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Club convergence and inter-regional inequality in Mexico, 1940–2015

Alfonso Mendoza-Velázquez^a, Vicente German-Soto^b, Mercedes Monfort^c and Javier Ordóñez^d

^aCentro de Investigación e Inteligencia Económica (CIIE), Universidad Popular Autónoma del Estado de Puebla (UPAEP), Puebla, Mexico;

^bAutonomous University of Coahuila, Faculty of Economics, Unidad Camporredondo, Edificio “E”, Planta Baja, Saltillo, Coahuila, México;

^cInstituto de Economía Internacional, Universitat Jaume I, Castellón, Spain; ^dInstituto de Economía Internacional and INTECO, Universitat Jaume I, Castellón, Spain

ABSTRACT

In this paper, we analyse the convergence patterns in inter-regional inequality and income per capita for the Mexican states over the period 1940–2015. To that end, we apply a time-series approach considering temporal and transitional heterogeneity. Results indicate that Mexican states do not converge to the same long-run equilibrium. Instead of overall convergence, we find club convergence for both regional inequality and income per capita. The existence of clubs means that measures aimed at reducing income inequality and promoting regional growth should consider the specific characteristics revealed in the convergence analyses. Furthermore, pro-growth regional policies in Mexico may not necessarily reduce inter-regional income inequality. Income disparities thus need to be specifically addressed through pro-poor regional policies.

KEYWORDS

Club convergence; income per capita; regional inequality; Mexico

JEL CLASSIFICATION

C33; C80; D63; R11

1. Introduction

The neoclassical growth models originally set out by Solow (1956) and Swan (1956) predict conditional income convergence. In this theoretical framework, convergence occurs when the growth rate of an economy is positively related to the distance between said economy's level of income and its own steady state. Bénabou (1996) points out that the neoclassical growth model predicts convergence in income per capita not just in the first moment, the mean, but also in higher moments, such as the variance. According to this author,

“Once augmented with idiosyncratic shocks, most versions of the neoclassical growth model imply convergence in distribution: countries with the same fundamentals should tend towards the same invariant distribution of wealth and pretax income.” (Bénabou 1996, 51).

This means that the neoclassical growth models predict convergence not only in income per capita but also in income inequality. There is far less literature on the latter concept of convergence, although several authors have analysed regional income inequality convergence (Ravallion 2003; Ezcurra and Pascual 2005; Panizza 2002; Gomes 2007; Tian et al. 2016; Monfort, Ordóñez, and Sala 2018).

Convergence in income level and its distribution are closely related. Quah (1996) explores the link between convergence in income per capita and income distribution, concluding that economic convergence is not just about the aggregate level of income but also how this income is distributed across countries or regions. According to this author, what matters for convergence is the relative performance of poor and rich economies or, in other words, how economic progress occurs differently in poorer economies than in richer ones. The traditional question about convergence between rich and poor countries (or regions) needs, therefore, to be re-specified in terms of convergence between poorer and richer economies, and between high and low inequality economies.

Thus, according to Quah (1996), for economic convergence to be observed, two mechanisms need to be in place: the *growth mechanism*, whereby agents in an economy push back technological and capacity constraints; and the *convergence mechanism*, through which poorer economies catch up with richer ones. It can be concluded that the prediction of convergence made by the neoclassical growth model holds when (a) poor economies grow faster

than rich ones (*growth mechanism*) and (b) within-country (or regional) income inequality falls in countries (regions) with initially high inequality (*convergence mechanism*). Importantly, as pointed out by Quah (1996, 2), 'the two mechanisms – pushing back and catching up – are related, but logically distinct: one can occur without the other.' This means that although similar convergence patterns can be observed in income per capita and inequality across economies, it is not possible to infer any causal link between these two processes.

In this paper, the predictions on convergence made by the neoclassical growth model are tested on the Mexican regions by examining income per capita as well as the distribution of regional incomes, as suggested by Quah (1996) and Rey and Janikas (2005), among others. To the best of our knowledge, it is the first time that both kinds of convergence have been tested for a developing country, although there have been some previous attempts to integrate the literature on convergence and inequality (Sala-i-Martin 2002; Epstein, Howlett, and Schulze 1999; Quah 2002) as well as to examine the link between growth and inequality (Bénabou 1996). Traditionally, due to a lack of data, analysis of inequality convergence has been based on the use of certain measures of income per capita. However, using such measures to test inequality convergence can be misleading since, as stated above, convergence in inequality and income level, although related, are distinct. This is one of the few studies comparing regional inequality and the rates of convergence in emerging markets.

We use regional rather than country data since this eliminates most of the data-related, structural, or institutional factors explaining the differences observed between empirical studies on convergence. Although differences in technology, preferences, and institutions do exist across regions, they are likely to be smaller than differences across countries (Barro and Sala-i-Martin 2004). Regions within a country tend to have access to similar technologies, have roughly similar tastes and culture, and share a common central government and a similar institutional and legal setup. This relative homogeneity means that regions are more likely to converge to similar steady states.

There are several reasons for using data on Mexican regions. First, Mexico has one of the highest inequality rates of any OECD country. Second, its

economy has undergone several political, economic, demographic, and institutional changes affecting both regional inequality and incomes. Third, inequality trends have been substantially different from those observed in other developing countries. And, fourth, the internationalization of the economy, a factor that is often proposed as an explanation of inequality, might have had heterogeneous effects on the different regions since not all regions participate equally in the globalization process. All these factors make Mexico a natural experiment for analysing inequality.

Regional inequality in Mexico has been almost entirely neglected in the literature. A very recent exception is Mendoza-Velázquez, Ventosa-Santaulària, and German-Soto (2019). These authors apply the concept of stochastic convergence to test inter-regional inequality convergence in Mexico. Using a battery of unit root tests, the authors conclude that most regions either diverge or are catching up. Leaving aside data snooping issues, this method presents some potential drawbacks. First, unit root tests provide misleading results if the data contain transitional dynamics (or combine both steady states and transitional dynamics). Second, if more than one equilibrium exists, these tests fail to detect convergence (Apergis, Christou, and Miller 2012). To overcome these issues, in this paper we use the club convergence methodology proposed by Phillips and Sul (2007, 2009), which accounts for heterogeneous transitional dynamics and does not rely on any assumption about the stationarity of the data but allows for multiple equilibria. In this regard, our results complement those of Mendoza-Velázquez, Ventosa-Santaulària, and German-Soto (2019).

To analyse convergence patterns in income and inequality in income distribution across Mexican regions, we test the hypothesis of club convergence for both regional real Gross State Product (GSP) per capita, as a proxy for income, and our measure of the inter-regional distribution of incomes. Through the concept of club convergence, we can examine the possibility that some regions in Mexico may have sluggish economic growth, limiting their ability to catch up with the rest of the regions, which are achieving a higher steady state. If all Mexican regions are in the same state of development, they should all converge to the same steady state.

The existence of club convergence would indicate varying degrees of output growth in the different Mexican regions. From a policy point of view, with respect to both implementation of pro-growth policies and better income distribution at a national scale, is important to establish which regions register similar levels of economic growth and, also, of inequality. The analysis of convergence in income inequality is of paramount importance since the traditional approach to convergence, which focuses only on the growth mechanism, ‘cannot at all address the concerns of policy-makers interested in regional development, economic and geographical redistribution, and comparative economic performance’ (Quah 1996, 3).

The remainder of this paper is organized as follows. Section II discusses regional inequality patterns and our measure of inter-regional distribution. Section III presents the convergence methodology. Section IV shows the results, and the final section concludes.

II. Patterns of regional inequality in Mexico

The lack of data has severely limited the research on regional inequality in Mexico. Szekely (2005), López-Calva and Szekely (2006) and German-Soto and Chapa-Cantú (2015) have used different measures of inequality based on either the National Survey of Household Income and Expenditure (ENIGH by its initials in Spanish) or the Human Development Index (HDI). However, samples are small and not available at regional levels. While the literature on convergence has focused on the longitudinal issue of whether poor economies catch up with rich economies, the study of inequality has mostly been based on the use of cross-sectional data to examine income differences. In this paper, we use a novel measure of inter-regional inequality in Mexico based on homogeneous and comparable information on per capita GSP constructed by German-Soto (2005), and on the economic distance concept derived from the Euclidean Norm Index (ENI) proposed by German-Soto (2016) for the Mexican states.¹ Using GSP as input, the ENI is a measure of the economic distance of one region

with respect to all other regions that make up the regional system. Therefore, it provides a measure of the inter-regional distribution of income and its evolution over time. Note that this index is different from the traditional inequality indexes available in the literature (Gini, Theil, or Atkinson, among other measures). A novel feature of using the ENI in the analysis of regional inequality is that it enables an assessment of the change in the income distribution of a given region over time; it is thus particularly well-suited to the analysis of convergence. Economic distance, as a measure of income distribution, has previously been suggested by other authors, such as Dagum (1980), Shorrocks (1982), and most recently by Peng, Bu, and Wang (2010). This is a new exploratory technique, which is useful for generating hypotheses about the underlying dynamics of a particular economic system. The ENI is also a natural unit of analysis of inter-regional income distribution, as envisaged by Rey and Janikas (2005).

The income vector space, the ENI index

The income vector space proposed by German-Soto (2016) centres on the idea that the national economy, comprising N regions, can be considered as Euclidean space of N -vectors, where the set of regions shapes the vectors. The Euclidean longitudinal properties apply to any variable measured in real numbers, such as the regional incomes. It is a non-negative variable that tends to zero as the distances become smaller, and is equal to zero in the hypothetical case of absolute equality. It is symmetrical, and all components of the vector space are considered in the calculation.²

Let X be the regional income per capita. The ENI index ($D_{i,t}$), calculated for region i , in time t , is defined as:

$$D_{i,t} = ||X_{i,t} - X_{j,t}|| = \sqrt{\sum_{j=1}^{32} (x_{i,t} - x_{j,t})^2} \quad \forall$$

$$j = 1, 2, \dots, 32 \quad (1)$$

when $i = j$ ENI is equal to zero. Note that the right-hand side of Equation (1) sums the squared differences on j , so the square root weights the

¹See also German-Soto (2019) for additional information on the construction of this index.

²See German-Soto (2016) for a discussion of how this index satisfies the standard properties of inequality measures.

differences in the income distribution only for the i th region. The calculation of Equation (1) for each region, at each time t , generates a path of the regional distribution dynamics.

German-Soto (2016) demonstrates that besides fulfilling the Euclidean norm properties, this index, when applied to regional income series, reflects the degree of inter-regional distribution of income and its changing pattern across time and space. German-Soto (2016) also shows that, in the Mexican case, this measure significantly correlates with social well-being, a feature highly consistent with theoretical expectations of inequality indexes.

Analysis of Mexican inter-regional inequality

German-Soto (2016) notes that states in the northern and central regions of Mexico show the highest levels of income per capita, along with the oil-rich states of Tabasco and Campeche in the south. He also notes that regional income distribution is heterogeneous and time variant. Analysing the regional output gap in Mexico, Gómez-Zaldívar (2012) also reports non-homogeneous production dynamics.

We now examine the inter-regional inequality index for each Mexican state for the period 1940–2015. There are 32 states in Mexico, each with diverse economic and social dynamics.

Figure 1 below shows the pattern of inequality for Mexican states at four different points in time: 1940, 1982, 2010, and 2015.

Figure 1 depicts the states with higher inter-regional income inequality in dark shades and states with lower inter-regional income inequality rates in lighter tones. The ENI reveals that states with the highest and lowest levels of income are also the most unequal, while states with levels of income close to the mean tend to register smaller inequality values, as would be expected from the theory. Figure 1 shows this pattern of inequality for four years of the overall period. First, in 1940, at the beginning of the analysis, Mexican states are strongly heterogeneous, and this heterogeneity is quite closely linked to the geographic location: inequalities are observable in the north, centre and south of the country. Second, up until the early eighties, the inequalities in these geographical areas gradually diminish, mainly in the north and central areas. In 1982, we observe more states depicted in light tones, suggesting a relative reduction of the regional inequalities. By 2010, regional differences are once again marked and very similar to those of the 1940s. The evolution of inequality seen here, where it declines before increasing, is similar to that identified and analysed by Carrion-i-Silvestre and German-Soto (2007), where, over 70 years, inequalities first decreased and then

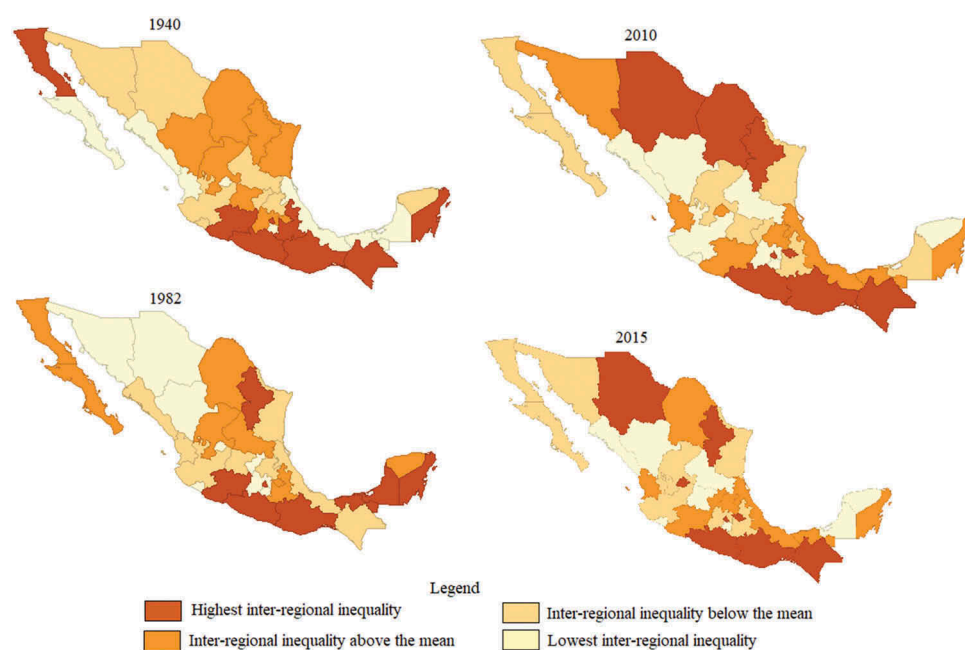


Figure 1. Quantile map of inter-regional inequality: 1940, 1982, 2010, and 2015.

Source: authors' own elaboration from GeoDa software.

increased. Figure 1 also reveals that some of the southern states with the lowest levels of income (Chiapas, Guerrero, and Oaxaca) report high inequality indexes, while other northern and central states with high levels of income (Aguascalientes, Baja California, and Distrito Federal), also report high inequality indexes. The pattern of inequality in the northern and central states shows frequent changes in terms of inequality, while southern states register almost no variation.

III. Methodology: the Phillips and Sul convergence analysis

The time-series approach to the study of convergence can be found in the seminal papers by Carlino and Mills (1993) and Bernard and Durlauf (1995), Bernard and Durlauf (1996). These authors developed the concept of stochastic convergence, based on the stationarity properties of the variables under analysis. Thus, two non-stationary variables converge if there is a cointegrating relationship between them. In other words, two non-stationary series converge if they share the same stochastic trend.

This definition of convergence can be empirically tested using time-series econometric techniques. However, as pointed out by Phillips and Sul (2009), traditional convergence tests are not appropriate when the speed of convergence is time-varying. To account for temporal and transitional Phillips and Sul (2007, 2009) introduced cross-sectional and time-series heterogeneity in the parameters of a neoclassical growth model. Heterogeneity is formulated as a non-linear time-varying factor model providing flexibility in idiosyncratic behaviour over time and across sections. The model retains some commonality across the panel, meaning that when the heterogeneous time-varying idiosyncratic components converge over time to a constant, panel convergence holds. These features of the model make it particularly suitable in the case of Mexico. Regions in Mexico that differ in terms of the respective sizes of their economies and populations may appear to follow a similar growth path but at different speeds; thus,

they may currently be at different stages on that path. Also, although technology is widely available for the common good, differences in the ability to use and learn the technology may mean that, at best, the poor provinces converge slowly to the common steady state path. The starting point of the test is a simple factor model:

$$X_{it} = \delta_{it}\mu_t \quad (2)$$

where δ_{it} is a time-varying factor-loading coefficient and measures the idiosyncratic distance between some common factor μ_t and the systematic part³ of X_{it} .

The simple econometric representation in (2) can be used to analyse convergence by testing whether the factor loadings δ_{it} converge. Phillips and Sul (2007) proposed modelling the transition elements δ_{it} by constructing a relative measure of the transition coefficients:

$$h_{it} = \frac{X_{it}}{\frac{1}{N} \sum_{i=t}^N X_{it}} = \frac{\delta_{it}}{\frac{1}{N} \sum_{i=t}^N \delta_{it}} \quad (3)$$

which measures the loading coefficient δ_{it} in relation to the panel. The variable h_{it} is called the relative transition path and traces out an individual trajectory for each i relative to the panel average. So, h_{it} measures region i 's relative departure from the common steady-state growth path μ_t .

To formulate a null hypothesis of convergence, the authors proposed a semiparametric model for the time-varying behaviour of δ_{it} as follows:

$$\delta_{it} = \delta_i + \frac{\sigma_i \xi_{it}}{L(t)t^\alpha} \quad (4)$$

where δ_{it} is fixed, $\sigma_i > 0$, ξ_{it} is i.i.d (0,1) across i but weakly dependent on t , and $L(t)$ is a slowly varying function for which $L(t)$ tends to infinity as t goes to infinity.⁴ Following Phillips and Sul (2007), the $L(t)$ function is assumed to be $\log t$. ξ_{it} introduces time-varying and region-specific components to the model. The size of α determines the behaviour (convergence or divergence) of δ_{it} . This formulation ensures convergence of the parameter of interest for all $\alpha \geq 0$, which is the null hypothesis

³The systemic part contains both a constant and a time trend.

⁴These conditions imply that the stochastic component declines asymptotically so that the trend vanishes, and each coefficient converges to δ .

of interest since $\delta_{it} = \delta$ as $t \rightarrow \infty$. Furthermore, if this hypothesis holds and $\delta_i = \delta_j$ $i \neq j$, the specification in (4) still allows for transitional periods in which $\delta_{it} \neq \delta_{jt}$, thereby incorporating the interesting possibility of transitional heterogeneity or even transitional divergence across i . Thus, the null hypothesis of convergence can be written as:

$$H_0: \delta_i = \delta \text{ and } \alpha \geq 0 \quad (5)$$

and the alternative:

$$H_A: \delta_i = \delta \text{ for all } i \text{ with } \alpha < 0 \quad (6)$$

or

$$H_A: \delta_i \neq \delta \text{ for some } i \text{ with } \alpha \geq 0, \text{ or } \alpha < 0 \quad (7)$$

The alternative hypothesis includes divergence, as in (6) and (7), but can also consider club convergence. For example, if there are two convergence clubs, the alternative is:

$$H_A: \delta_{it} \rightarrow \begin{cases} \delta_1 \text{ and } \alpha \geq 0, & \text{if } i \in G_1 \\ \delta_2 \text{ and } \alpha \geq 0, & \text{if } i \in G_2 \end{cases} \quad (8)$$

where G stands for a specific club.

Phillips and Sul (2007) show that these hypotheses can be statistically tested by means of the following 'log t ' regression model:

$$\log(H_1/H_t) - 2 \log L(t) = \hat{c} + \hat{b} \log t + u_t \quad (9)$$

for $t = [rT], [rT]+1, \dots, T$ with an $r > 0$, and $\log(H_1/H_t)$ is the cross-sectional mean square transition differential and measures the distance of the panel from the common limit. Phillips and Sul (2007) suggest $r = 0.3$ based on their simulation experiments.

The regression test of convergence in (9) is made up of four steps (Phillips and Sul 2009, 1170). In the first step, individuals are sorted in the panel in decreasing order according to the observations in the last period. If there is substantial time series volatility in the data, the sorting can be based on the time-series average of the last $[rT]$ observations, with $r = 1/2$ or $1/3$. The second step consists of the formation of the core group of k^* countries. In this step, the first subgroup of k individuals (or G_k) is selected by running the log t regression and calculating the convergence

test statistic t_k for this subgroup. Once the first k highest individuals in the panel have been selected, the core group of size k^* is obtained by maximizing t_k over k according to the criterion $k^* = \arg \max_k$ subject to $\min \{t_k\} > -1.65$. In the third step, the individuals in the panel not included in the first core group are added one at a time to the core group with k^* member and the log t -test is run again. The individual in question should be included in the convergence club if the associated t -statistic is greater than the critical value c . In the last step, a subgroup is formed with the remaining individuals which do not meet the criterion for inclusion in step three. The log t -test is performed for this group. If the statistic is greater than -1.64 , this subgroup forms another convergence club. Otherwise, steps 1 to 3 are repeated to see if this second subgroup can itself be subdivided into smaller convergence clusters.

The novel aspect of this approach is that convergence patterns within groups can be examined using log t regressions, that is, the existence of club convergence and then clustering. This is particularly relevant since the rejection of the null of convergence does not necessarily imply divergence; it could in fact indicate several different scenarios, such as separate points of equilibrium or steady-state growth paths, as well as club convergence and divergent regions in the full panel.

The approach proposed by Phillips and Sul (2007) presents clear benefits. First, it is a test for relative convergence as it measures convergence to some cross-sectional average, in contrast to the concept of level convergence analysed by Bernard and Durlauf (1996). Second, this approach outperforms the standard panel unit root tests since with the latter $X_{it} - X_{jt}$ may retain nonstationary characteristics even when the convergence condition holds, in other words, panel unit root tests may classify the difference between gradually converging series as non-stationary. As a further problem, a mixture of stationary and non-stationary series in the panel may bias results. Moreover, results of the tests are sometimes not particularly robust. In contrast, the Phillips and Sul (2007) test does not depend on any particular assumption

concerning trend stationarity or stochastic non-stationarity of the variables to be tested.⁵

IV. Results

Results from equation (1), the inter-regional distribution of incomes, are reported in Table 1, with estimates of b and $\log t$ from equation (9). According to our results, overall convergence can be rejected in favour of club convergence, with two clubs. From a methodological point of view, our results highlight the need to use methods that allow for multiple steady states as otherwise we may end up wrongly concluding that there is an overall lack of convergence.

Figure 2 provides a geographical reference for the regions in Mexico. Our measure of inter-regional inequality assigns the states of Aguascalientes, Campeche, Chiapas, Chihuahua, Ciudad de México (Distrito Federal), Guerrero, Nayarit, Nuevo León, Oaxaca, Quintana Roo, and Veracruz to the first inequality convergence club. A common feature of the Mexican states in this first club is that they show the highest inter-regional inequality rates. This is the club that contains the most widely differing inter-regional inequality rates. In particular, the states of Ciudad de México (Distrito Federal), Oaxaca, and Nuevo León show the highest rates of inter-regional inequality; within the first convergence club, these states register a higher income distance than the others. Of all the states in this first club, Campeche

has the greatest variability of inter-regional inequality (oil production seems to be the main reason).

The second convergence club shows both lower rates of inter-regional inequality and more homogeneous behaviour. It includes states with an income level close to or above the mean, which are generally located at the north and the centre of Mexico: for example, Baja California, Baja California Sur, Coahuila, and Sonora, in the North; and Guanajuato, Hidalgo, Morelos, México, Puebla, and Querétaro, in the central region.

The identification of two inter-regional inequality convergence clubs reflects the heterogeneous development of regions in Mexico, shaped by the persistent occurrence of recessions as well as specific economic, social, and even political factors leading to different dynamics in the two groups of Mexican states.

Given that the clustering procedure tends to find more groups than may actually exist – although it does not seem to be the case in our analysis – we have tested whether adjacent clubs can be merged into larger groups. Table 2 shows the results; the test rejects the merging of the clubs.

To further investigate the regional convergence behaviour, Table 3 and Figure 3 present the results on club convergence in income per capita. This analysis allows us to investigate whether regions with high levels of inter-regional inequality display different growth patterns from those with low levels of inequality (Rey and Janikas 2005).

The regions are, once again, clearly divided into two clubs. The first convergence club of GSP per capita contains the states with the highest levels of development, namely, Aguascalientes, Baja California, Baja California Sur, Chihuahua, Coahuila, Ciudad de México, Guanajuato, Jalisco, Nuevo León, Querétaro, Sonora, and Tamaulipas. The second convergence club includes Chiapas, Guerrero, Hidalgo, Michoacán, México, Nayarit, Oaxaca, Puebla, Sinaloa, Tabasco, Tlaxcala, Veracruz, and Yucatán, mainly characterized by low levels of development.

As shown in Figure 3, GSP per capita convergence clubs show clearer patterns of geographical distribution. Additionally, as with the regional

Table 1. Tests for convergence in inter-regional inequality.

	<i>First cluster</i>	
	<i>b coefficient</i>	<i>t statistic</i>
$\log t$	0.480 (0.050)	9.523***
First cluster: Aguascalientes, Campeche, Chiapas, Chihuahua, Ciudad de México, Guerrero, Nayarit, Nuevo León, Oaxaca, Quintana Roo, and Veracruz.		
	<i>Second cluster</i>	
	<i>b coefficient</i>	<i>t statistic</i>
$\log t$	0.058 (0.032)	1.759**
Second cluster: Baja California, Baja California Sur, Coahuila, Colima, Durango, Guanajuato, Hidalgo, Jalisco, Michoacán, Morelos, México, Puebla, Querétaro, San Luis Potosí, Sinaloa, Sonora, Tabasco, Tamaulipas, Tlaxcala, Yucatán, and Zacatecas.		

Standard errors in parentheses. ** and *** indicate significance at the 5% and 10% level, respectively.

⁵The Phillips-Sul methodology is based on the neoclassical growth model; it is therefore well-suited to testing the predictions of the model (convergence in both income per capita and its distribution). Furthermore, Bénabou (1996) suggests that the same tests, which are standard in the literature on convergence of income per capita, should be used to test for income inequality convergence.

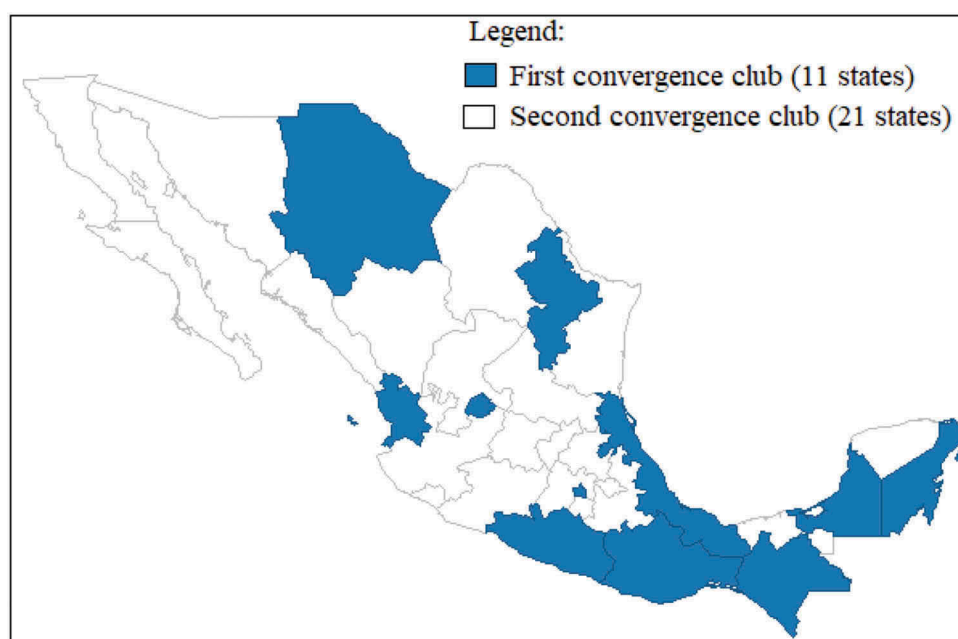


Figure 2. Club convergence with inter-regional inequality.

Source: authors' own elaboration from GeoDa software.

Table 2. Club merging test: inter-regional inequality and GSP per capita.

Clubs	b coefficient	t statistic
<i>Inequality</i>		
Club 1 + Club 2	−0.591 (0.056)	−10.531
<i>GSP per capita</i>		
Club 1 + Club 2	−0.480 (0.110)	−4.341

Standard errors in parentheses. ** and *** indicate significance at the 5% and 10% level, respectively.

Table 3. Tests for convergence in income per capita (GSP).

	b coefficient	t statistic
<i>First cluster</i>		
log t	0.115 (0.014)	8.341***
First cluster: Aguascalientes, Baja California Norte, Baja California Sur, Campeche, Chihuahua, Coahuila, Colima, Ciudad de México, Durango, Guanajuato, Jalisco, Morelos, Nuevo León, Querétaro, Quintana Roo, San Luis Potosí, Sonora, Tamaulipas, and Zacatecas.		
	b coefficient	t statistic
<i>Second cluster</i>		
log t	0.746 (0.047)	15.763***

Second cluster: Chiapas, Guerrero, Hidalgo, Michoacán, México, Nayarit, Oaxaca, Puebla, Sinaloa, Tabasco, Tlaxcala, Veracruz, and Yucatán.

Standard errors in parentheses. ** and *** indicate significance at the 5% and 10%, level respectively.

inequality case, we test whether convergence clubs 1 and 2 can be merged. Results reported in the

bottom half of Table 2 indicate that this is not possible.

Our empirical results point to a first important conclusion: the composition of the convergence clubs for regional inequality differs from that of the clubs found for GSP per capita. For instance, while the states of Chiapas, Guerrero, Nayarit, Oaxaca, and Veracruz are classified in the first regional inequality convergence club, they do not appear in the first convergence club in terms of GSP per capita. Similarly, another 13 Mexican states grouped in the first convergence club of GSP per capita are not in the first convergence club in terms of regional inequality. Only six states appear in the first convergence club for both GSP per capita and income inequality, namely, Aguascalientes, Campeche, Chihuahua, Ciudad de México, Nuevo León, and Quintana Roo. Likewise, only eight states are classified in the second convergence club for both GSP per capita and income inequality. A first policy insight from this result would be that the design of regionally-targeted measures to promote growth should be different from the regionally-targeted programmes aimed at reducing inequality.

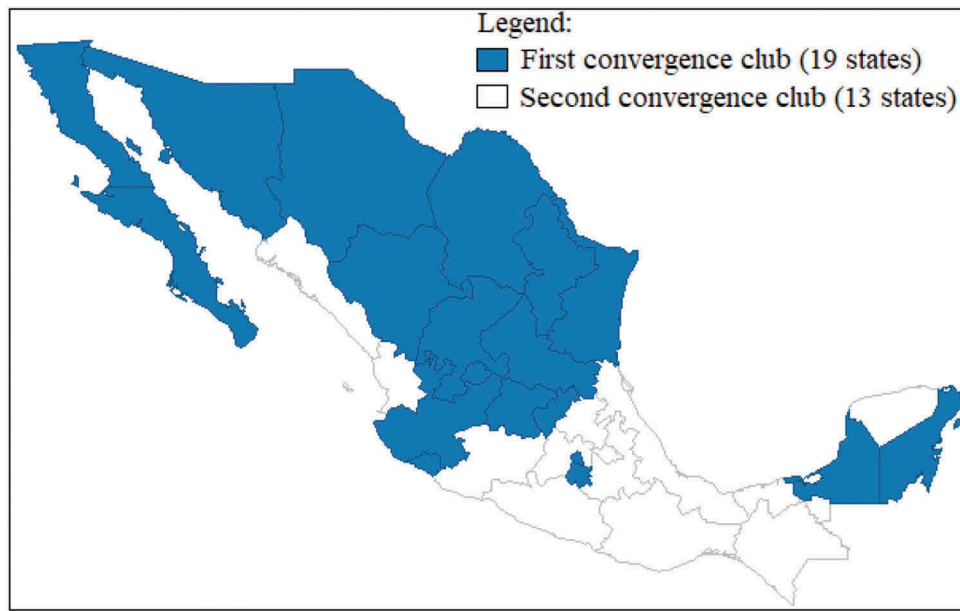


Figure 3. Club convergence with GSP per capita.
Source: authors' own elaboration from GeoDa software.

The complete distribution of states by convergence clubs is shown in Table 4. Note that rows show the two convergence clubs by regional inequality, while the columns show the two convergence clubs of economic development measured by GSP per capita. The totals at the bottom of columns and the ends of rows show the number of states in the column/row in question and the percentage share with respect to the total number of states in Mexico (32).

Quadrant I (first row, first column) contains six states with high inter-regional inequality together with a high level of development. These six states represent 19% of all states in Mexico. Quadrant II (first row, second column) shows five states with high regional inequality together with low levels of development (5 states, 16%). States in quadrant II show the greatest dissimilarity from the rest of the regions in Mexico, and low income levels. It is not surprising to find some of the poorest states in Mexico in this second cell. In turn, quadrant III (second row, first column), which contains 13 states with low rates of regional inequality and high levels of development, comprises the largest club (13 states, 41%). That is, the largest group of states (as measured by the ENI index) corresponds to the states that are least dissimilar from the rest and have a relatively high level of economic development. Finally, quadrant IV (second row, second column) contains eight

states with low levels of dissimilarity, together with low levels of economic development, representing a quarter of the total sample (8 states, 25%). Overall, the table shows that 66% of the states in Mexico (21 states) have low levels of regional inequality, i.e., low levels of dissimilarity from the rest of the states, while 59% of the states (19 states) show a relatively high level of income.

Useful economic policy insights can be derived from the results. It is evident that regions with high levels of inequality display different growth patterns from those regions with low levels of inequality. Pervasive regional economic disparities in inequality and income per capita pose a great challenge to social cohesion and economic stability and may reveal an inefficient and unsustainable development strategy. In the presence of a persistent gap in regional income and inequality, permanent fiscal transfers from rich to poor states can reinforce these differences instead of promoting economic convergence. The convergence clubs found in this study indicate that measures aimed at reducing income inequality and promoting regional growth should consider the specific characteristics revealed in these analyses. The low correspondence shown in most cases between the convergence clubs highlights that the structural economic forces that give rise to the two convergence clubs in terms of GSP

Table 4. Distribution of states by clusters: income and inequality.

		Income per capita (GSP) convergence club		Total
		Club 1 (high income)	Club 2 (low income)	
Inequality convergence clubs		<i>I. Highly dissimilar and High-Income</i>	<i>II. Highly dissimilar and Low-Income</i>	
	Club 1 (high dissimilarity)	Aguascalientes, Campeche, Chihuahua, Ciudad de México, Nuevo León, Quintana Roo (6 states, 19%)	Chiapas, Guerrero, Nayarit, Oaxaca, Veracruz (5 states, 16%)	(11 states, 34%)
		<i>III. Similar and High-Income</i>	<i>IV. Similar and Low-Income</i>	
	Club 2 (low dissimilarity)	Baja California, Baja California Sur, Coahuila, Colima, Durango, Guanajuato, Jalisco, Morelos, Querétaro, San Luis Potosí, Sonora, Tamaulipas, Zacatecas (13 states, 41%)	Hidalgo, Michoacán, México, Puebla, Sinaloa, Tabasco, Tlaxcala, Yucatán (8 states, 25%)	(21 states, 66%)
	Total	(19 states, 59%)	(13 states, 41%)	(32 states, 100%)

Note: shown in parentheses in each cell are the number of states in the club and as a share of all 32 states in Mexico. Numbers at the end of columns and rows are the sum of all states in the column/row in question.

Source: authors' own estimates.

per capita differ from those formed by regional inequality in Mexico.

V. Concluding remarks

Although convergence in income per capita and its distribution may be closely related, one can occur without the other, which means it is not possible to infer any causal link between these two processes (Bénabou 1996; Quah 1996; Rey and Janikas 2005).

In this paper, we test the predictions of the neoclassical growth model by examining regional inequality and income per capita convergence for the Mexican states over the period 1940–2015. This analysis is very relevant for Mexico, a country which has among the highest levels of income inequality of any OECD nation, and which is currently undergoing several socio-economic and institutional changes, with different degrees of regional growth. The convergence method employed in this paper allows us to identify regional club convergence by accounting for income and growth heterogeneity in a non-linear time-varying framework.

The finding of two convergence clubs for GSP and two for regional inequality suggest that there are different forces driving development and inequality in Mexican regions. In terms of policy, this means that measures aimed at reducing income inequality and promoting regional growth should distinguish between the particular patterns of four specific types of Mexican regions and take into account the specific

characteristics revealed in the club convergence analysis. Pro-growth regional policies in Mexico may not necessarily reduce inter-regional income inequality and, therefore, income disparities need to be specifically addressed through pro-poor regional policies.

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ORCID

Vicente German-Soto  <http://orcid.org/0000-0001-5844-1296>

Mercedes Monfort  <http://orcid.org/0000-0002-0614-5716>

Javier Ordóñez  <http://orcid.org/0000-0002-1453-2441>

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