Efficient creativity in Mexican metropolitan areas

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Abstract

This paper examines the efficiency of the production of creative goods in Mexico. The empirical examination is made covering 36 metropolitan areas at four different periods of time, using the quinquennial economic censuses taken in 1998, 2003, 2008 and 2013. The paper first estimates the static performance of the creative industries by means of super-efficiency data envelopment analyses. Subsequently, the study uses the Malmquist productivity index to estimate their dynamic efficiency. Using both analyses, it is found that 83 per cent of the creative sectors in the metropolitan areas are inefficient. It is also shown that, contrary to a commonly held view in the literature, most of the efficient creative industries are to be found in metropolitan areas that are not relatively large.

Keywords: Creative industries, Mexico, Metropolitan areas, Super-efficiency DEA, Malmquist productivity index

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1. Introduction

As it has been stressed by, among others, DCMS (1998), Caves (2000), Howkins (2001), Florida (2002) and Hartley (2005), human creativity is the most important resource for a large number of economic activities. Moreover, creativity is not only an essential factor at the industry level, but also at the regional and national levels, since creative industries are an important driving force for the emergence of new markets (Potts et al., 2008). The recognition of their economic value has grown steadily over this century, specially after the reports on the creative sector made by three agencies of the United Nations: UNCTAD and UNDP (2008), UNCTAD and UNDP (2010) and UNDP and UNESCO (2013). As noted in one of those reports, creative industries are currently one of the few robust economic sectors worldwide. For instance, from 2002 to 2011, a period that includes the years of the Great Recession, the creative sector had an average annual growth rate of 8.8 per cent worldwide. In the case of the exports of creative goods from the part of developing countries, the growth rate was, in particular, even higher: about 12.1 per cent over the same period (UNDP and UNESCO, 2013, p. 9). Furthermore, for the specific purposes of this paper it is also worth to note that Mexico is the biggest exporter of creative goods among Latin American countries (UNCTAD and UNDP, 2010, p. 161).

Given the growing worldwide recognition of the importance of the creative industries, some authors have tried to identify the key factors that may account for their dynamism. An obvious condition is the existence of cities that can nurture those industries. After all, to paraphrase Glaeser (2011), cities are among the greatest creative inventions. But, clearly, there have to be other relevant factors as well. The most well-known model on that regard, known as the 3Ts, is due to Florida (2002). It states that creative regions must also have an abundance of three elements: technology, talent, and tolerance. Needless to add, in order to make that model operational at the level of cities or countries, it is necessary to proxy each of those elements using variables that are not only closely related, but that are also readily available. To provide an example, in the construction of the Global Creativity Index (Florida et al., 2015) the authors end up estimating a country's technology using as proxies the country's share of GDP devoted to R&D, as well as its number of patents.

Macro analyses such as the one suggested by the 3Ts model are certainly quite useful for policy-makers and investors alike. Yet, it would also seem to be worth examining the production process of creative goods at the micro level. The paper illustrates this last approach by offering an analysis of the static and dynamic efficiencies of the Mexican creative sectors. This is done by focusing on those industries that are located in the Mexican metropolitan areas, where about 80 per cent of the urban population currently lives.

The efficiency analysis starts by considering the creative sector of each metropolitan area as a single decision-making unit. A data envelopment analysis model is then used to estimate, in relative terms, the static efficiency of each unit. Finally, by means of the Malmquist productivity index, a dynamic analysis is subsequently made using the static results obtained at the different periods of time. That index can be used to estimate, both, the efficiency change and the technological change in the production of creative goods in each metropolitan area.

It should be noted that the two non-parametric methods mentioned above have been already used in, literally, a myriad of studies that attempt to measure the relative efficiency in the production of goods across industries and regions. Nonetheless, few of those studies are dedicated in particular to the case of creative industries, and only from a static perspective. This is not meant to say that there are no studies on the dynamic performance of the creative sectors in the literature. Two interesting examples in that respect are Stam et al. (2008), for the case of the Netherlands, and Hong et al. (2014), for the case of China. But the methodologies used in those papers are quite different from the one used in this work. On the other hand, it should also be pointed out that there are several studies in the case of other knowledge-based industries that do use the same methods as the ones employed here (see, e.g., Han et al., 2016).

The content of this paper unfolds as follows. Section 2 presents the metropolitan areas to be studied, as well as a list of the industries that constitute the creative sectors in each area. The selection of those specific industries is not as straightforward as it would seem at first sight, since there are contrasting views about what constitutes a creative good. As is also detailed in that section, the efficiency analysis uses data from the last four quinquennial economic censuses taken by the Mexican federal government. Afterwards, Section 3 reviews the two non-parametric methods to be used to evaluate the static and dynamic efficiencies of the Mexican creative industries. Section 4 then presents the empirical implementation of those methods, as well as an analysis of the static and dynamic results. The conclusions of the study are drawn in Section 5.

2. Creative industries in metropolitan areas

The Mexican federal government established the existence of 59 metropolitan areas (MAs) in 2010 (SEDESOL et al., 2012). Although those areas are the result of aggregating only 367 municipalities, about 15 per cent of the total number of Mexican municipalities, their contribution to national employment is around 73 per cent, and their production accounts for about 77 per cent of total gross product (INEGI, 2014). The group of MAs is, nevertheless, quite heterogeneous. In terms of population, the metropolitan area officially named as Valle de México is by far the largest, since it has a population of more than 20 million people. The area includes Mexico City's 16 demarcations, as well as 60 municipalities from two neighbouring states. The next two largest metropolitan areas are Guadalajara and Monterrey, with a population of about 5 million people each. On the other hand, eight of the 59 metropolitan areas have populations smaller than 200,000 people.

The population growth rate of the Mexican metropolitan areas as a whole was 17.5 per cent from 2000 to 2010, but there were a dozen of them with population growth rates of at least 30 per cent during that decade. They are, listed in decreasing order, Cancún, Puerto Vallarta, Reynosa-Río Bravo, Pachuca, Querétaro, Tuxtla Gutiérrez, Tijuana, Saltillo, Aguascalientes, Zacatecas-Guadalupe, León, and Villahermosa. It is also interesting to note that seven of all MAs are located south of the US border, and, somewhat atypically for international standards, only 13 of the 59 metropolitan areas are located on the coast.

Needless to add, the heterogeneity among the MAs manifests itself not only in terms of their population or location, but also in terms of their creative sectors. For instance, a study made by the Ministry of Economy (SE, 2008) identifies as interactive media hubs in Mexico just the following eight metropolitan areas: Aguascalientes, Guadalajara, Mérida, Mexicali, Monterrey, Querétaro, Tijuana and Valle de México (Mexico City). Furthermore, a more recent study made by the government, based on cluster analysis (SE, 2016), identifies 30 information technology clusters that are constituted by about 1,500 companies. But the report only labels the following four metropolitan areas as information technology hubs: Guadalajara, Monterrey, Querétaro and Valle de México. This is not meant to imply that the rest of the MAs do not produce enough creative goods since, as is noted next, there are creative industries of different nature.

2.1. Classification of creative industries

At the end of the last century, the UK's Department for Culture, Media and Sport singled out the following 13 industries that might constitute the creative sector (DCMS, 1998): advertising, antiques, architecture, crafts, design, fashion, film, leisure software, music, performing arts, publishing, software, and TV and radio. Other classifications were later offered by, among others, Howkins (2001), Florida (2002), and Hartley (2005). However, the most commonly cited classification worldwide is the one offered by UNCTAD and UNDP (2008). In their influential report, those two UN agencies propose that creative industries should be classified into four broad groups (subdivided into nine subgroups): heritage (traditional cultural expression and cultural sites), arts (performing and visual arts), media (audiovisuals and publishing, and printed media), and functional creation (design, creative services, and new media).

The list suggested by UNCTAD and UNDP (2008) is comprehensive and well-balanced. However, it is too large for the purposes of this paper, since the empirical models described later require specific data on inputs and outputs for the creative industries. In that regard, the only available data at a sufficient level of detail come from the economic censuses taken by the government in 1998, 2003, 2008 and 2013 (INEGI, 1999, 2004, 2009, 2014). Some of the industries in the UN list mentioned before, such as the ones in the heritage group, do not have their counterparts in the economic census. Thus, taking as a guide the available information, as well as the specific lists proposed for Mexico by NEA (2013) and SE (2013a), Table 1 presents the creative industries to be studied here.

[Insert Table 1 around here]

It should be noted that the classification given in that table conforms to the North American Industry Classification System (NAICS). More precisely, the 1997 and 2002 versions of NAICS were employed for, respectively, the censuses taken in 1998 and 2003. The latest version of NAICS, published in 2007, was used in the 2008 and 2013 censuses. Another point to keep in mind is that each census provides information at the municipality level only, so that the data for each metropolitan area has to be calculated by aggregating the figures of all the corresponding municipalities.

2.2. Inputs and output

The census contains information on a good number of input and output measures for each economic unit. These are, among others, gross product, value-added, sales, employment, wages and salaries, services, fixed assets, and investment. However, given the non-parametric models to be used below, the selection of the representative variables has to be kept as small as possible. The reason is that those models can quickly lose their explanatory power as the dimensionality of the input/output space increases. Having that restriction in mind, it seems reasonable to quantify the creativity output by total gross product (y_1). This is so not only because some firms can produce more than one output, but, even more importantly, because, for the analysis that follows, it is necessary to aggregate outputs across all the firms in each metropolitan area.

On the other hand, in the case of the inputs there are a variety of possible variables, although not all of them are suitable because of that aggregation issue. To begin with, and given the role that outsourcing plays in some creative industries, labor is represented here by the total number of working hours (x_1) and not by the number of workers. The next inputs to capture are related to the use of capital. This is partly accomplished by using the book value of fixed assets (x_2) to represent a second input. Furthermore, a variable that is taken to reflect the intensity of the use of that stock of capital is the cost of energy consumption (x_3). Finally, a variety of external services are selected to capture other costs of production. They are: consulting costs, marketing costs, repair costs and royalty payments. Since some of those cost categories contain a relatively high share of zero values, then, in order to satisfy the positivity requirement for the well performance of the non-parametric models below, all external services are aggregated into a single variable (x_4). In summary, the production technology of the creative industries in each metropolitan area is represented by a single output (gross product) and four inputs (number of working hours, fixed assets, energy consumption, and external services).

2.3. Metropolitan areas

Among the metropolitan areas officially designated as such by the government, there are some that basically have a primary sector vocation (agriculture and livestock). There are others that, although they do have some firms in the tertiary sector, they do not have significant economic activity in the quaternary (knowledge-based) sector. More precisely, the following MAs have a creative sector, as defined in Table 1, whose production represents less that 0.5 per cent of their total gross product: Acayucan, Coatzacoalcos, Cuautla, Guaymas, La Piedad-Pénjamo, Minatitlán, Monclova-Frontera, Ocotlán, Orizaba, Piedras Negras, Saltillo, San Francisco del Rincón, Rioverde-Ciudad Fernández, Tampico, Tecomán, Tehuantepec, Tianguistenco, Teziutlán, Tlaxcala-Apizaco, Toluca, Tula, Tulancingo and Zamora-Jacona. Those metropolitan areas are discarded in what follows, so that the group to be studied is reduced to 36 of them (identified in the tables below).

3. Methodology

This paper uses the data envelopment analysis (DEA) model, as well as the Malmquist productivity index (MPI), to evaluate the efficiency, both static and dynamic, of the production of creative goods in the metropolitan areas. First proposed by Charnes et al. (1978), the DEA is a non-parametric method that makes use of linear programming to calculate, for a group of decision-making units (DMUs), the relative efficiencies in the production of one or more outputs by means of some inputs. It is a non-parametric method since it does not require the specification of a production function. This feature is particularly useful in the case of the production of creative goods, since an explicit functional form that relates inputs and outputs cannot be easily established.

In the context of data envelopment analysis, Färe et al. (1992, 1994) were the first authors to make use of the Malmquist productivity index to measure changes in total factor productivity over two or more periods of time. Using panel data information, the MPI allows for the decomposition of productivity changes into two components: the efficiency change (also called the catch-up effect) and the technical change (the frontier-shift effect). But before reviewing the details of that decomposition, it is needed to present first the static framework.

3.1. Static efficiency

In its original version, the DEA model assumes that the firm's production possibility set exhibits constant returns to scale. Other alternative models, such as the variable returns to scale model due to Banker et al. (1984), dispose of that assumption. Nevertheless, the original model is better suited for the purposes of this paper, as the Malmquist productivity index could be biased otherwise (Grifell-Tatjé and Lovell, 1995). It should also be noted that although the data envelopment analysis model can be either input- or output-oriented, in this paper the input-oriented approach is implicitly adopted since, for reasons given earlier, there is a single output.

The main goal of the DEA model is to estimate the relative efficiency of the decision making units. In the particular case of this paper, the purpose is to estimate the efficiency of the creative sector of each MA relative to the creative sectors of the other metropolitan areas. The estimations are based on the productivity ratio of the output to its weighted inputs, and the values of the relative efficiencies are scaled between 0 and 1. The subsequent ranking of the units in terms of their efficiency is not, however, a simple task. This is so because there could be a number of ties among the efficient units. In order to circumvent this problem, Andersen and Petersen (1993) introduced the super-efficiency DEA model, where each metropolitan area under evaluation is excluded from the reference set made of the rest of the MAs. The ranking of the units is then viable, since the relative efficiency values can be now greater or less than one.

More formally, for the creative sector corresponding to the j-th metropolitan area (where $j = 1, \ldots, 36$), let $X_j = (x_{1j}, \ldots, x_{4j})$ be the vector that denotes the level of the four inputs identified earlier for each sector, and let $Y_j = y_{1j}$ denote the output level as represented by the gross output from each sector. Thus, under the assumption of constant returns to scale, the input-oriented super-efficiency DEA score for a given metropolitan area MA_k is then defined by:

$$\begin{aligned}\theta_k^{\mathrm{s}}(X_k, Y_k) = \min_{\theta,\lambda}\Bigg\{\theta\,\Bigg|\, & \sum_{\substack{j=1\\ j\neq k}}^{36} \lambda_j x_{ij} \leq \theta x_{ik} \quad i = 1, \ldots, 4; \\ & \sum_{\substack{j=1\\ j\neq k}}^{36} \lambda_j y_{1j} \geq y_{1k}; \quad \lambda_j \geq 0, \quad j = 1, \ldots, 36\Bigg\},\end{aligned} \tag{1}$$

where λ_j is the weight of each MA_j in the benchmark for MA_k, and θ_k^{s} is the level of super-efficiency. The k-th metropolitan area under consideration is said to be super-efficient in the production of creative goods if $\theta_k^{\mathrm{s}} \geq 1$, while it is said to be inefficient if $\theta_k^{\mathrm{s}} < 1$.

3.2. Dynamic efficiency

The static efficiency analysis estimates, for each creative industry, its relative productivity for a given period, without any consideration of the productivity changes arising over time. But for industries as dynamic as the creative sectors, a ranking based on those estimates alone could lead to misleading results. To solve that shortcoming, a framework to estimate dynamic efficiencies is now introduced.

The DEA-based Malmquist productivity index can be used to measure changes in the total factor productivity of a decision-making unit over time. The index has the advantage of dividing the total factor productivity into its two components, the efficiency change (EC) and the technological change (TC). The index can be calculated by estimating, for each creative sector and for any two contiguous time periods, standard DEA scores. More precisely, for the j-th metropolitan area ($j = 1, \ldots, 36$), let X_j^t and Y_j^t denote the input and output vectors for period t. For the k-th metropolitan area, MA_k, and any single period, the following constant returns to scale DEA model can be used to estimate the creative sector's technical efficiency score:

$$D^t\big(X_k^t, Y_k^t\big) = \min_{\theta,\lambda}\left\{\theta \,\middle|\, \sum_{j=1}^{36} \lambda_j x_{ij}^t \le \theta x_{ik}^t \quad i = 1, \dots, 4; \right.$$
$$\left. \sum_{j=1}^{36} \lambda_j y_{1j}^t \ge y_{1k}^t; \quad \lambda_j \ge 0, \quad j = 1, \dots, 36 \right\}. \tag{2}$$

On the other hand, for any two contiguous periods the following technical efficiency score can be also computed:

$$D^t\big(X_k^{t+1}, Y_k^{t+1}\big) = \min_{\theta,\lambda}\left\{\theta \,\middle|\, \sum_{j=1}^{36} \lambda_j x_{ij}^t \le \theta x_{ik}^{t+1} \quad i = 1, \dots, 4; \right.$$
$$\left. \sum_{j=1}^{36} \lambda_j y_{1j}^t \ge y_{1k}^{t+1}; \quad \lambda_j \ge 0, \quad j = 1, \dots, 36 \right\}. \tag{3}$$

A similar model can be used to calculate $D^{t+1}(X_k^t, Y_k^t)$.

Having estimated for, a given MA_k, the four technical efficiency scores corresponding to the single and mixed periods, the input-oriented Malmquist productivity index can be now defined as:

$$\mathrm{MPI}\big(X_k^t, Y_k^t, X_k^{t+1}, Y_k^{t+1}\big) = \left[\frac{D^t\big(X_k^{t+1}, Y_k^{t+1}\big)}{D^t(X_k^t, Y_k^t)} \frac{D^{t+1}\big(X_k^{t+1}, Y_k^{t+1}\big)}{D^{t+1}(X_k^t, Y_k^t)}\right]^{1/2}. \tag{4}$$

Furthermore, as noted by Färe et al. (1992, 1994), the productivity index can be decomposed into two components:

$$\mathrm{MPI}\big(X_k^t, Y_k^t, X_k^{t+1}, Y_k^{t+1}\big) = \underbrace{\frac{D^{t+1}\big(X_k^{t+1}, Y_k^{t+1}\big)}{D^t\big(X_k^t, Y_k^t\big)}}_{\mathrm{EC}} \underbrace{\left(\frac{D^t\big(X_k^{t+1}, Y_k^{t+1}\big)}{D^{t+1}\big(X_k^{t+1}, Y_k^{t+1}\big)} \frac{D^t\big(X_k^t, Y_k^t\big)}{D^{t+1}\big(X_k^t, Y_k^t\big)}\right)^{1/2}}_{\mathrm{TC}}. \tag{5}$$

The first component on the right-hand side of the last equation, EC, measures the efficiency change. The second component, TC, measures instead the technical change. Clearly, since the Malmquist productivity index is the product of the two components, a finding that the index is greater (less) than one does not necessarily imply that both EC or TC are greater (less) than one.

In the context of this paper, for a given metropolitan area, EC measures the ability of the creative sector to improve its relative technical efficiency from period t to $t+1$. A finding of EC > 1 means that the creative industry is closer to the production frontier in period $t+1$ than it was in t; that is, the sector is catching-up to the technology frontier. The opposite interpretation holds when EC < 1. In the case of the other component, when TC > 1 there is evidence of technical progress from the part of the creative sector; that is, there is a positive technology frontier-shift between the periods t and $t+1$. On the other hand, when TC < 1 there is technical regress (a negative frontier-shift).

Finally, the combination of the static and dynamic analyses, obtained using models (1) and (2)-(5) above, may lead to the classification of the creative sectors of the metropolitan areas into four different groups. Borrowing the useful taxonomy proposed by Han et al. (2016), these are:

- *Leading group.* This first class is made of the metropolitan areas that have creative sectors which show, both, super-efficiency, according to the static analysis, and an increasing productivity, as measured by the Malmquist productivity index.

- *Improving group.* The metropolitan areas in this group have creative sectors that are, from a static point of view, inefficient. Nevertheless, the sectors exhibit an increasing productivity over time.

- *Deteriorating group.* This class contains the metropolitan areas that have creative sectors that, from a static perspective, are super-efficient, but show a decreasing productivity over time.

- *Lagging group.* Finally, this last group is made of the metropolitan areas that have creative industries that are inefficient and exhibit a decreasing productivity over the years.

4. Results

4.1. Evaluation of static efficiency

Using model (1), Table 2 reports the super-efficiency scores of the creative sector for each of the 36 metropolitan areas considered here.[1] As noted earlier, a score greater than one indicates that the production of creative goods is super-efficient, while a score less than one indicates that it is inefficient. The average score for all the metropolitan areas in Table 2 was 0.51, 0.78,

[1]The table identifies the metropolitan areas not only by their names, but also by their official numbers.

0.61 and 0.55 in 1998, 2003, 2008 and 2013, respectively. Thus, in the last three periods there was a decreasing trend in the average efficiency of the creative sectors at the national level.

[Insert Table 2 around here]

According to the Mexican government (SE, 2013b), the most competitive interactive media sectors in the country are found in Mexico City and the federal states of Baja California, Jalisco and Nuevo León. The findings in Table 2 are consistent with that view, as Mexico City constitutes the core of the Valle de México metropolitan area, which is placed fifth in the table, while Puerto Vallarta (Jalisco), Mexicali (Baja California), and Monterrey (Nuevo León) are also ranked in the first ten places. Nevertheless, Guadalajara, which is the second largest metropolitan area in Mexico (and the capital of Jalisco), is poorly ranked at position 28 in Table 2. Another noteworthy finding is that the first three places in the table are occupied by the creative sectors of relatively small and isolated metropolitan areas: Reynosa-Río Bravo, Poza Rica and Villahermosa.

4.2. Evaluation of dynamic efficiency

Using now the dynamic model, given in (2)-(5), Table 3 shows the estimates of the Malmquist productivity index and its two components. Regarding the MPI, in the period 1998-2003 only 8 creative sectors of the 36 metropolitan areas attained an index greater than one, which means that more than two-thirds of the producers of creative goods did not improve their dynamic efficiency over those five years. A similar result was obtained for the period 2003-2008, when only 7 creative sectors had productivity gains according to the index. However, a better performance was attained during the last period of interest, 2008-2013, since 17 creative sectors showed an improvement in technical productivity.

It may be also noted that those findings are consistent with the geometric means shown in the last row of Table 3. As can be seen from there, the geometric means of the index for the periods 1998-2003, 2003-2008 and 2008-2014 were 0.79, 0.81, and 0.97, respectively. These last values imply that, for the creative sectors of the Mexican metropolitan areas as a whole, there was a productivity decline in the order of 21, 19 and 3 per cent during the corresponding periods.

[Insert Table 3 around here]

For the purpose of ranking the creative sectors by their dynamic performance, the last column of Table 3 shows, for each metropolitan area, the geometric mean of the Malmquist productivity indexes estimated during the three periods under consideration. As can be appreciated from the table, the first positions correspond to Mexicali, Reynosa-Río Bravo, Querétaro and Veracruz, which are the only MAs for which the geometric mean is greater than one. Interestingly enough, the first two happen to be located to the south of the US border. The other two are in the middle of Mexico, one relatively near to the capital, and the other on the east coast. Another interesting finding is that, although Valle de México is relatively well-placed in both Table 2 and Table 3, the next two most populated metropolitan areas, Guadalajara and Monterrey, exhibit relative dynamic efficiencies that are quite contrasting with their static performances. In Table 3 the rank numbers for Guadalajara and Monterrey are, respectively, 11 and 26, while in Table 2 the rank numbers are almost the opposite: 28 and 10.

It is also worth to examine separately the two components of the MPI, the efficiency change (EC) and the technical change (TC). As can be appreciated from Table 3, for the first period under consideration, 1998-2003, the TC component mostly explains the regress exhibited by most of the creative sectors in the metropolitan areas. The negative frontier-shift effect was so strong and widespread that the maximum of the TC values for that period was surprisingly low, 0.69, and the geometric mean of the TCs across all the MAs was a meager 0.51. On the contrary, during the 2003-2008 there was a widespread fall in the EC component (a decrease in the catch-up effect), while the technical change component improved notably. This positive frontier-shift effect became even more pronounced during the last period, 2008-2013, but the efficiency change continued to be low for most of the creative sectors in the metropolitan areas.

In sum, the evolution of the two components of the Malmquist productivity index suggest that most of the creative sectors in the metropolitan areas had efficient production processes in the first period under study. On the other hand, during the other two time periods, covering the years from 2003 to 2013, the rate of change in efficiency indicates that the creative sectors moved away from the efficient use of the factors of production. Nevertheless, during those ten years there was, simultaneously, a sizable and generalized progress in the degree of technical innovation.

Before concluding this section, it is interesting to merge the static and dynamic analyses given above to classify, following the taxonomy given earlier, the creative sectors of all the metropolitan areas. Figure 1 shows the geographic localization for each of the 36 regions, and, making use of the average scores in Table 2 and Table 3, also highlights the productivity profile of the corresponding creative sector. As can be seen from the figure, the border city of Reynosa-Río Bravo has the only creative industry in Mexico that can be classified as leading, since it is statically and dynamically efficient. On the other hand, the creative sectors of Mexicali, Querétaro, and Veracruz are the only ones that can be classified as improving. That is, the sectors are inefficient from a static point of view, but they do exhibit an increasing productivity over time. Interestingly enough, and in contrast to the case of Reynosa-Río Bravo, those three metropolitan areas have been mentioned by the federal government as having promising creative industries (SE, 2013a,b).

[Insert Figure 1 around here]

Poza Rica and Villahermosa are the only two metropolitan areas that have creative sectors that can be classified as deteriorating; that is, although their creative industries are super-efficient, they do not show an improvement in their average productivity over time. Finally the most striking finding is that out of the total of 36 metropolitan areas under study, 30 of them (83 per cent) have creative sectors that belong to the lagging group: the firms are neither statically nor dynamically efficient. As noted earlier, the average scores obtained by the creative sectors of the second and third largest metropolitan areas, Guadalajara and Monterrey, are sufficiently low to make them members of the lagging group. But the same can be said of the creative industries of other regions that are, as well, relatively large and economically important, such as Aguascalientes, León, Mérida and Tijuana.

Nevertheless, there are two positive findings that are also worth mentioning. The first is that the average scores obtained by Valle de México, which is by far the most important metropolitan area in the country, are relatively close to one. The second is that, keeping in mind that the whole period of analysis covers 15 years, there is a definite improvement in the technical change (positive frontier-shift) exhibited during the last period, 2008-2013, by almost all the creative sectors. The next economic census, to be taken in 2018 and released in 2019, will hopefully show that this improvement is lasting.

5. Conclusion

Creative industries are strategic, since they can promote sustainable and inclusive growth in developed and developing countries alike. This paper has provided one of the first country studies that attempts to measure the efficiency of the creative sectors from, both, a static point of view and a dynamic perspective. As a general conclusion, the evidence provided here shows that, in the case of Mexico, the production of creative goods in most of the metropolitan areas is far from efficient. Furthermore, this paper also shows that, contrary to a view commonly held by the federal and local governments, most of the efficient creative industries are to be found in metropolitan areas that are not relatively large.

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Table 1: **Creative industries classification**

NAICS Code	Description
5111	Newspaper, Periodical, Book, and Directory Publishers
5112	Software Publishers
5121	Motion Picture and Video Industries
5122	Sound Recording Industries
5151	Radio and Television Broadcasting
5152	Cable and Other Subscription Programming
5191	Other Information Services
5413	Architectural, Engineering, and Related Services
5414	Specialized Design Services
5415	Computer Systems Design and Related Services
5416	Management, Scientific, and Technical Consulting Services
5417	Scientific Research and Development Services
5418	Advertising, Public Relations, and Related Services
5419	Other Professional, Scientific, and Technical Services
5611	Office Administrative Services
6116	Other Schools and Instruction
7111	Performing Arts Companies
7113	Promoters of Performing Arts, Sports, and Similar Events
7115	Independent Artists, Writers, and Performers

Note: In the 1998 economic census the codes 5151, 5152 and 5192 were defined instead as: 5131 Radio and Television Broadcasting; 5132 Cable Networks and Program Distribution; and 5141 Information Services.

Table 2: **Static super-efficiency scores**

Metropolitan area	1998	2003	2008	2013	Average	Rank
01. Aguascalientes	0.34	0.60	0.61	0.48	0.53	26
02. Tijuana	0.40	0.59	0.60	0.53	0.56	23
03. Mexicali	0.40	0.80	1.51	0.76	0.89	7
04. La Laguna	1.07	0.82	0.67	0.71	0.86	9
08. Colima	0.36	0.61	0.37	0.42	0.50	34
10. Tuxtla Gutiérrez	0.29	1.05	0.57	0.32	0.73	14
11. Juárez	0.53	1.28	0.63	0.43	0.83	11
12. Chihuahua	1.41	0.75	0.77	0.40	0.97	4
13. Valle de México	0.63	1.33	0.95	1.04	0.90	5
14. León	0.34	0.61	0.52	0.53	0.51	32
16. Moroleón-Uriangato	0.21	0.72	0.65	0.37	0.56	25
17. Acapulco	0.51	0.45	0.58	0.65	0.53	27
18. Pachuca	0.60	0.60	0.48	0.68	0.58	20
21. Guadalajara	0.40	0.64	0.49	0.45	0.53	28
22. Puerto Vallarta	0.79	1.06	0.86	0.31	0.89	6
25. Morelia	0.37	0.88	0.44	0.39	0.66	18
28. Cuernavaca	0.37	0.74	0.70	0.38	0.73	15
30. Tepic	0.35	0.50	0.35	0.41	0.50	36
31. Monterrey	0.68	1.06	0.70	0.52	0.86	10
32. Oaxaca	0.47	0.37	0.48	0.30	0.50	35
34. Puebla-Tlaxcala	0.43	0.71	0.55	0.47	0.60	19
35. Tehuacán	0.30	0.54	0.65	0.42	0.52	31
36. Querétaro	0.43	1.06	0.70	0.74	0.82	12
37. Cancún	0.67	0.91	0.50	0.68	0.80	13
38. San Luis Potosí	0.42	0.72	0.49	0.44	0.58	21
41. Villahermosa	0.62	1.07	1.38	0.88	1.02	3
43. Reynosa-Río Bravo	0.52	2.19	0.68	1.23	1.13	1
44. Matamoros	0.34	0.84	0.58	0.24	0.70	16
45. Nuevo Laredo	0.31	0.86	0.52	0.43	0.69	17
47. Veracruz	0.42	0.64	0.54	0.61	0.58	22
48. Xalapa	0.59	0.53	0.46	0.39	0.56	24
49. Poza Rica	1.85	0.61	0.73	1.67	1.05	2
53. Córdoba	0.70	1.21	0.73	0.37	0.87	8
55. Mérida	0.46	0.53	0.53	0.39	0.52	30
56. Zacatecas-Guadalupe	0.28	0.67	0.50	0.45	0.50	33
57. Celaya	0.48	0.59	0.45	0.38	0.53	29
Average	0.51	0.78	0.61	0.55		

Table 3: **Efficiency change and technological change**

Metropolitan area	1998 - 2003			2003-2008			2008 - 2013			MPI	Rank
	MPI	EC	TC	MPI	EC	TC	MPI	EC	TC	mean	
01. Aguascalientes	0.81	1.77	0.46	1.03	1.02	1.01	0.93	0.79	1.18	0.92	12
02. Tijuana	0.79	1.50	0.53	1.11	1.01	1.10	0.99	0.88	1.13	0.95	6
03. Mexicali	0.92	1.99	0.46	1.70	1.26	1.36	0.88	0.76	1.17	1.11	1
04. La Laguna	0.41	0.82	0.50	0.84	0.83	1.02	1.21	1.06	1.14	0.75	31
08. Colima	0.82	1.70	0.48	0.67	0.60	1.13	1.34	1.15	1.17	0.90	13
10. Tuxtla Gutiérrez	1.72	3.47	0.50	0.48	0.57	0.85	0.70	0.56	1.25	0.83	23
11. Juárez	0.91	1.90	0.48	0.71	0.63	1.12	0.79	0.68	1.16	0.80	27
12. Chihuahua	0.36	0.75	0.48	1.04	1.03	1.01	0.58	0.52	1.12	0.60	36
13. Valle de México	0.91	1.58	0.58	0.86	0.95	0.90	1.02	1.06	0.97	0.93	9
14. León	0.84	1.78	0.47	0.85	0.85	1.00	1.13	1.02	1.10	0.93	7
16. Moroleón-Uriangato	1.74	3.46	0.50	0.60	0.90	0.67	0.76	0.57	1.35	0.93	8
17. Acapulco	0.43	0.87	0.49	1.16	1.30	0.89	1.37	1.13	1.22	0.88	17
18. Pachuca	0.51	1.00	0.51	0.66	0.80	0.82	1.74	1.43	1.22	0.84	22
21. Guadalajara	0.79	1.62	0.49	0.94	0.76	1.23	1.06	0.92	1.15	0.92	11
22. Puerto Vallarta	0.71	1.26	0.56	0.79	0.86	0.92	0.49	0.37	1.35	0.65	35
25. Morelia	1.20	2.37	0.51	0.46	0.50	0.93	1.03	0.89	1.16	0.83	24
28. Cuernavaca	0.99	1.99	0.50	0.82	0.94	0.87	0.61	0.55	1.12	0.79	29
30. Tepic	0.81	1.46	0.56	0.75	0.69	1.08	1.30	1.18	1.10	0.93	10
31. Monterrey	0.75	1.46	0.51	0.86	0.71	1.21	0.84	0.73	1.15	0.81	26
32. Oaxaca	0.38	0.79	0.48	1.08	1.30	0.83	0.71	0.62	1.14	0.66	34
34. Puebla-Tlaxcala	0.76	1.63	0.47	0.88	0.78	1.14	0.97	0.86	1.13	0.87	19
35. Tehuacán	0.82	1.80	0.45	0.85	1.20	0.70	0.86	0.64	1.35	0.84	20
36. Querétaro	1.22	2.35	0.52	0.70	0.70	1.01	1.30	1.06	1.23	1.04	3
37. Cancún	0.70	1.37	0.51	0.66	0.55	1.20	1.54	1.34	1.15	0.89	14
38. San Luis Potosí	0.90	1.73	0.52	0.69	0.67	1.03	1.12	0.91	1.23	0.89	15
41. Villahermosa	0.85	1.62	0.52	0.91	1.00	0.91	0.85	0.88	0.96	0.87	18
43. Reynosa-Río Bravo	1.32	1.92	0.69	0.55	0.68	0.80	1.72	1.46	1.18	1.08	2
44. Matamoros	1.09	2.49	0.44	0.85	0.69	1.24	0.43	0.41	1.06	0.74	32
45. Nuevo Laredo	1.30	2.79	0.47	0.53	0.60	0.88	1.02	0.84	1.22	0.89	16
47. Veracruz	0.83	1.53	0.54	0.93	0.85	1.09	1.37	1.12	1.22	1.02	4
48. Xalapa	0.50	0.90	0.56	0.95	0.86	1.10	0.88	0.85	1.04	0.75	30
49. Poza Rica	0.27	0.61	0.44	1.40	1.20	1.17	1.58	1.38	1.15	0.84	21
53. Córdoba	0.82	1.42	0.57	0.59	0.73	0.81	0.69	0.52	1.34	0.69	33
55. Mérida	0.64	1.17	0.55	0.95	0.99	0.96	0.83	0.75	1.11	0.79	28
56. Zacatecas-Guadalupe	1.17	2.38	0.49	0.76	0.76	1.01	1.01	0.89	1.14	0.97	5
57. Celaya	0.68	1.23	0.55	0.85	0.77	1.12	0.98	0.85	1.16	0.83	25
Geometric mean	0.79	1.55	0.51	0.81	0.82	0.99	0.97	0.83	1.16		

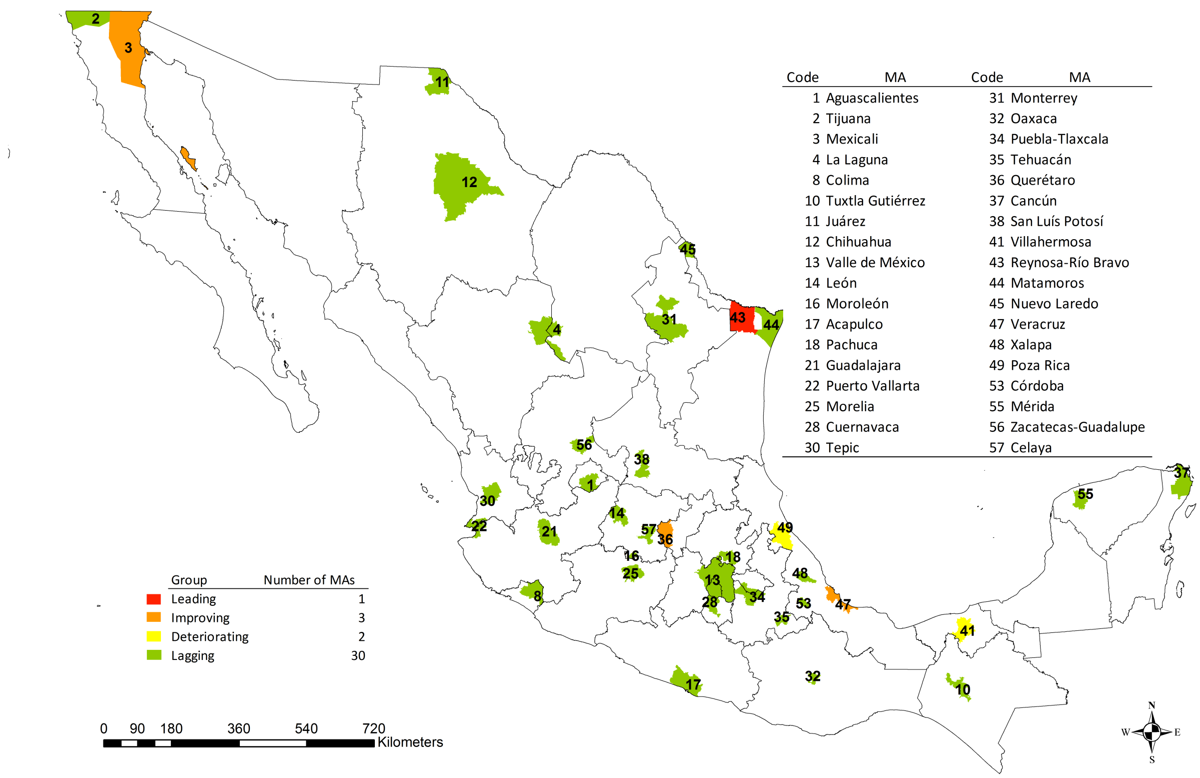

Figure 1: **Efficiency patterns in the creative sectors of the metropolitan areas**