REGIONAL CONVERGENCE, INFRASTRUCTURE, AND INDUSTRIAL DIVERSITY IN MEXICO

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ABSTRACT

This paper introduces a convergence analysis of productivity growth in the manufacturing sector in Mexico using regional data from the National Economic Census 1999 and 2004. The absolute convergence analysis indicates that regional productivity growth follows a slow convergence trajectory. However, a conditional convergence analysis indicates that current productivity gaps can be directly attributed to divergences in the industrial profile of the regional economy as well as to differences in infrastructure endowments. The results of the paper suggest that productivity gaps originated by the liberalisation reforms of the 1980s and 1990s will be exhausted in a term of 25 years approximately. The innovation of this paper is the extension of a convergence analysis to the industrial sector. The use of regional data improves the details of the analysis and allows the identification of growth patterns that had not been previously identified. Finally, it applies innovative metrics to model the industrial profile of a region and the value of transport infrastructure.

1. INTRODUCTION

The North American Free Trade Agreement (NAFTA), signed in 1994 was the peak of a liberalisation reform in the Mexican economy that started in the mid 1980s and dramatically transformed the country. In the first 5 years after the NAFTA took effect, between 1995 and 2000, Mexico underwent an average growth rate of 7.8 percent fostered by an incredible growth of its export sector. However, the development process that NAFTA triggered was far from being even across Mexican region.

Between 1995 and 2000 the Border States experienced a growth rate of 7 percent, considerably higher than that experienced by the Southern States, which was on average 3 percent.¹ This behaviour has generated a geographical polarisation of the Mexican economy, which has deep consequences on the social and demographic development of the country as a whole.

In order to investigate the root of this process, this paper analyses the patterns of labour productivity growth for the manufacturing sector in the post-NAFTA era. It uses regional data from the National Economic Census 1999 and 2004 to verify whether productivity gaps in the country are widening or closing up. The empirical analysis estimates an absolute and conditional convergence model using four different econometric approaches, including a spatial autocorrelation model.

The most important result of the analysis is that region productivity growth in Mexico follows a slow convergence trajectory. The present gaps can be directly associated to regional differences in the industrial profile as well as divergences on infrastructure endowments. In particular, the analysis identifies industrial specialisation and accessibility to international markets as the most significant determinants of the conditional convergence model.

¹ This average growth rate corresponds to the states of Chiapas, Guerrero and Oaxaca.
The long-run interregional convergence of productivity growth can be traced back to two factors. The first one is the change in the industrial profile of industrially specialised regions to a more diverse composition, closer to the average national profile. The second factor is that the productivity gains originally generated by the 1980s and 1990s liberalisation reforms have been exhausted. The analysis suggests that transport infrastructure has been able to generate positive spillovers on productivity growth as long as it was complementary to the liberalisation reforms. These results highlight the importance of infrastructure policy as a tool for achieving an even development process at regional level.

The paper is organised as follows: section 2 presents a literature review, section 3 shows the results of the empirical analysis, and finally section 4 present a discussion and some final remarks.

2. BIBLIOGRAPHICAL REVIEW

One of the most important predictions of neo-classical economic growth theory is convergence. This concept implies that if two economies have the same technology, and their economic agents have the same preferences, the initially poorer economy will grow faster in per capita terms.

Barro and Sala-i-Martin (1992) propose a simple empirical framework to test the validity of this prediction. Starting from a standard neo-classical growth model, the authors derive the expression presented in Equation 1.

\[
\log \left( \frac{y_{i,t+T}}{y_{i,t}} \right) = \alpha - \frac{1}{T} \log(y_{i,t}) + \epsilon_{i,t+T} e^{-\beta T}
\]

In Equation 1, \( y_{i,t} \) is an initial per capita income for the economy \( i \), \( y_{i,t+T} \) is income level when \( T \) years have elapsed, \( \epsilon_{i,t+T} \) is a random variable, and \( \alpha \) is a constant. In this expression, \( \beta \) assesses the speed of convergence to a long-run steady state common to all economies. A positive value for this parameter implies absolute convergence, and a negative value suggests that the per capita income diverges across different economies.

Barro and Sala-i-Martin (1992) applied this framework to the analysis of historic US data at state level, finding strong evidence of income convergence. However, when the analysis is extended to an international context it is not possible to get the same result. This puzzle has been tackled with the introduction of conditional convergence. The idea is that the intrinsic parameters that determine the long-run steady state of per capita income –ie technology and preferences- vary across different economies. Therefore, conditional convergence predicts that income per capita will converge given these parameters. In practice, economies that exhibit similar characteristics are expected to converge in their income levels. In fact, this is the case for the developed countries in the OECD (Barro and Sala-i-Martin 1992).

Some of the authors that have analysed convergences for the Mexican case are Chiquiar (2002), Equivel (1999), Equivel and Mesmacher (2002), Garcia-Verdu
(2002), Juan-Ramon and Rivera-Batiz (1996), Mallick and Carayannnis (1994), Messmacher (2000), Rodriguez-Oreggia (2001), Rodriguez-Pose and Sanchez-Reza (2002a), and Rodriguez-Pose and Sanchez-Reza (2002b). These works have shown that, in general terms, per capita income seemed to converge across states until the mid 1980s, when this pattern was broken.

It has been suggested that the divergences in the geographical distribution of income that the literature has identified, can be directly associated with trade liberalisation (Rodriguez-Pose and Sanchez-Reza 2002b). In the mid 1980s Mexican economy started a deep structural transformation, driven by a change in international trade policy. It started precisely in 1986 when the country entered into the General Agreement on Tariffs and Trade (GATT) and culminated in 1994 with the signature of the NAFTA. Some of the works that have analysed growth patterns after the mid 1990s have shown that after NAFTA, the convergence process has not been restored. In fact, there is robust evidence showing that trade liberalisation and membership of NAFTA is connected to a greater geographical polarization.

After Mexico enters into the NAFTA, the national economy experiences an outstanding boost of its exportation sector. For example, between 1993 and 2000, the share of non-oil exports in the gross domestic product increased from 13 to 38 percent. This improvement has been driven by the export-orientated manufacturing sector. However, the distribution of these improvements has not been even across the country. Actually, the empirical literature shows that the states that are closer to the US market have benefited more from the structural changes in comparison to the the states in the South (Rodriguez-Pose and Sanchez-Reza 2002a).

An illustration of this point is one of the most successful exportation programmes in Mexico: the maquiladora industry. This programme entitles special customs treatment to the export-orientated firms. It is based on the assembling and manufacturing of final products using temporarily imported raw materials and intermediate goods. The program gives tax exception to intermediate goods imported from the US and Canada, which are the main destinations of production. The gross product of the maquiladora sector in 2003 represented 59 percent of the total manufacturing product and up to 99 percent of the production was exported.

The importance of the maquiladora industry in Mexican exports, its weight in manufactures’ production, and the peculiarities of its spatial distribution, strongly suggest that the polarisation of income levels described in the literature, has been driven by an asymmetric growth of the manufacturing sector.

Physical proximity to the international markets is only part of the explanation of the uneven process of growth. Infrastructure endowments, human capital, and the industrial composition of the economy have been identified as some of the key variables that explain the divergences in growth rates across Mexico. For example, the empirical literature has shown that the states that had sufficient availability of communications and transport infrastructure, a large presence of large firms with export capabilities and a relatively well educated labour force has been more likely to take advantage of the liberalisation reforms that started in the mid 1980s (Chiquiar 2002).
Within a country, the regional differences in institutional factors, such as the legal framework, the rule of law, and definition of property rights might not be significant, given that the country shares these features as a whole political unit. This is a strong argument supporting that the differences in socio-economic determinants, rather than the divergences in institutions are the cause of the regional gaps in income levels.

3. REGIONAL CONVERGENCE IN THE MANUFACTURING SECTOR

This paper applies the methodology of the convergence literature to the analysis of the recent evolution of the manufacturing sector in Mexico. We use data from the National Economic Census in 1999 and 2004 to study the growth pattern of labour productivity -defined as production per worker- during this period. The objective is to verify whether present productivity gaps across the country are widening or closing. The dataset constitutes the most the most updated information about industrial production in the country at local level, covering a period that has not been analysed previously at this geographical level.

Following the limited availability of data, the existing literature has relied on the analysis of state economies. The state-level approach has an important limitation, since it cannot analyse in detail any kind of intra-state divergences. This can be particularly troublesome in the analysis of conditional convergences. The geographic scale effects of variables such as infrastructure might be limited to a local context rather than to a state level. Under this scenario, if the weight of a region in a state is not large enough to be captured by aggregate state data, an analysis might underestimate the real effects of infrastructure.

The National Economic Census provides an exceptional opportunity to analyse growth patterns at local level, since it presents comprehensive information about production at municipal level. However, the direct analysis of municipal data might not be as useful for the study of conditional convergence. For example, the industrial composition of a municipality might not provide useful information, given that a municipality could be interacting strongly with neighbouring locations. In this case, the industrial composition of a region might be a more relevant piece of information. A middle point to tackle this geographical scale trade-off is the use of regional data. We use the National Economic Census to build-up a dataset about manufacturing production at regional level following the regionalisation of Bassols (1993).

3.1. Absolute Regional Convergence

Absolute convergence is analysed using four different econometric models. The first one estimates the non-linear model presented in Equation 1 under a non-linear least squares regression (NLLS). This model assumes the error term $\varepsilon$ is independent of the explanatory variables.

It is worth noting that Equation 1 is intrinsically a linear model. A linear version of this model, as presented in Equation 2, would estimate $\alpha$ and $\beta$ such that it would be possible to recover the original values of the parameters of the non-linear model. In

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2 For a complete description about regionalisation in Mexico see Duran (2007).
fact, the only relevant difference between the estimation of the NLLS model and a linear estimation of Equation 2 is the assumed distribution of their parameters.

Equation (2) \[
\log \left( \frac{y_{i,t}}{y_{i,0}} \right) = \alpha - \beta \log(y_{i,0}) + \varepsilon_{i,t}
\]

The NLLS model assumes that the variance of the error term is constant for all the observations. This could be a restrictive assumption since the number of industrial activities in a particular location varies considerably from region to region. Therefore, we could expect the variance of the model to depend on the relative size of the region. To investigate this possibility the model is estimated using robust maximum likelihood (ML). This estimation considers a Huber-White estimator of variance. The linear model was also estimated using robust OLS. The results are presented for comparison purposes.

The fourth model considers a spatial autoregressive (SAR) error term. A concern in empirical research dealing with small-scale geographic data is the possibility of spatially correlated errors. This possibility arises when the error term is not independent from the errors of the neighbouring observations. In particular, we consider a case where the magnitude of the dependence of the spatially-lagged residuals, decays as a function of an impedance measure among the observations. This relationship is described in the SAR model presented in Equation 3.

Equation (3) \[
\varepsilon_{i,t} = \rho W \varepsilon_{i,t} + u_{i,t}
\]

In this expression, \(\varepsilon_{i,t}\) and \(u_{i,t}\) are independent and identically distributed random variables. \(W\) is a spatial weighting matrix of known constants with rank equal to number of observations, and \(\rho\) is a spatial autoregressive parameter. The elements of \(W\) are assumed to be the inverse of an impedance measure \(d_{i,j}\). For this exercise, it is defined as the time required to travel between any two regions \(i\) and \(j\), following an optimal route on the road network. The optimal routes and travel times were estimated using a GIS model of the Mexican road system presented in Duran (2007). Equation 4 presents the formula used to estimate the elements of the spatial weighting matrix \(W\). The matrix was row-normalised multiplying each row by a constant \(C_j\) such that the sum of \(w_{i,j}\) across \(j\) is equal to 1.

Equation (4) \[
\frac{w_{i,j}}{\sum_j w_{i,j}} = \frac{1}{C_j} d_{i,j}
\]

The SAR error term model is estimated using a generalised moment estimation for the autoregressive parameter (GMSAR) proposed by Kelejian and Prucha (1999). Under this methodology, the autoregressive parameter \(\rho\) and the variance of \(u_{i,t}\) are estimated through a generalised moments estimation, which is based on the residuals of a first-stage OLS regression of Equation 2. The estimated parameters are used to perform a spatial Cochrane-Orcutt transformation of the original model. Finally, the transformed model is used to obtain feasible generalised least squares (FGLS) estimates of the parameters \(\alpha\) and \(\beta\). Kelejian and Prucha (2004) present a method to estimate the
variance of the autoregressive parameter $\rho$. This parameter follows a normal distribution, which allows us to test its significance.

Table 1 presents the results of the estimation of the four models. All the coefficients present a positive sign and are statistically significant at one percent level.\(^3\) The value of the estimated coefficient is robust across the four models. The implicit non-linear $\beta$ of the ML and OLS models is the same as in the NLLS model. The estimation of this parameter under the GMSAR model is also very similar. The estimated value of the autoregressive parameter $\rho$ in the GMSAR model is -0.55 and is statistically significant at one percent level. Therefore, it is not possible to reject the hypothesis of spatially lagged error terms.

The results show that for the analysed period, labour productivity experienced sharper improvements in the regions that were relatively less productive. Under a convergence framework, this implies that interregional productivity gaps tend to reduce. According to these results, the estimated half-life of productivity gaps is 25.7 years. This value can be interpreted as the time that it would take to reduce the present gaps by a half.

### 3.2. Conditional Regional Convergence

The positive convergence in productivity discussed in the previous section, suggests that on average, existing productivity gaps during the period of analysis have been closing up. Nevertheless, this result does not rule out the possibility of finding local divergences of this variable, conditional on certain socioeconomic factors. This possibility is illustrated in Figure 1. In this diagram, there are two types of economies ($U$, $L$) and each of them converges to their own equilibrium. However, the gap between $U$ and $L$ is closing up in time, and in the limit both types will converge to $A$.

In order to investigate this mechanism, we estimate a conditional version of the convergence model. Following the results from the growth literature, the differences between the $U$ and $L$ economies might be characterised by different levels of infrastructure endowments, variations of the industrial profiles and divergences in human capital. Therefore, the conditional model incorporates metrics of these variables to analyse their impact on productivity growth rates during the period of analysis.

Transport infrastructure has been identified as one of the determinants that explain divergences in Mexico’s growth pattern. Nevertheless, given the limited data about the value of infrastructure stock, the literature has relied on poor indicators. In the present study, we introduce a set of attraction-accessibility measures ($AM$) that quantify different dimensions of the value of the road infrastructure.

An $AM$ measures the market potential of a region in function of the structure of a road system, the average speed on each road, the quality and number of lanes of each section of the network, and the relative size of the regions that it articulates. This approach allows identifying international, interregional and local market potential

\(^3\) By construction a positive sign in the model implies convergence, since the models are estimating the value of $-\beta$. 

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separately. Therefore, it is possible to evaluate whether or not a particular dimension of the road infrastructure has an effect on growth convergence.

Equation (2) \[ A_j = \sum_j \frac{p_j}{d_{i,j}^\theta} \]

Equation 2 shows the functional form of the AM used in the present study, where \( p_j \) is population in location \( j \), \( d_{i,j} \) is an impedance measured between location \( i \) and \( j \), and \( \theta \) is a parameter that can be interpreted as the elasticity of the market potential with respect to impedance. The analysis considers three versions of this index. The first one concerns only the interconnection of the national markets, the second one takes into account the international links with the US. Finally, we consider an index based on the average value that the index takes for all the urban settlements in a particular region.

We refer to these indexes as interregional, international, and intraregional accessibility respectively. They are a measure of the market potential of the national, international and local markets. Duran (2007) describes the methodology followed to build these variables in detail.

In addition to the accessibility indexes, the conditional convergence analysis includes a control for the quality of the roads at local level. This variable is defined as the ratio between the length of the optimal routes between \( i \) and \( j \) in a region and the linear distance between them. This network curvature index is a measurement of road quality in any region \( r \) under the assumption that higher quality roads will tend to trace direct linear paths.

Previous literature has proposed that convergence might be conditional on the internal composition of the economy, suggesting that similar economies tend to converge. A conventional approach to prove this statement is to estimate a convergence model under a restricted sample of economies grouped by an ad hoc criterion. For example, Barro and Sala-i-Martin (1992) showed that during the mid 19th Century the historic North and South converged to different income per capita levels. Unfortunately, the identification of a grouping criterion might not be straightforward. In order to solve this problem, we introduce the Shannon Entropy Index (SEI) as a way to model the industrial profile of an economy.

In ecology, the SEI is applied to model biodiversity in an ecosystem. According to this discipline, the diversity of an ecosystem is defined as the variability among living organisms from all sources. The diversity of an ecosystem can be measured by either its species richness or its heterogeneity. The first measure takes into account only the number of species of a given taxonomic group in a given ecosystem. On the other hand, a heterogeneity measures takes into account species richness and the variability in species abundances, defined as evenness (Magurran 2004).

These concepts can be analogously applied to measure the industrial diversity of an economy. The ecological concept of species richness and evenness can be interpreted as an equivalent expression for the industrial range and specialisation in an economic system. These measures would depend heavily on the industrial composition of the
economy so, in principle they are a good metric for the characterisation of unique industrial profiles. The economic analogous of the SEI is presented in Equation 3, where \( p_{i,j} \) can be estimated as the ratio of production of the \( i^{th} \) industrial activity respect to the total.

Equation (3)  
\[ H = -\sum_i p_i \ln(p_i) \]

Heip (1974) shows that the SEI can be decomposed in their richness (\( S \)) and evenness (\( E \)) components as presented in Equation 4. In an economic context, \( S \) is equivalent to the industrial range of an economy. It can be measured as the number of industrial activities carried out in a particular location. On the other hand, industrial evenness would model the degree of specialisation of the economy. An independent measure for \( E \) can be obtained from Equation 4, in terms of \( H \) and \( S \). This measure is known as the Heip Evenness Index (\( E \)) and the higher its value the less the specialisation degree of a region.

Equation (4)  
\[ H = \ln(S) + \ln(E) \]

The conditional convergence model incorporates the two components of industrial diversity in order to measure separately the impact of industrial diversification and specialisation on converge rates. These variables are expected to capture the effects that different industrial profiles might have on aggregate growth.

Finally, the conditional convergence analysis considers human capital. This variable is measured using average schooling for each region. The estimation is based on municipal schooling rates from the 2000 population census.

The conditional converge analysis re-estimates the four original non-linear and linear models presented in Equations 1 and 2. They include as additional explanatory variables the four infrastructure variables (interregional, international and intraregional accessibility as well as the curvature index), industrial diversity (\( S \) and \( E \)), and human capital. For the linear model, this specification is presented in Equation 5, where \( x_i \) are the additional controls and \( \gamma \) is a parameter. The non-linear model also assumes a linear specification of the controls.

Equation (5)  
\[ \log(y_{i,1}) = \alpha - \beta \log(y_{i,0}) + \sum \gamma x_{i,1} + \epsilon_{i,1} \]

Table 2 presents the results of the estimation of the conditional models. The results show that the convergence parameter is positive and statistically significant under the four specifications. The implied half-life of the conditional productivity gaps is 8.08. Following the stylised facts illustrated by Figure 1, this would be the time for a given economy to reduce by a half the productivity gap with respect to the short-run equilibrium (\( U \) or \( L \)). On the other hand, the half-life of the gaps with respect to the long-run equilibrium (\( A \)) would be the one reflected by the absolute convergence model: 25.7 years. The results of the convergence model help to characterise the variables that determine the short-run convergence to a type \( U \) or \( L \) equilibrium.
The coefficient of *industrial evenness* suggests that productivity growth is on average larger for specialised economies. This effect is identified by the four econometric specifications. On the other hand, the *industrial range* has a positive coefficient, however it is not statistically significant. Since the *SHE* is equal to the sum of these variables, the result indicates that growth responds negatively on overall industrial diversity.

The metrics for infrastructure, *interregional* and *international accessibility*, present a positive sign, indicating that regions with higher market potential tend to exhibit higher productivity growth rates. *International accessibility* is statistically significant for all the models, a characteristic that is not shared by *interregional accessibility*. However, a test about their joint significance show the two variables are statistically different from cero at 5 percent confidence level ($\chi^2 = 6.02$).

*Interregional accessibility* and *network curvature* present a positive and negative coefficient respectively; however, the coefficients are not significant for any of the models. Nevertheless, a joint significance test indicates that both parameters are jointly significant at a confidence level of 10 percent ($\chi^2 = 4.97$). This result would suggest that regions with highly interconnected local markets and good road quality exhibit higher productivity growth. Finally, schooling is positive under the four models but it is not statistically significant.

The results of the estimation of the models show in general terms that specialised regions, which are well-connected to international markets, present higher productivity growth. However, the joint significance tests suggest that accessibility to both international and national markets, as well as the local transport infrastructure, have a positive effect on the short-run equilibrium level of productivity growth.

The autoregressive parameter $\rho$ of the GMSAR model is -0.97. It is statistically significant at one percent level suggesting that an error term follows a SAR process. Under this hypothesis, transport infrastructure has a secondary effect on productivity growth, since it serves as a medium for the diffusion of the spatially lagged growth shocks.

Nevertheless, the SAR hypothesis cannot be categorically accepted. A crucial assumption of the GMSAR estimation is the homoskedascity of the non-spatial component $u_{i,t}$ in Equation 3. If this assumption is violated the distribution of $\rho$ does not necessarily follow the one presented in Kelejian and Prucha (2004). Under this scenario, the GMSAR estimation does not prove the presence of a SAR process. The differences between the estimated variance of the robust and the GMSAR coefficients suggest that this might be the case. Unfortunately, neither the ML nor the OLS models generate minimum variance estimators. Therefore, it is not possible to test formally via a Hausman specification test, which estimation is more likely to be correct. Given this uncertainty, the robustness of the estimations across the models is very valuable, since the results appear not to be sensitive to the econometric specification.

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4 The joint significance test is carried out under the ML model.
4. DISCUSSION AND FINAL REMARKS

The origins of regional divergences on income per capita have been traced to the liberalisation reforms of the 1980s and 1990s (Rodríguez-Pose and Sanchez-Reza 2002b). The productivity growth patterns identified in this paper suggest that productivity gains of trade liberalisation have been higher for specialised regions as well as for those with high infrastructure endowments. Nevertheless, those spillovers will be eventually exhausted, and in the long term, they will tend to fade out.

The geographical implications of these findings support this claim. Figure 2 maps international accessibility at regional level in Mexico. The figures show a strong geographic bias for this variable. The regions with the largest international accessibility are heavily clustered in the northern part of Mexico. This spatial distribution might be the direct cause of the border state effect identified in previous literature (Chiquiar 1999).

The impact of accessibility can be directly associated to road infrastructure. Duran (2007) indicates that approximately 30 percent of the variations of this variable can be directly attributed to the structure and quality of the road network. This is clearly illustrated in Figure 2, which shows that accessibility is not completely determined by proximity to the international border. Higher accessibility has a direct effect on productivity levels as long as it is reflected in lower transportation costs. On the other hand, its effect on growth could follow different channels.

If production exhibits increasing returns to scale with respect to accessibility, this will be reflected in a higher growth equilibrium level for high-accessibility regions. Accessibility might also have a positive impact on transaction costs, which have an indirect impact on productivity growth. For example, private investment could be attracted to high accessibility regions. Actually, there is small but positive linear correlation (0.11) between international accessibility and the growth of private capital. Finally, it is also important to consider the possibility that higher accessibility is associated to improvements of technological diffusion, a process that would impact directly productivity growth rates.

Table 3 compares the regional averages of the components of industrial diversity for 1999 and 2004. It shows that average industrial diversity has increased during those years, pulled by a decrease of industrial evenness. On the other hand, the industrial range has experienced a mild reduction: on average the regions have lost 3.8 industrial activities during those years.

The reduction of industrial evenness indicates that the regional industrial sectors are becoming less specialised, implying that non-dominant activities have been growing at higher rates. An interesting feature of this behaviour is that the average evenness appears to converge. Table 4 presents a robust ML convergence regression for this variable. This result indicates that the reduction in the degree of specialisation has been higher for the more specialised regions for these years. The estimation predicts half-life of the interregional evenness gaps of 13.4 years. These figures, and the negative effect on growth associated to industrial evenness, strongly suggest that productivity growth in specialised regions is catching-up that in diversified regions.
The most important implication of this mechanism is that it can explain the absolute convergence patterns of productivity growth. Since *industrial evenness* is converging to a unique level, this movement has an effect on the long-term equilibrium. Recalling the stylised diagram of Figure 1, *industrial evenness* would be one of the variables that pull together the trajectories of U and L.

The spatial distribution of *industrial evenness*, presented in Figure 3, points another interesting situation. The most specialised regions are located in central and southern Mexico. This suggests that the aforementioned convergence mechanism is geographically concentrated in the south and not the north of the country. In fact, this variable is negatively correlated with *international accessibility*. Therefore, the positive effect of industrial specialisation cannot be unambiguously associated to trade-liberalisation. The forces behind the convergence of *industrial evenness* could include the development of an export-oriented industry far beyond the Border States. However, it could also originate in the growth of the internal markets. Unfortunately, the data does not allow any further analysis in this direction.

These findings show that the absolute gaps in productivity growth can be partially attributed to changes in the regional industrial profile. Since the estimated half-life of the interregional *industrial evenness* gap is shorter than the absolute productivity growth gap, there are necessarily other factors that hinder a faster convergence rate for this variable. The most obvious candidate, as pointed out in previous literature, is trade liberalisation. This point is illustrated by Figure 4. This graph presents national productivity levels for the manufacturing sectors as well as for the export-orientated manufacturing industry. The historic behaviour of these variables shows that after the signature of the NAFTA, productivity in the export-orientated sector grew at considerably higher rates in comparison to the rest of the industrial sector. However, since 2003, this process has reverted and productivity is converging again to the national average.

The results of this paper portraits the aforementioned macroeconomic indicators. They show that higher infrastructure endowments generate positive spillovers on productivity growth rates in a period characterised by the development of the international markets. This suggests that trade liberalisation and accessibility to international markets have been complementary to each other. However, the results of this paper indicate that in a term of 25 years, these productivity gains would be completely exhausted.

Policy makers in Mexico have linked the origin of this behaviour to the lack of structural reforms (PRONAFIDE 2001) as well as the poor development of infrastructure systems (PNI 2007). Among the structural reforms that have been proposed, we find the liberalisation of the labour legislation, the liberalisation of the energy sector, and the implementation of a more efficient tax system. If infrastructure investment is complementary to these reforms, as it seemed to be case for the trade reforms of the 1990s, infrastructure policy will play a crucial role in the future development of the country. In particular, the allocation of transport infrastructure investments and the subsequent modification of the accessibility landscape could be

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5 This data is from the maquiladora sector.
used as an instrument to achieve a more even regional economic development in Mexico.

5. REFERENCES


Duran (2007). “Infrastructure, accessibility and spillovers of the manufacturing sector in Mexico: A quantitative assessment at regional level”. Oxford University. MIMEO


### Table 1 Absolute Convergence Analysis
(Standard Errors in Parenthesis)

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Significance level *1% ** 5% *** 10%
Source: Own assessment

### Table 2 Conditional Convergence Analysis
(Standard Errors in Parenthesis)

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Significance level *1% ** 5% *** 10%
Source: Own assessment

Source: Own assessment
Table 3 Industrial Diversity and Components
(Standard Deviations in Parenthesis)

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Source: Own assessment with data of the 1999 and 2004 Economic Census

Table 4 Absolute Convergence for Industrial Evenness
(Standard Errors in Parenthesis)

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Source: Own assessment
Figure 1

Figure 2. International Accessibility Index

Source: Own assessment
Figure 3. Industrial Evenness

Source: Own assessment

Figure 4. Productivity Index. Manufacturing and Maquila Sectors (1996=100)

Source: INEGI

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