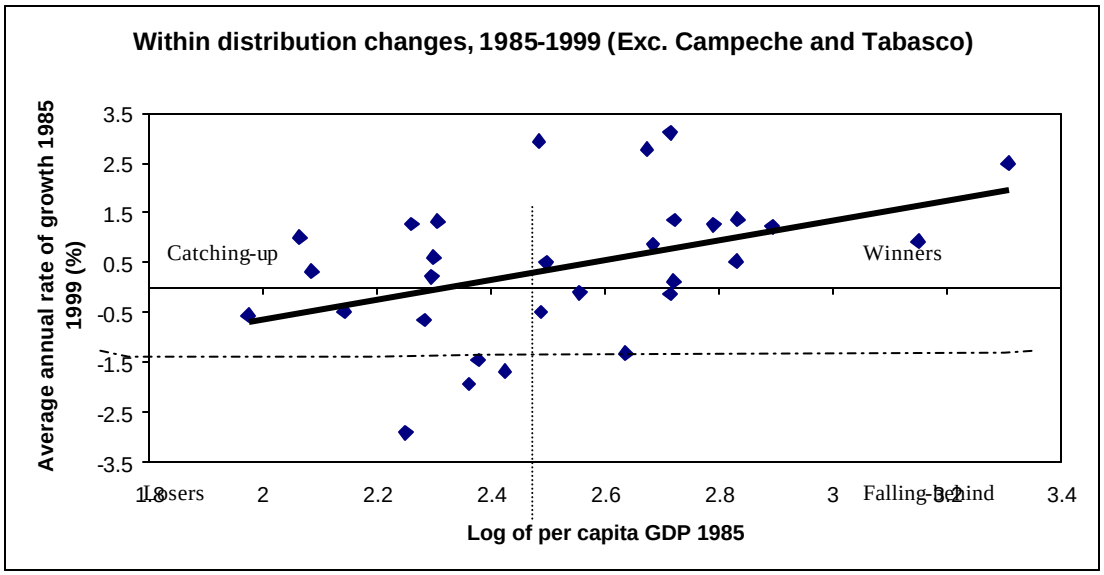


Figure 2 displays the relationship between per capita GDP in 1985 and the average rate of growth during the period 1985-1999, excluding again Campeche and Tabasco. The scatter plot shows a positive relation, the states with a higher initial income having higher rates of growth, while the states with lower initial income has negative rates of growth during the period. In comparison with the outline of previous period, most of the areas fall in classifications of "winners" or "losers".

Figure 2



From the scatter plots it is evident that from one period to the other regions can move from one classification to another. In order to track the evolution of individual regions within the distribution change, Table 2 shows the four classifications in which a region can be. The sign √ marks the classification in which the region technically falls in the period. However, some regions are also very closer to other classifications, in these cases a sign • will be shown in the classification the regions is very close to.

There are interesting changes from one period to another. States in the North, bordering with the US are classified as "falling-behind" in the period 1970-1985, but they move to the "winner" classification in the period after liberalization. This may suggests that border regions may have taken advantages from their geographical position, next to the US, to benefit from the free trade agreements and experience more higher growth.

Table 2

Within distribution changes (Excluding Campeche and Tabasco)

	1970-1985				1985-1999			
State	**W**	**F**	**L**	**C**	**W**	**F**	**L**	**C**
Aguascalientes	•	Ö	•		•			Ö
Baja California		Ö			Ö			
Baja California Sur		Ö			Ö			
Coahuila		Ö			Ö			
Colima	Ö					Ö		
Chiapas				Ö			Ö	
Chihuahua		Ö			Ö			
Distrito Federal		Ö			Ö			
Durango				Ö		Ö		
Guanajuato			Ö				•	Ö
Guerrero			•	Ö			Ö	•
Hidalgo				Ö			Ö	
Jalisco		Ö				Ö		
Mexico		Ö				Ö		
Michoacan			Ö	•				Ö
Morelos		Ö			•	•	•	Ö
Nayarit			Ö				Ö	
Nuevo Leon		Ö			Ö			
Oaxaca				Ö			Ö	
Puebla			•	Ö				Ö
Queretaro	•	Ö			Ö			
Quintana Roo	•	Ö			Ö			
San Luis Potosi				Ö				Ö
Sinaloa		Ö				•	Ö	
Sonora		Ö			Ö			
Tamaulipas		Ö			Ö	•		
Tlaxcala				Ö			Ö	
Veracruz		Ö					Ö	
Yucatan			Ö					Ö
Zacatecas				Ö			Ö	

W=winner; F=falling-behind; L=loser; C=catching-up.

Ö Shows the technical classification in which regions are. • Shows the classification the region is very close to, in addition to its main classification.

Southern and some central states, relying more on primary sector activities, move from a "catching-up" position in the first period, to a "loser" position in the last period. Those who are "losers" in the first period, generally continue in the same category in the following term. As a mode of comparison, and independent of the magnitude of the

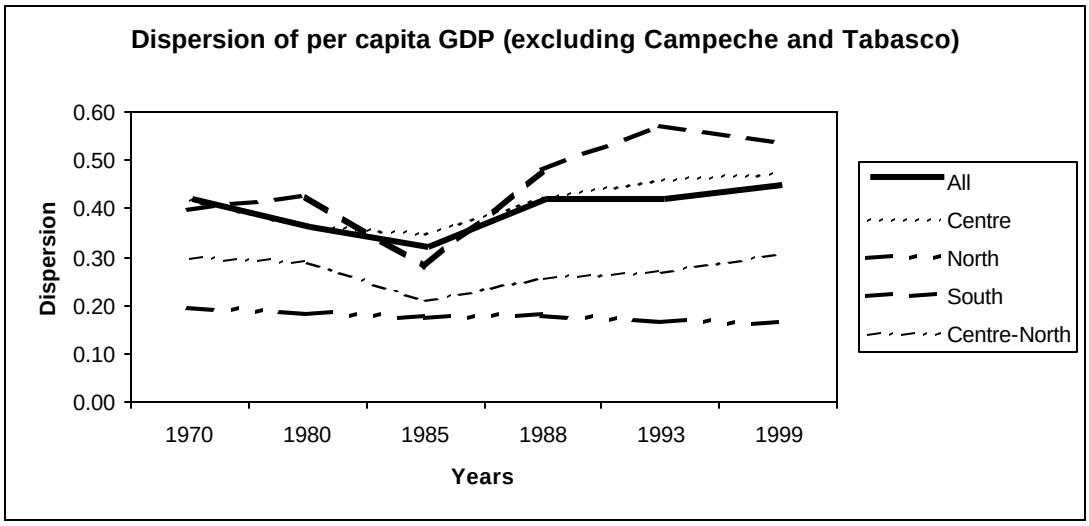
disparities between regions, this process, also happens in the European regions, where rich regions grow faster than poor ones with almost no change in relative positions [Boldrin and Canova, 2001].

SIGMA CONVERGENCE

Another important guide for the evolution of regional disparities is how dispersed is per capita GDP. Per capita GDP dispersion across states is typically measured by the standard deviation of the natural logarithm of the states' real per capita GDP. This concept is called in the literature sigma and it measures how the distribution of income evolves over time [Sala-i-Martin, 1996], existing a sigma convergence when the coefficient gets smaller.

To assess to what extent there has been σ convergence process across states in Mexico we calculated the standard deviation of the natural logarithm of the real per capita GDP since 1970 as is depicted Figure 3, excluding Campeche and Tabasco form the sample. These results show that the dispersion of per capita GDP in all states declined from 0.41 in 1970 to 0.32 in 1985. Notice that 1985 marks a year of structural change in the economy. The big leap in the dispersion occurred in the period 1985-1988, and since then dispersion has remained almost constant, around 0.42 and 0.44. Dispersion in the second half of the 1990s is at the same level as it was in 1970. These findings adjust to the beta coefficients, the sigma coefficient decreasing in the period that the beta suggests convergence, while in the period that sigma increases the beta suggests divergence.

Figure 3



Dividing the country in purely geographical areas it becomes evident that states in the North show the lower dispersion, while states in South have the higher dispersion, followed by central states. Results for the whole sample differ slightly from those presented by Juan-Ramon and Rivera-Batiz [1996]. In their results the dramatic rise in disparity is during the period 1988-1993. Cermeño [2001] also found a decreasing per capita GDP rate during the period 1970-1995, although with a convergence rate around 4.2% using panel data with spans of five years. In all cases it becomes relevant that it will be more difficult to close differences between rich and poor states.

In Europe, Boldrin and Canova [2001] show that a process of convergence occurred in the period 1950-1973 while in periods after the process stops. They argue that the period of convergence corresponds with absent regional policies and with the increase of trade, while after implementing regional policies, the increase in trade was not accompanied with reductions in disparities. In the US the process of convergence experienced all along

the century has halted since 1979, although the reasons are said to be still unclear [Bernat, 2001].

These results are also similar to findings in other developing countries under economic liberalization and with few areas with strong geographical advantages, e.g. in China, where differences between coastal and interior areas have increased during the 1980s and especially during the 1990s due to globalisation and further economic liberalization; the coastal regions, with the geographical advantage of access to the sea, showing a convergence process [Demurger, 2000; Fujita and Hu, 2001; Yao and Zhang, 2002].

Regional disparities, however, not only fluctuate according to economic performance or macro policies. As the measure of per capita GDP depends on population measures, a subject to be considered is how people move between regions inside an economy, being likely that any process of convergence might be speeded or decreased due to the migration flows, issue analysed in the next section.

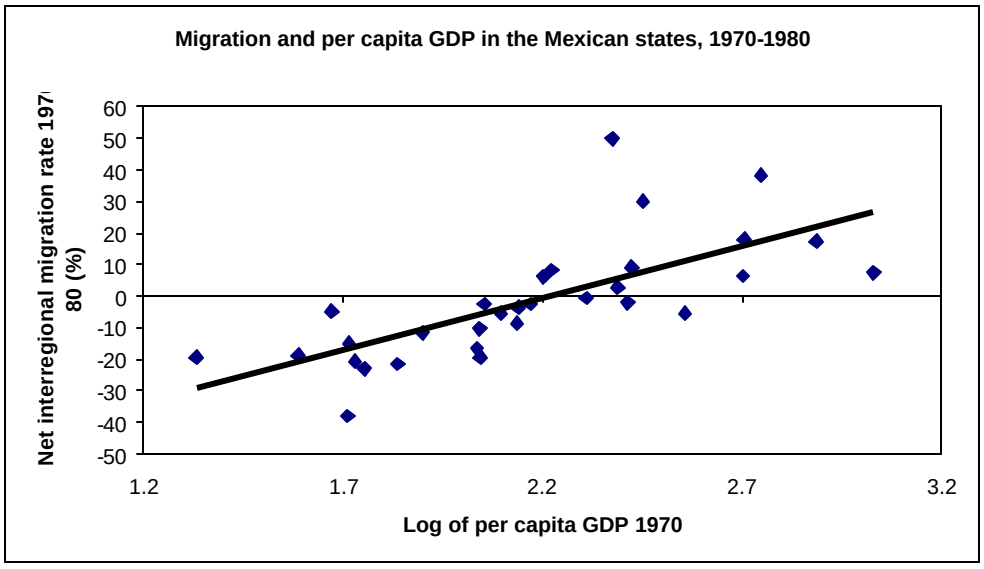
MIGRATION AND CONVERGENCE

The neoclassical model views migration flows as an equilibrating tool to contract income differentials given that people tend to move from low-income regions to high-income regions in search for higher salaries, income growth offering a significant incentive for net migration [Lowry, 1966; Richardson, 1973; Lande and Gordon, 1977]. It also could be argued that income differentials are among the major determinants of migration and the existence of regional differences in income is likely to be self-correcting through the migration effect [Dunlevy and Bellante, 1983]. Then, migration can be an important tool for the speed of convergence among regions.

To what extent the net migration rate is positively associated with the initial per capita GDP? The next figures will depict the relation between these two variables. Data for net migration rate was taken from the book Estadísticas Históricas de México, edited by INEGI [1994], and the database of INEGI at www.inegi.gob.mx. The data does not match exactly with the periods used before, as it is only available for the periods presented in the figures. Figure 4 depicts the scatter points of both variables for the period 1970-1980.

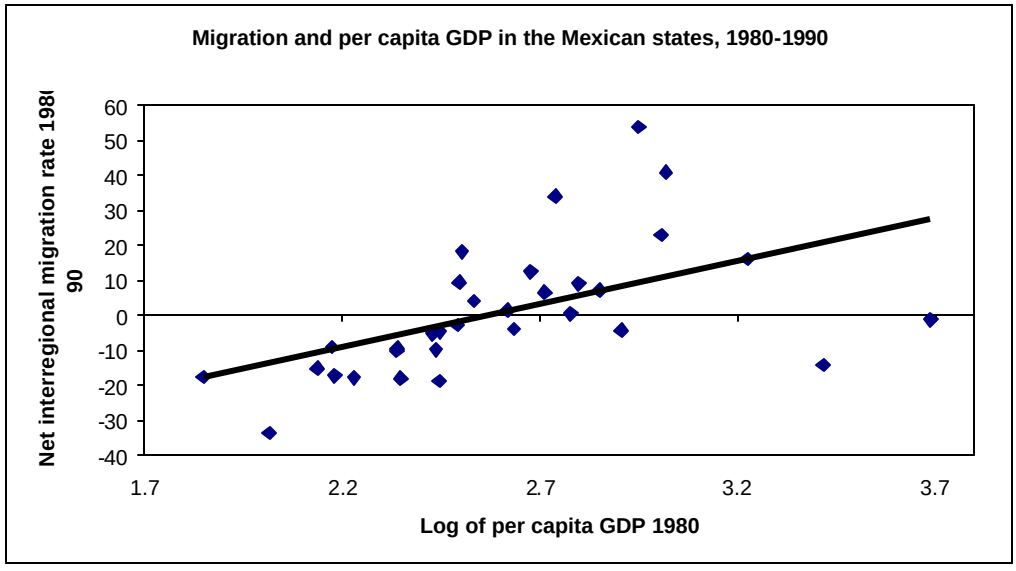
The scatter plot shows a positive relation between the variables net migration and per capita GDP (correlation coefficient 0.71). The highest point of net migration the state of Quintana Roo, which started as a tourist centre in the 1970s. The Distrito Federal (Mexico City) has the highest per capita GDP and a positive rate of migration. The flows of migration seems to be channelled instead to the State of Mexico, next to Distrito Federal, which holds the second highest rate of net migration. In general, states with lower per capita GDP in 1970 experienced negative net migration rate in the period 1970-1980.

Figure 4



In Figure 5 the association between net migration and initial per capita GDP for the period 1980-1990 is still positive (correlation coefficient 0.52). The highest net migration rate still corresponds to Quintana Roo, which has been pole of attraction of migration due to the development of the service sector, mainly tourism in areas such as Can Cun and the small islands in the state. Tabasco, with the highest per capita GDP in 1980, experiencing an almost null net migration rate. Migration at the beginning of the 1980s was a floating migration due to the activities in the oil sector; after the oil boom many people came to the oil states to work, but after the oil crises many people had to move to other regions as the opportunities in this state were mainly built around the oil sector.

Figure 5

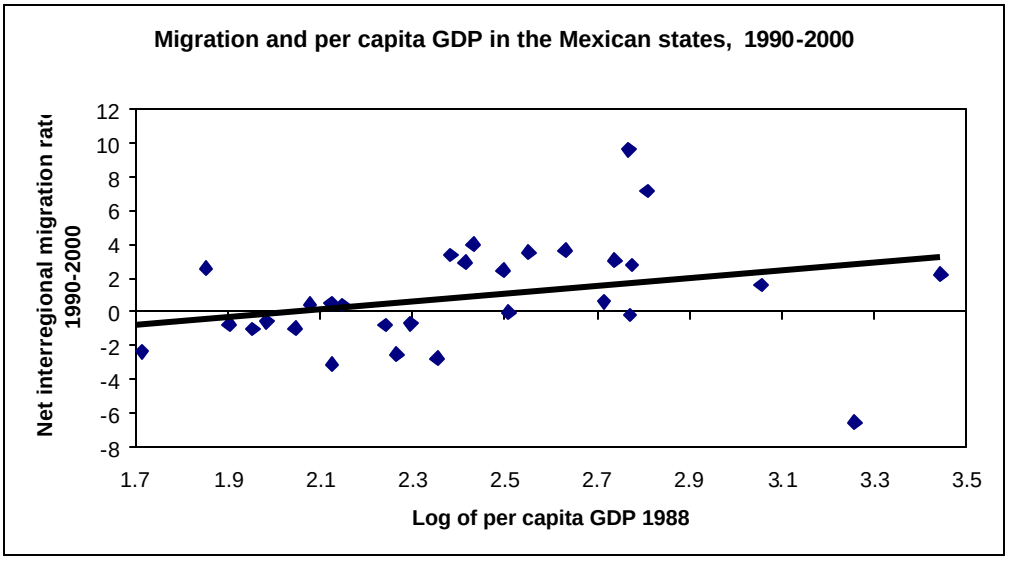


Distrito Federal, with the second highest income in 1980, experienced a negative migration rate. Distrito Federal turned from being a pulling migration city to become an expelling city. Such change is a consequence of factors such as the increase in the cost of

living, the incapacity to generate more employment to absorb migration inflows, and also the high levels of pollution, criminality, and seismic activity in Mexico City [Cruz-Piñeiro, 1998]. Northern states bordering the US received more flows of people not only from states with lower income, but also from the Distrito Federal [Escobar Latapi, 1999]. If we exclude Distrito Federal, Quintana Roo, and Tabasco from the sample, the correlation is 0.77, which is at the same levels than in the previous period.

Figure 6 shows the same relation for period 1990-2000, except that the income is for 1988 (there is no annual data for state's GDP before 1993).

Figure 6



In this period the scatter plot shows a positive relation between the variables, but the correlation coefficient of 0.33 is lower than in previous periods. The highest income in 1988 corresponds to Distrito Federal, experiencing a negative rate of net migration. The fact that Distrito Federal shows negative rates of migration, while State of Mexico

positive is to some extent derived from the implications that a high sector of the population has changed their address to the metropolitan areas of the State of Mexico although still working in the Distrito Federal [Chávez-Galindo, 1999]. Quintana Roo is the state attracting more flows of people due to its increasing tourism industry mainly in the area of Can Cun.

In general, Northern states bordering with the US have positive rates of net migration. The changing pattern of migration flows from the Centre to the North respond mainly to the sustained economic dynamic in Northern states and the boom of the maquiladora industry in those areas, and the inability of the main cities to deliver in the requirements of new basic infrastructure [Chávez-Galindo, 1999]. Excluding Distrito Federal and Quintana Roo from the sample the correlation becomes 0.56.

Up to this point, we have found a wide disparity between the Mexican regions. In the period where the country was closed to international markets and with high state intervention in the economy convergence was the norm, i.e. poor states were growing more than richer states on the average. Nevertheless, the pattern changed drastically after the opening and reform of the economy. After 1985 convergence is substituted by divergence, i.e. richer states growing more than poor states on the average. Migration flowing from poor states to richer states seems to have played an important role in the convergence period.

CONCLUSIONS

The evolution of disparities among the Mexican regions has been uneven. During the 1970s regions experienced an absolute convergence effect in per capita GDP, measured through beta and sigma coefficients. This process continued until year 1985 and it is more likely to happen because of the migration flows. In the middle of the 1980s Mexico entered the GATT and started a period of wide economic liberalization and reform, but was also immersed in a continuous of crises originated due to the fall of oil prices and the enormous public debt acquired as a consequence of the former boom in oil prices. After 1985 the Mexican regions started a process of absolute divergence in terms of per capita GDP, process that still continues, although at a slow pace.

Within distribution income mobility also shows an interesting activity. States in the North, closer to the US border, moved from being categorized as "falling-behind" regions during the period 1970-1985, to be considered as "winners" during the period 1985-1999. Southern states, in opposition, moved from being considered as "catching-up" regions in the first period, to be "loser" in the period of liberalization. These results are similar to findings in other developing countries under economic reforms, e.g. in China, where differences between coastal and interior areas have increased due to globalisation and economic liberalization.

Flows of migration have played an important role in determining convergence among states, and the evidence shows that states with higher per capita GDP at the beginning of any period have higher interregional rates of net migration, while states with lower per

capita GDP have negative net interregional migration rates. These flows, however, have changed from the 1970s and beginning of the 1980s from Mexico City (winner area, but extremely congested) and surrounding areas, to be directed to the northern states (winner states).

The increasing disparities suggests there is an open door for implementation of central public policies towards building local capacities for development and seeking the reduction of local components of inequality. Aspects such as human capital, public investment and export promotion could be considered. Human capital requires especial attention in an environment dominated by free trade as it may act as the cornerstone for innovation, which has been considered one of the main roads to development. Other policies cannot be dismissed given that building local capacities requires of long time and a coordinated and well-focused regional policy.

NOTES

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1 Esquivel [2000] calculated per capita GDP per state since 1940, but he used unofficial sources for his calculations.

2. Including Campeche and Tabasco in the sample the ration maximum/minimum in terms of per capita GDP is 5.5 in 1970, 12.5 in 1985 and 6.13 in 1999.

3. States were grouped in zones as follows: North includes Baja California, Coahuila, Chihuahua, Nuevo Leon, Sonora and Tamaulipas; Centre-North includes Aguascalientes, Baja California Sur, Colima, Durango, Jalisco, Nayarit, San Luis Potosi, Sinaloa, and Zacatecas; Centre includes Distrito Federal, State of Mexico, Morelos, Puebla, Queretaro, Michoacan, Guanajuato, Hidalgo, Tlaxcala and Veracruz; South includes Chiapas, Guerrero, Oaxaca, Quintana Roo and Yucatan.

4. In example Barro and Sala-i-Martin [1995] reported a coefficient of 0.0174 for the US regions in the period 1880-1990, and a coefficient of 0.0279 for the Japanese prefecture during the period 1930-1990. Sala-i-Martin [1996a] reported significant coefficients for different samples, e.g. for Germany 0.014 during 1950-1990; for the United Kingdom 0.020 during 1950-1990; for France 0.016 during 1950-1990; for Spain 0.021 during 1950-1987. Jian, Sachs and Warner [1996] reported a significant coefficient of 0.020 for China during 1978-1993, while Yao and Zhang [20029 report a beta of –0.39 with geographical dummies during the period 1978-1995. We only mention few studies as the amount of published research on the topic during the last years has been high and it is impossible to mention all of them.

5. Regions with higher than the average growth and higher than the average initial per capita GDP can be categorised as “winners”. Regions with less than the average initial

per capita GDP but higher than the average rates of growth are classified as "catching-up" areas. Regions with less than the average in both variables are "losers". Finally, regions with higher than average initial per capita GDP, but lower than the average rates of growth can be catalogued as "falling-behind" regions.

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