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CREATIVITY, EFFICIENCY, AND SPATIAL CONCENTRATION IN MEXICO

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Abstract

Regional competitiveness evolves in close parallel to productivity, which, at present, is increasingly tied to creativity and innovation. A range of studies on the theme recognize that the spatial concentration of creativity drives productivity; nevertheless, few have managed to quantify the magnitude of this relationship. Via a stochastic production frontier analysis, this paper evaluates the levels of technical efficiency and productivity found across Mexico's 59 metropolitan regions (MR) and measures the contribution of the creative activities located in each of them.

Keywords: metropolitan zones, regional competitiveness, technical efficiency, and productivity, production and efficiency frontier models.

1. INTRODUCTION

The initial impetus for this work entailed constructing regional indicators of competitiveness in Mexico, specifically, in 59 metropolitan zones in which, pursuant to the latest census data, around 70% of the gross domestic product (GDP) is generated, and where 57% of the population lives. Analyzing the competitiveness of cities and regions has become an in-vogue topic in the field of regional studies, giving rise to numerous indices of local or regional competitiveness, which are then used to conduct draw comparisons and make rankings. Krugman (1994) called the affair a "dangerous obsession."

Despite the wide range of available indices —Berger (2011) came up with a list as of 2009 of at least 217 different competitiveness indices— it is unclear what they measure or how these measurements are bound up in a region's prosperity (Martin *et al.,* 2004).

The idea of regional competitiveness has run up against criticism, considering that regions themselves cannot compete, at least not in the same way companies do (Krugman, 1994; Martin *et al.,* 2004). Nevertheless, competitiveness is simply another way to speak of productivity, Krugman (1994) claimed; in our view, it makes sense to the extent that productivity can still be approached within the framework of economic theory, while competitiveness is a more open, one might venture multidisciplinary, concept. Accordingly, efforts ought to be channeled into measuring productivity and the sources or drivers of its growth.

This is a recurring problem, or at least it has been since Solow's (1957) [2] paper was published on the appearance of new methodologies revising aggregate productivity or total factor productivity (TFP) measurements and other structural aspects of an economy, such as technological change and, more recently, changes in productive efficiency. The downside of using the Solow approach is that it fails to truly identify the sources of TFP growth. It is just an accounting breakdown (Barro and Sala-i-Martin, 2003). It is unable to pinpoint whether TFP growth is coming about via technical change or improvements in efficiency.

Luckily, in the production (or cost) frontiers field, many alternative methodological possibilities have emerged to measure TFP (Table 1 summarizes a brief taxonomy). Of this wide range, only those stochastic frontier models taking into account an estimate of inefficiency were considered, to the extent that if inefficiency is not reflected, the estimated measure of productivity growth could be biased, without any notion of the precision involved (Grosskop, 1993, sec. 4.3.2, p. 173).

As such, this study is interested in why these models make it possible to construct relationships between productivity and technical efficiency, which are economic concepts frequently employed to analyze the economic performance of observed economic units (states, regions), and both are directly tied to the same production theory framework (Nishimizu and Page, 1982; Kumbhakar *et al.,* 2000; Lobo *et al.,* 2013). With these stochastic production frontier models, it becomes possible to decompose TFP growth into its sources ("causes"): technological change, changes in technical efficiency, and change of scale. In the context of production theory, it is therefore possible to establish an analytical bridge between competiveness, productivity, and technical efficiency.

The strategy to estimate TFP requires a prior estimate of the level of efficiency and how it has changed over time, as it is one of the three components mentioned. This study makes an initial approach with this sort of methodology with a scope restricted, initially, to exploring the role played y the creative sector in driving technical efficiency in metropolitan zones.

This is an economic sector that is at present at the heart of TFP growth in several urban hubs or dynamic regions in both Mexico and across the globe. The scope of this application is also constrained by the information available. We are working with a short panel in time, and it has to restrict the specification of the basic model implemented.

As a result, this study sets out primarily to find empirical evidence for the following working hypothesis: the creative sector plays an important (significant) role in reducing productive inefficiency in metropolitan zones, as part of broader mechanisms that capture the effects of economies of agglomeration, spillover effects, or positive externalities favorable to endogenous growth in Mexico's urban hubs. The evidence from European cities reveals that creative activities tend to have a significant impact on discrepancies in productivity, by raising the number of innovations via the creation of new products and varieties (Boix and Soler, 2014).

Table 1. Summary of Methodologies

	Deterministic Methodologies	*Econometric Methodology*	
		Parametric	*Semi-parametric*
Frontier	» Data Envelopment Analysis (DEA) (Micro-Macro) » FDH (Free Disposal Hull) (Micro-Macro)	» Stochastic Frontier Analysis (Micro-macro)	» For a broader literature review, see Dario and Simar (2007)
Non-frontier	» Growth Accounting (Macro) » Index Numbers (Micro-Macro)	» Growth regressions (Macro)	» Proxy variables (Micro)

Source: Del Gatto *et al.* (2011), modified.

With that in mind, this paper conducted an analysis of technical efficiency in the 59 metropolitan regions throughout the Mexican republic, quantifying their technical efficiency levels (average), ranking them hierarchically, and estimating the effect of the creative sector on driving efficiency.

This paper is composed of six sections. The second offers an overview of fundamental contributions to the topic; the third and fourth discuss the measurement methodology and introduce the empirical model underpinning the analysis; the fifth shows the descriptive statistics and interprets the results. Finally, section six presents some final considerations.

2. LITERATURE REVIEW

Traditionally, productivity in cities has been directly tied to some type of economy of agglomeration (Fujita *et al.,* 1999; Fujita and Thisse, 2002). Companies try to set up shop where there are already other companies. Marshall (1981, 2006) already noted that advantages of that location are to be had, via access to concentrations of inputs and specialized labor and the "spillover" of knowledge and innovation. Melo *et al.* (2009) contains a broad meta-analysis of 24 papers published on the relationship between economies of agglomeration and productivity, from which it emerges that the effects on productivity depend on characteristic effects (belonging to) the region, its industrial coverage, and, in general, the way economies of agglomeration are structured. In a context like that, what has come to be known as human capital, which includes aspects pertaining to the quality of the workforce, is undoubtedly a vehicle or part of a mechanism to transmit the (non-observable) impact of technological capture, location, and more (Ghosh and Mastromarco, 2013). The idea consists of building a bridge between productivity and the performance of sectors characteristic to a regional economy, as is the case of the creative sectors.

Since the nineteen-nineties, the literature on the role of the creative economy has taken off. Analysis has focused on studying creative cities (Yenken, 1988; Landry and Bianchini, 1995; Landry, 2000), the creative industries (Pratt, 1997; Higgs *et al.,* 2008; UNCTAD, 2010; DCMS, 2015) and the creative classes (Florida, 2002, 2004, and 2008). One aspect common to these different studies and outlooks is that they agree on the fact that creative activities have gained a great deal of relevance in understanding the forces that detonate growth and economic and social development in the most dynamic regions in the world.

There is as of yet no clear and precise conceptualization as to how a creative economy or creative activities should be understand, in large part as a result of the very breadth of how creativity is understood: "a process to generate something new based on the combination of already-existing elements" (Candance *et al.*, 2015, p. 3). Originally, the idea of the creative industries was tied to culture (DCA, 1994) and the first alternative measurement methodologies were developed for the United Kingdom, focusing on activities characterized by talent, skills, and individual creativity (DCMS, 1998 and 2001).

At present, the most significant proposal for defining and recording (measuring) creative industry activities is the formula used by the United Nations in its report on the creative economy, where these industries are defined as generators of symbolic products (UNCTAD, 2008). Table 2 summarizes the activities that UNCTAD considers to be an integral part of the creative activities or industries.

In its most recent report, UNCTAD (2015) measures the high economic impact of the creative industries at present: around the world, the cultural and creative goods and services market as of 2012 was on the order of 547 billion dollars, with a sustained annual growth rate of 8.6% between 2002 and 2012.

Table 2. Classification of Creative Industries

Groups	Subgroups	Activities
Heritage	Cultural sites	Archeological sites, museums, libraries, exhibitions, etc.
	Traditional cultural expressions	Arts and crafts, festivals, and celebrations
Arts	Visual arts	Painting, sculpture, photography, and antiques
	Performing arts	Live music, theater, dance, opera, circus, puppetry, etc.
Media	Publishing and printed media	Books, press, and other publications
	Audiovisuals	Film, television, radio, and other broadcasting
Functional creations	Design	Interior, graphic, fashion, jewelry, toys
	New media	Software, video games, and digitalized creative content
	Creative services	Architectural, advertising, cultural and recreational, creative research and development (R&D), digital and other related services

Source: Based on UNCTAD, 2008.

Analyses of the creative industries have focused on evaluating their impact on the provision of some sort of urban amenity (Florida, 2004; Glaeser, 2012), the development of new technologies, innovation, and technological change (Cunningham, 2008; Jaaniste, 2009; Lee and Rodriguez-Pose, 2014), the level and type of employment (DCMS, 2016), and productivity (Chapain *et al.,* 2010).

Despite the diversity of the analyses piling up about the creative industries, little headway has been made to understand their role in the unequal development of cities in terms of more efficient usage of available resources by a society. Although it has been acknowledged that the concentration of creative activities drives productivity and has a differential impact on city growth, few studies address this phenomenon in the framework of a production frontier model or seek to quantify the effect of the creative sector on the level of technical efficiency (Mandula and Auci, 2013). At the urban scale, these concepts, fundamental to public policy, implicitly contain the requirement that cities need to be efficient in using resources as a whole. One way to understand this can be the production theory framework, but with the entity of analysis being the region or city.

Accordingly, it is appropriate to delve into the exploration with a sample of 59 Mexican cities in an attempt to quantify the effect of the creative sector on driving levels of technical efficiency; it is a conventional exercise just as if it were any other economic sector (for example, manufacturing). It is therefore necessary to specify that the purpose of the study is not the same as the Mundula and Auci (2013, 2016) study. To analyze creative activities and in this study, the more common classification system proposed by UNCTAD was used, adapted to the North American Industrial Classification System (NAICS). The sectors considered are listed in Table A1 (see Statistical Annex).

3. METHODOLOGY

Although the neoclassical paradigm in production theory supposes that the producers in an economy always operate efficiently (maximum possible product), in reality, they are inefficient. As similar as two companies may be, they never produce the same product, and their costs and benefits are never equal. These discrepancies can be explained in terms of efficiency and several unpredictable exogenous shocks. This is the basic idea that can be conceptually extrapolated for this case to explain differences across Mexican cities in terms of efficiency levels determined by the presence of sectors with creative activities.

Although a wide range of parametric and econometric methods have been developed to measure (in)efficiency, this paper employs the stochastic production frontier model with panel data, the technique originally developed for cross-sectional data by Aigner, Lovell, and Schmidt (1977) and Meeusen and van den Broeck (1977), which have evolved into applications with panel data. For details on the evolution of this methodology, see Kumbhakar *et al.* (2015), Greene (2008), Kumbhakar and Lovell (2000), and for non-parametric approaches, see Daraio and Simar (2007). In the panel data model framework, drivers of changes in efficiency are initially considered, subsequently leading to families of models, from the basic (fixed and random effects) to the more recent, which better separate the heterogeneity of persistent (or structural) inefficiency and variant inefficiency over time (Kumbhakar *et al.,* 2015).

Generally speaking, production frontier and efficiency models are built as follows. Briefly, given a vector of variables for the input of the producer-i,[3] there is a production function $f(x_i;\beta)$, which defines the maximum product possible, meaning a technical or potential maximum, known as the production frontier. What is interesting here is that even when the input vector x_i is exactly the same for different producers, nothing guarantees that they reach the maximum product. In other words, it is very possible for there to be a difference between the observed product y_i and the potential product, $y_i \le f(x_i;\beta)$, and the quotient $\frac{y_i}{f(x_i;\beta)}$, it is consistent to define as technical efficiency $(0 \le ET \le 1)$. As such, it is usual to define technical inefficiency as $IT = 1 - ET$, or equivalently, $IT = (f(x_i;\beta) - y_i) / f(x_i;\beta) \ge 0$, which measures that deficit or what is missing to reach the maximum product. This is salient to the methodological implementation, because inequality, $y_i \leq f(x_i;\beta)$ can be expressed also as inequality $\ln y_i = \ln f(x_i;\beta) - u_i$, with the addition of the $u_i \geq 0$ term, which is interpreted as technical inefficiency. This inequality ignores the role of uncontrollable or unpredictable factors, even when in reality these factors are numerous and it is inevitable that they will end up "accounted for" as randomness via a second error term v_i or random noise; neither u_i nor v_i are observable. That is why it can be justified to estimate the production function as a stochastic relationship specified by:

$$\ln y_i = \ln f(x_i;\beta) - u_i + v_i \qquad (1)$$

As an initial approach to the topic, the choice was made to use the Battese and Coelli (1995) panel data model, the first of its kind and in extremely widespread use still, which enables an estimate of the exogenous variables that alter the efficiency level, for example, those pertaining to the creative sector. The notation is direct to the case of panel data and, in practice, it is frequent to use a logarithmic transformation of the variables, so y_{it} is the log of the product for each metropolitan zone ZM-I and time t, x_{it} is a vector (k x 1) of producer-i input variables measured at time t, and there is a vector β of unknown parameters to estimate. A linear form is therefore assumed for $f(\cdot)$ as follows:

$$y_{it} = x_{it}\beta + (v_{it} - u_{it}) \qquad (i = 1,...,N; t = 1,...,T) \qquad (2)$$

The non-observable global error has thus been decomposed into a first component v_{it}, which is a random variable that is distributed pursuant to $[iid\ N(0,\sigma_v^2)]$ and a second component u_{it}, which is a random variable as well (non-negative), which supposedly captures the effects of technical inefficiency in the generation of the product and is independently distributed pursuant to a truncated normal distribution $N(m_{it},\sigma_u^2)$. The expected or average inefficiency, $E(u_{it}) = m_{it}$ is a function of the z_{it} variables that may affect the technical efficiency of the metropolitan zones and is expressed as follows:

$$E(u_{it}) = z_{it}\delta + \varepsilon_{it} \qquad (3)$$

Where z_{it} is a vector (1xp) of explanatory variables that could have an effect on the production function of a metropolitan zone and δ is a vector (px1) of parameters to estimate.

Looking at the explanatory variables in z in the inefficiency model, any variable could be included that explains the degree to which observed production falls below the stochastic frontier values.[4] The estimate of the parameters defined by equations (2) and (3) is done using the maximum likelihood method. The derivation of the likelihood function expressed in terms of the variance parameters $\sigma^2 = \sigma_v^2 + \sigma_u^2$ and $\gamma = \sigma_u^2 / (\sigma_v^2 + \sigma_u^2)$ can be found in Battese and Coelli (1993, pp. 19-22).[5] Given that the variables in (2) are in log terms, it is direct to express technical efficiency (ET) via:

$$ET_{it} = e^{-u_{it}} \qquad (4)$$

The Battese and Coelli (1995) model, still in widespread use, does suffer from major weaknesses, one of which is that it is not possible to correct for heteroscedasticity. In the stochastic frontier models and, in particular, maximum likelihood estimates, the presence of heteroscedasticity biases the coefficients by overestimating the intercept and underestimating their slope. That is why Caudill, Ford, and Gropper 81995) extended the model by assuming a functional form for heteroscedasticity (multiplicative type) in estimating the variance, expressed as: $\sigma_{u_{it}} = \exp(z_{it}\gamma)$, now dependent on a vector $z_{it}(1\times m)$ with control variables that explain the variance of this error component and a vector γ containing the coefficients associated with the z_{it} to estimate; u_{it} is distributed pursuant to a semi-normal, $u_{it} \sim N+(0,\sigma_{it}^2)$. Later on, Hadri (1999) added a similar specification to the idiosyncratic error term: $\sigma_{v_{it}} = \exp(z_{it}\theta)$, with $v_{it} \sim N(0,\sigma_{it}^2)$. Although the range of models has grown and become more complex (see Kumbhakar *et al.,* 2015), given the empirical scope of this research, the Battese and Coelli (1995) model was considered sufficient with the controls for heteroscedasticity mentioned before.

4. EMPIRICAL MODEL

This study analyzed economic performance in terms of efficiency in 59 metropolitan zones throughout Mexico[6] (see Map 1) inspired by the smart cities application in Mundula and Auci (2013). Both follow the model specified by Battese and Coelli (1995), using panel data (see Section 5).

The difference between this study and the Mundula and Auci (2013) study resides in the variables used, as the present study drew on conventional variables to measure capital stock and the labor factor as compared to houses per number of residents and length of the public transport network (km) as a measure of the capital factor, the number of employees for the labor factor, as is usual, and moreover added in human capital.

To quantify the effects of the inefficiency of smart cities, Mundula and Auci (2013) employed a set of six indicators in which they add in different observable variables. In this case, as this is a first approach, the variables of employed personnel and number of creative-sector economic units were used as variables indicative of size and concentration.

(SEE MAP 1)

Equation (2), relativized by a scale variable as a labor factor,[7] is thus estimated as an equation in terms of productivity, which is specified via a Cobb-Douglas function, linear in logs, and for our stochastic frontier model, is as follows:

$$\ln(VACB_{it} / PO_{it}) = \alpha_0 + \beta' \ln(ABKF_{it} / PO_{it}) + (v_{it} - u_{it}) \quad (5)$$

Where the dependent variable is the value of the product ZM-I at time t measured by the log of the quotient between the real gross census added value (VACB) and employed people (PO) in each metropolitan zone in the years 2003, 2008, and 2013. The input variable, also in relation to labor and in logs, was calculated as the quotient of gross fixed capital stock (ABKF) relative to employed people in each metropolitan zone in the same years.

$$u_{it} = \gamma_0 + \gamma_1 \cdot EC_{it} + \gamma_2 \cdot OC_{it} + \gamma_3 \cdot pEC_{it} + \gamma_4 \cdot pOC_{it} \quad (6)$$

Where EC_{it} is the number of creative economic units in the metropolitan zone i in year t; OC_{it} is the people employed in the creative activities, pEC_{it} is the concentration of creative activities measured by the participation of the creative units in the total productive units (as a percentage), and pOC_{it} is the concentration of creative employment with respect to total employment (as a percentage), both for metropolitan zone i in time period t.

One sensitive aspect in these models is the incorporation of external influences driving the efficiency level. These variables are not under full control of the observed unit (firm, state, region, etc.), but do impact its performance. It is usual in practice to distinguish two types of influences of this sort: *i*) the characteristics of the observed unit (regional heterogeneity), which affect its potential for individual production; and *ii*) the factors driving efficiency, such as: characteristics of the population, geographic traits, and other institutional aspects (Kalb, 2010). For each study in particular, underpinned by the economic and statistical theory available, these variables were selected.[8] Given the limited scope of this study, it is necessary to explore in this direction.

5. DESCRIPTIVE STATISTICS AND INTERPRETATION OF THE RESULTS

Table 3 provides the basic descriptive statistics for the census variables used in the analysis. At the detailed level, this is a (balanced) panel database consisting of 10 variables measured for each of the 59 metropolitan zones in Mexico in the years 2003, 2008, and 2013.

The estimated production frontier results are summarized in Table 4.[9] As is to be expected, capital density (capital per employed man) contributes positively to increasing the product per employed man (equivalent to general labor productivity) in the metropolitan zones, and does so inelastically given that its value is less than 1. This coefficient, which is statistically significant, is interpreted as an increase of 10% in the capital density in the metropolitan zones increases the product pertaining to labor by 4.95%. Because this is a simple model (one input and one output), the sum of the elasticities implies decreasing scale yields.

The coefficients of the four factors driving the technical efficiency level in the metropolitan zones, associated to variables indicating the size (measured by employed people and number of creative economic units) and concentration (measured by their relative shares in the total of the creative activity sector) are statistically significant. The OC and pOC coefficients show negative signs, indicating that both variables have a positive effect on reducing the inefficiency level (or raising efficiency). The other two variables (EC and pEC) display an effect contrary to what was expected, driving up inefficiency (or, on the flipside, diminishing efficiency). This basic, exploratory exercise does come with the inconvenience that it is a short-panel data model,[10] which may make it difficult to fully capture the behavior of several variables, such as the number of companies that over time tend to change more slowly than the employed people. Nevertheless, with the information available, it is the best approximation that can be had to the problem under study. Even so, it does contribute empirical evidence to go deeper into the topic.

With these same results from estimating the model (see Table 4), it is shown that the average technical efficiency level at which production is generated in Mexican metropolitan zones is barely 69.3%, which empirically documents the existence of a margin still to be explored in order to improve efficiency in the use of production factors.

Table 5 shows the ranking of the average (in)efficiency levels over the three years for each metropolitan zone, revealing that the highest levels appear in cities along the northern border of the country; the top two are: Reynosa-Río Bravo and Monterrey; of the ten metropolitan zones with the highest productive efficiency, eight are northern cities, with the exception of Valle de México, in third place, and Guadalajara, in sixth.

Table 3. Statistical Description of the Variables Used (N=177)

Variable	*Mean*	*Std. Dev.*	*Min*	*Max*
Variables of the production function				
v01 Economic units	37975.38	95224.54	3563	817973
v02 Total employed people	238907.4	615959.9	11520	5083414
v03 Gross census added value (millions of pesos)	60266.08	201094.9	-1866.652	1560131
v04 Gross fixed capital formation (millions of pesos)	4919.781	13727.85	-2174.09	123154.1
v05 Total fixed asset stock (millions of pesos)	74133.25	238055.4	745.118	2631453
Variables driving inefficiency and heteroscedasticity in the two components of the error				
v06 Economic units in the creative industries	737.8757	2089.502	12	17878
v07 Employed people in the creative industries	7163.825	28330.65	46	267200
v08 % Creative economic units	1.644511	0.4740448	0.2677974	2.633952
v09 % Total population employed in the creative industries	1.823916	0.8739864	0.1942157	5.25631
v10 Creative industry location index	0.6229619	0.2953954	0.0650575	1.584433

Source: Created by the authors

Table 4. Results of the Productive Efficiency Model in Mexican Cities, 2003-2013

Frontier	*Coeff.*	*Std. Err.*	*z*	*P>z*	*95% confidence interval*	
ln(FBKF/PO)	0.495	0.035	14.01	0	0.426	0.564
_cons	-0.611	0.167	-3.67	0	-0.937	-0.284
Mu:						
EC	0.257	0.084	3.05	0.002	0.092	0.423
OC	-0.335	0.079	-4.23	0	-0.49	-0.18
pEC	1.482	0.28	5.29	0	0.933	2.032
pOC	-1.137	0.225	-5.05	0	-1.578	-0.696
Usigma:						
pEC	-5.226	1.869	-2.8	0.005	-8.89	-1.563
pOC	3.452	1.044	3.31	0.001	1.405	5.498
Vsigma:						
pEC	-2.549	0.206	-12.4	0	-2.952	-2.146
pOC	2.421	0.323	7.5	0	1.789	3.053
E(sigma_u)	0.121				0.109	0.133
E(sigma_v)	0.266				0.263	0.269
	Obs	Mean	Std. Dev.	Min	Max	
u	176	0.382	0.14	0.088	0.746	
Exp(-u)	176	0.693	0.096	0.482	0.916	

Source: Created by the authors.

Table 5. Technical Efficiency and Inefficiency by Metropolitan Zone, 2003-2013

Ranking	*Metropolitan Zone*	*Inefficiency*	*Efficiency*
1	Reynosa-Río Bravo	0.124	0.884
2	Monterrey	0.126	0.882
3	Valle de México	0.153	0.861
4	Juárez	0.153	0.861
5	Tijuana	0.172	0.843
6	Guadalajara	0.224	0.802
7	Saltillo	0.236	0.790
8	Mexicali	0.254	0.777
9	La Laguna	0.262	0.770
10	Matamoros	0.268	0.767
11	Chihuahua	0.276	0.761
12	León	0.277	0.759
13	Toluca	0.292	0.748
14	Tehuantepec	0.298	0.745
15	Piedras Negras	0.311	0.734
16	Monclova-Frontera	0.318	0.728
17	Puebla-Tlaxcala	0.319	0.727
18	San Luis Potosí-Soledad de Graciano Sánc	0.322	0.726
19	Querétaro	0.324	0.725
20	Nuevo Laredo	0.331	0.720
21	Tula	0.336	0.715
22	Canaún	0.339	0.714
23	Tianguistenco	0.339	0.715
24	Guaymas	0.342	0.711
25	Poza Rica	0.347	0.711
26	Coatzacoalcos	0.351	0.708
27	Tampico	0.357	0.700
28	Aguascalientes	0.364	0.696
29	Orizaba	0.364	0.695
30	Cuernavaca	0.369	0.692
31	Mérida	0.370	0.693
32	Celaya	0.382	0.683
33	Villahermosa	0.395	0.674
34	Veracruz	0.405	0.668
35	Acayucan	0.410	0.665
36	Minatitlán	0.418	0.661
37	Puerto Vallarta	0.425	0.656
38	Acapulco	0.430	0.651
39	Tlaxcala-Apizaco	0.436	0.647
40	Pachuca	0.445	0.643
41	Tehuacán	0.446	0.642
42	La Piedad-Pénjamo	0.465	0.633
43	Morelia	0.477	0.622
44	San Francisco del Rincón	0.482	0.618
45	Córdoba	0.483	0.619
46	Oaxaca	0.488	0.614
47	Tuxtla Gutiérrez	0.495	0.610

Table A2 presents the ranking of the technical inefficiency values in greater detail for each year in the sample, reinforcing the congruence of the result: the top ten lowest-inefficiency places include the metropolitan zones in the north in all three years, although their rankings among each other did change; Table A3 supplements these results, showing which metropolitan regions rose in the ranking (with negative signs) or got worse in the national ranking (see Statistical Annex).

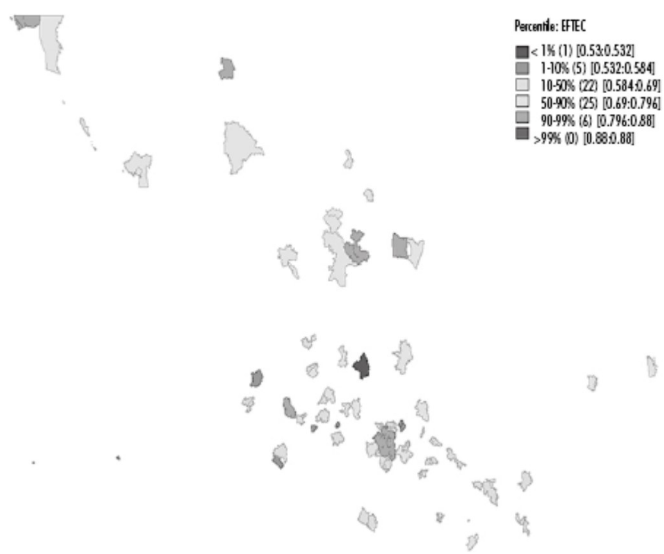
Looking at the values in this ranking, the map in Figure 1 shows the geographic location of the metropolitan zones by percentile. It emerges clearly that the efficiency levels are not randomly distributed across the national territory, and in effect, the improvement in efficiency (reduced inefficiency) responds to a pattern associated with the most dynamic economic spaces concentrating the metropolitan zones in the meso-regions: center-north with the highest levels of efficiency and center-south with the poorest performance. Dark gray tones point to efficiency above the median. The lighter tones are those below the median. It thus appears that four border cities, Valle de México, and Guadalajara have the highest efficiency percentile (see Figure 1).

They are followed in importance by a set of 25 cities located in the northern region, Bajío, and the Yucatan Peninsula. Gray tones reveal the cities with the lowest efficiency levels, where of the 28 cities in this category, most are in the southeast and in the Pacific region of the country, notably, Ríoverde, with the lowest observation in the entire sample of metropolitan zones.

The technical efficiency determined by the variables listed above in the creative sector displays a clear pattern of spatial dependence. Figure 2 shows the scatter plot of the Moran index, which resulted in a spatial dependency coefficient with a positive value of 0.32, which is evidence that there is a positive association across technical efficiency levels in the metropolitan zones.[11] This situation is confirmed in the map in Figure 2 showing the values for the local Moran index, clearly revealing the formation of a cluster of cities with high levels of efficiency in the north of the country and in Cuernavaca, Morelos, another of the cities with low efficiency levels in the state of Michoacán, and a cluster of high-efficiency cities surrounded by low-efficiency cities in the Pacific zone, Guadalajara, and in Cuautla, Morelos.

Finally, it also is clear that the efficiency levels are positively tied to the location of creative activities in Mexican metropolitan zones. Figure 3 shows a graphic panel in which technical efficiencies are positively tied with the weight of the creative economic units (UECR) in cities, with the weight of creative employment (POCR), and with regional specialization in creative activities (ESPCR).[12]

Figure 1. Technical Efficiency by Percentile in the Metropolitan Zones, Average 2003-2013



Source: Created by the authors.

(SEE FIGURE 2)

(SEE FIGURE 3)

6. FINAL CONSIDERATIONS

Mexican metropolitan zones represent the primary spatial concentrations of economic and population activity in the country. According to the latest census data from 2010, they generate around 70% of the national GDP and are home to 57% of the population. As part of the stochastic frontier analysis, 59 delimited metropolitan zones in Mexico were sampled to determine their economic behavior measured in terms of technical efficiency levels. An initial approach to the problem explored four descriptive variables in the creative sector as drivers of inefficiency levels and estimated the effect or impact on the rise in the product.

Pursuant to the results of this work, in Mexico, the metropolitan zones generate a product with an average overall efficiency level of just 69.3%, equivalent to inefficiency of 31.7%. Nevertheless, there is considerable variation between the top performer (88.4%) in the border metropolitan zone of Reynosa-Río Bravo and the lowest performer (53%) in the Ríoverde-Ciudad Fernández zone, so the range is 21%. This is further evidence of how heterogeneity in regional development is expressed.

Strikingly, technical efficiency was higher in the northern border countries and in Valle de México in the central area of the country. By contrast, the lower values clustered in southeastern Mexico. The exploratory analysis revealed that the border-area metropolitan zones in the north of the country constitute a cluster of highly technically-efficient cities, which in turn neighbor cities that are also highly efficient. This points to the conjecture that in some way, the location of companies that are very oriented toward exporting in these zones since the early nineteen-nineties has fueled the rise in technical efficiency and, therefore, in productivity in this region of the country. Finally, although it is just a basic model with a very restricted scope, the outcome furnishes initial empirical evidence as to the need for deeper comparisons with various models, in an endeavor to find more robust results.

STATISTICAL ANNEX

Table A1. NAICS Classification of Creative Industries

NAICS (1998)		*NAICS (2003)*		*NAICS (2008)*	
Code	*Name*	*Code*	*Name*	*Code*	*Name*
511	Print publishing and software	511	Print publishing and software	511	Newspaper, magazine, book, software, and other material publishers, and publishing integrated with printing
512	Film and sound industry	512	Film and sound industry	512	Film and video industry and sound industry
5131	Production, broadcasting, and reruns of radio and television shows	515	Radio and television, except Internet	515	Radio and television
5132	Production and distribution of subscription television programs	51411	News agencies	51911	News agencies
51411	News agencies				
5415	Computation consulting services	5415	Computation consulting services	5415	Computer system design services and related services
		5161	Creation and sharing of content exclusively online	51913	Editing and sharing of content exclusively online and web search services
5142	Electronic processing of information	518	Internet access providers, web search services, and information processing services	518	Electronic processing of information, hospitality, and other related services
5413	Consulting and design services in architecture, engineering, and related activities	5413	Consulting and design services in architecture, engineering, and related activities	5413	Architecture services, engineering, and related activities
5417	Scientific research and development services	5417	Scientific research and development services	5417	Scientific research and development services
54162	Environmental consulting services	54162	Environmental consulting services	54162	Environmental consulting services
54169	Other science and technical consulting services	54169	Other science and technical consulting services	54169	Other science and technical consulting services
5418	Advertising services and related activities	5418	Advertising services and related activities	5418	Advertising services and related activities
54191	Market research and public opinion survey activities	54191	Market research and public opinion survey activities	54191	Market research and public opinion survey activities
5414	Specialized design	5414	Specialized design	5414	Specialized design
54192	Photography services	54192	Photography services	54192	Photography and video recording services
54193	Translation and interpreting services	54193	Translation and interpreting services	54193	Translation and interpreting services
7111	Companies and groups of art shows	7111	Companies and groups of art shows	7111	Companies and groups of art and cultural shows
7115	Artists and independent technicians	7115	Artists and independent technicians	7115	Artists, writers, and independent technicians
51412	Libraries and archives	51412	Libraries and archives	51912	Libraries and archives
71211	Museums	71211	Museums	71211	Museums
No data for 71212		71212	Historical sites	71212	Historical sites
71213	Botanical gardens and zoos	71213	Botanical gardens and zoos	71213	Botanical gardens and zoos
7132	Casinos, lotteries, and other gambling games	7132	Casinos, lotteries, and other gambling games	7132	Casinos, lotteries, and other gambling games
7112	Athletes and professional	7112	Athletes and professional and	7112	Athletes and professional sports

Table A2. Technical Inefficiency (Ranking, Lowest to Highest)

2003		*2008*		*2013*	
nom_zm	*ranking*	*nom_zm*	*ranking*	*nom_zm*	*ranking*
Juárez	1	Valle de México	1	Reynosa-Río Bravo	1
Valle de México	2	Reynosa-Río Bravo	2	Monterrey	2
Monterrey	3	Monterrey	3	Saltillo	3
Reynosa-Río Bravo	4	Juárez	4	Tijuana	4
Tijuana	5	Tijuana	5	Juárez	5
Guadalajara	6	Guadalajara	6	Valle de México	6
Tehuantepec	7	Poza Rica	7	Ocotlán	7
Matamoros	8	Coatzacoalcos	8	Tianguistenco	8
Mexicali	9	Toluca	9	Mexicali	9
Chihuahua	10	Mexicali	10	Guadalajara	10
La Laguna	11	Chihuahua	11	La Laguna	11
León	12	Matamoros	12	Acayucan	12
Saltillo	13	Saltillo	13	León	13
Piedras Negras	14	La Laguna	14	Orizaba	14
Monclova-Frontera	15	León	15	Toluca	15
Puebla-Tlaxcala	16	Querétaro	16	Piedras Negras	16
Nuevo Laredo	17	Guaymas	17	Monclova-Frontera	17
San Luis Potosí-Soledad de Graciano Sánchez	18	Tianguistenco	18	Matamoros	18
Querétaro	19	Nuevo Laredo	19	Chihuahua	19
Mérida	20	Cancún	20	Puebla-Tlaxcala	20
Cancún	21	San Luis Potosí-Soledad de Graciano Sánchez	21	Tula	21
La Piedad-Pénjamo	22	Tehuantepec	22	San Luis Potosí-Soledad de Graciano Sánchez	22
Aguascalientes	23	Tula	23	Guaymas	23
Cuernavaca	24	Puebla-Tlaxcala	24	Tehuantepec	24
Toluca	25	Minatitlán	25	Veracruz	25
Tampico	26	Monclova-Frontera	26	Tampico	26
Tula	27	Tampico	27	Querétaro	27
Tehuacán	28	Aguascalientes	28	Celaya	28
Puerto Vallarta	29	Piedras Negras	29	Coatzacoalcos	29
Villahermosa	30	Veracruz	30	Nuevo Laredo	30
Guaymas	31	Mérida	31	Cuernavaca	31
Celaya	32	Celaya	32	Poza Rica	32
Pachuca	33	Villahermosa	33	Cancún	33
Orizaba	34	Cuernavaca	34	Aguascalientes	34
Tlaxcala-Apizaco	35	Orizaba	35	Villahermosa	35
Acapulco	36	Puerto Vallarta	36	Mérida	36
Córdoba	37	Pachuca	37	Minatitlán	37
Tecomán	38	Acapulco	38	Acapulco	38
Poza Rica	39	Acayucan	39	Tlaxcala-Apizaco	39
Morelia	40	Oaxaca	40	San Francisco del Rincón	40
Teziutlán	41	Tlaxcala-Apizaco	41	Puerto Vallarta	41
Coatzacoalcos	42	Tehuacán	42	Oaxaca	42
Tulancingo	43	Tuxtla Gutiérrez	43	Zamora-Jacona	43
Zacatecas-Guadalupe	44	Teziutlán	44	Pachuca	44
San Francisco del Rincón	45	Morelia	45	Tehuacán	45
Acayucan	46	Xalapa	46	Tuxtla Gutiérrez	46
Tianguistenco	47	Córdoba	47	Morelia	47

Table A3. Technical Inefficiency by Metropolitan Zone (Ranking, Lowest to Highest)

	Technical inefficiency, ranking			*Improvement (-) or decline (+) in the ranking*	
nom_zm	*2003*	*2008*	*2013*	*2008-03*	*2013-08*
Acapulco	36	38	38	2	0
Acayucan	46	39	12	-7	-27
Aguascalientes	23	28	34	5	6
Cancún	21	20	33	-1	13
Celaya	32	32	28	0	-4
Chihuahua	10	11	19	1	8
Coatzacoalcos	42	8	29	-34	21
Colima-Villa de Álvarez*	51		48		-2
Córdoba	37	47	53	10	6
Cuautla	53	51	50	-2	-1
Cuernavaca	24	34	31	10	-3
Guadalajara	6	6	10	0	4
Guaymas	31	17	23	-14	6
Juárez	1	4	5	3	1
La Laguna	11	14	11	3	-3
La Piedad-Pénjamo	22	49	54	27	5
León	12	15	13	3	-2
Matamoros	8	12	18	4	6
Mérida	20	31	36	11	5
Mexicali	9	10	9	1	-1
Minatitlán	49	25	37	-24	12
Monclova-Frontera	15	26	17	11	-9
Monterrey	3	3	2	0	-1
Morelia	40	45	47	5	2
Moroleón-Uriangato	57	57	56	0	-1
Nuevo Laredo	17	19	30	2	11
Oaxaca	52	40	42	-12	2
Ocotlán	59	54	7	-5	-47
Orizaba	34	35	14	1	-21
Pachuca	33	37	44	4	7
Piedras Negras	14	29	16	15	-13
Poza Rica	39	7	32	-32	25
Puebla-Tlaxcala	16	24	20	8	-4
Puerto Vallarta	29	36	41	7	5
Querétaro	19	16	27	-3	11
Reynosa-Río Bravo	4	2	1	-2	-1
Rioverde-Ciudad Fernández	55	58	57	3	-1
Saltillo	13	13	3	0	-10
San Francisco del Rincón	45	48	40	3	-8
San Luis Potosí-Soledad de Graciano Sánchez	18	21	22	3	1
Tampico	26	27	26	1	-1
Tecomán	38	53	59	15	6
Tehuacán	28	42	45	14	3
Tehuantepec	7	22	24	15	2
Tepic	58	50	49	-8	-1
Teziutlán	41	44	55	3	11
Tianguistenco	47	18	8	-29	-10
Tijuana	5	5	4	0	-1

BIBLIOGRAPHY

Aigner, D., Lovell, C. A. K. and Schmidt, P. (1977), "Formulation and Estimation of 25 Stochastic Frontier Production Function Models", *Journal of Economics*, 6.

Barro, R. and Sala-i-Martin, X. (2003), "Economic Growth", *The* MIT *Press Cambridge,* Second Edition.

Battese, G. E. and Coelli, T. J. (1993), "A Stochastic Frontier Production Function Incorporating a Model for Technical Inefficiency Effects", *Working Papers in Econometrics and Applied Statistics*, no 69, Department of Econometrics, University of New England. Available at: <http://www. une.edu.au/__data/assets/pdf_ le/0004/16087/emetwp69.pdf>

______ (1995), "A Model for Technical Inefficiency Effects in a Stochastic Frontier Production Function for Panel Data", *Empirical Economics* 20.

Belotti, F., Daidone, S., Ilardi, G. and Atella V. (2013), "Stochastic Frontier Analysis Using Stata", *The Stata Journal 13*, no. 4.

Berger, T. (2011), "An Overview and Analysis on Indices of Regional Competitiveness", *Review of Economics & Finance*.

Boix, R. and Soler, V. (2014), "Creative Industries and the Productivity of the European Regions", *International Conference on Regional Sciences, Universidad de Zaragoza*. Available at: <https://www.uv.es/raboixdo/references /2014/14005.pdf>

Caudill, S.B., Ford, J.M. and Gropper, D.M. (1995), "Frontier Estimation and Firm-Specific Inefficiency Measures in the Presence of Heteroskedasticity", *Journal of Business and Economic Statistics*, 13.

Chapain, C., Cooke, P., Propis L. D. *et al*. (2010), "Creative Clusters and Innovation", *NESTA Research report*, London.

Cunningham, S. (2008), From "Creative Industries to Creative Economy", in G. Hearn and D. Rooney (eds.), *Knowledge Policy: Challenges for the 21st Century*, Cheltenham, Edward Elgar.

Daraio, C. and Simar, L. (2007), "Advanced Robust and Nonparametric Methods in Efficiency Analysis: Methodology and Applications", *Springer Science+Business Media*, LLC.

DCA (1994), "Creative Nation: Commonwealth Cultural Policy, Department of Communications and the Arts" (DCA). Available at: <http://pandora.nla.gov.au/pan/21336/20031011-0000/www.nla.gov.au/creative. nation/contents.html>

DCMS (1998), "Creative Industries Mapping Document, Department for Culture, Media and Sport". Available at: < https://www.gov.uk/government/publications/creative-industries-mapping-documents-1998>

______ (2001), "Creative Industries Mapping Document, Department for Culture, Media and Sport". Available at: < https://www.gov.uk/government/publications/creative-industries-mapping-documents-2001>

______ (2015), "Creative Industries Economic Estimates: January 2015", London Department for Culture Media and Sport. Available at: <https://www.gov.uk/government/statistics/creative-industries-economic- estimates-january-2015>

______ (2016), "Creative Industry Statistics", Available at: < https://www. gov.uk/government/statistics/creative-industries-economic-estimates- january-2016 >

Del Gatto, M., Di Liberto, A. and Petraglia, C. (2011), "Measuring Productivity", *Journal of Economic Surveys*, vol. 25, no. 5.

Florida, R. (2002), *The Rise of the Creative Class,* Basic Books, New York, USA.

______ (2004), *Cities and the Creative Class*, Routledge, London.

______ (2008), *Who's your City? How the Creative Economy is Making Where You Live the Most Important Decision of your Life*, Basic Books, New York, USA.

Fried, H., Knox Lovell, C. and Schmidt, S. (2008), "Efficiency and Productivity", Chapter 1, in H. Fried, C. Knox Lovell and S. Schmidt, *The Measurement of Productive Efficiency and Productivity Growth*, Oxford University Press.

Fujita, M. and Thisse J. F. (2002), *Economics of Agglomeration: Cities, Industrial Location, and Regional Growth,* Cambridge University Press, Cambridge.

Fujita, M., Krugman, P. and Venables, A. J. (1999), *The Spatial Economy. Cities, Regions, and International Trade*, MIT Press.

Ghosh, S. and Mastromarco, C. (2013), "Cross-border Economic Activities, Human Capital and Efficiency: A Stochastic Frontier Analysis for OECD Countries", *The World Economy*, DOI: 10.1111/twec.12010.

Glaeser, E. (2012), *El triunfo de las ciudades*, Taurus Ediciones, Madrid, Spain.

Greene, W. H. (2008), "The Econometric Approach to Efficiency Analysis", Cap. 2, in H. Fried, C. Knox Lovell and S. Schmidt, *The Measurement of Productive Efficiency and Productivity Growth,* Oxford University Press.

Grosskop, S. (1993), *Efficiency and Productivity, the Measurement of Productive Efficiency: Techniques and Applications*, edited by H. Fried, C. Knox Lovell and S. Schmidt, Oxford University Press.

Hadri, K. (1999), “Estimation of a Doubly Heteroscedastic Stochastic Frontier Cost Function”, *Journal of Business & Economic Statistics*, vol. 17, no. 3.

Hay, D. and Liu, G. (1997), “The Efficiency of Firms: what Difference does Competition Make?”, *The Economic Journal* 107.

Higgs, P., Cunningham, S. and Bakhshi, H. (2008), “Beyond the Creative Industries: Mapping the Creative Economy in the United Kingdom”, *London Nesta*.

Instituto Nacional de Estadística y Geografía (INEGI) (2013), Sistema de Cuentas Nacionales de México: Productividad Total de los Factores 1990- 2011.

Jaaniste, L. (2009), “Placing the Creative Sector within Innovation: The full Gamut. Innovation”, *Journal Innovation Organization and Management*, vol. 11, no. 2.

Jondrow, J., Lovell, C. K., Materov, I. S. and Shmidt, P. (1982), “On the Estimation of Technical Inefficiency in the Stochastic Frontier Production Function Model”, *Journal of Econometrics*, 19.

Kalb, A. (2010), “Public Sector Efficiency: Applications to Local Governments in German”, Serie Gabler research, Gabler Verlag (ed.). Available at: <https://books.google.com.mx/books?id=7qseijgEoGEC>

Krugman, P. (1994), “Competitiveness: a Dangerous Obsession, Foreign A airs”, vol. 73, no. 2, March-April.

Kumbhakar, S.C., Denny, M. and Fuss, M. (2000), “Estimation and Decomposition of Productivity Change when Production is not Efficient: A Panel Data Approach”, *Econometric Reviews*, vol. 19(4).

______ and Knox Lovell, C. (2000), *Stochastic Frontier Analysis*, Cambridge University Press.

______, Wang, K. J. and Horncastle, A. (2015), *A Practitioner´s Guide to Sthochastic Frontier Analysis Using Stata*, Cambridge, Cambridge University Press.

Landry, C. (2000), *The Creative City: A Toolkit for Urban Innovators,* Earthscan, London.

Landry, C. and Bianchini, F. (1995), *The Creative City*, Demos, London.

Lee, N. and Rodriguez-Pose, A. (2014), “Creativity, Cities, and Innovation”, *Environment and Planning A*, 46(5).

Lobo, J., Bettencourt, L.M.A., Strumsky, D. and West, G.B. (2013), “Urban Scaling and the Production Function for Cities”, PLoS ONE 8(3): e58407. DOI:10.1371/journal.pone.0058407. Available at: <http:// journals.plos.org/plosone /article?id=10.1371/journal.pone.0058407>

Marshall, A. (2006), *Principios de Economía*, Editorial Síntesis, Madrid, Spain based on the first 1891 edition.

Martin, R., Kitson, M. and Tyler, P. (2004), “Regional Competitiveness: An Elusive yet Key Concept?”, *Regional Studies*, vol. 38:9, December.

Meeusen, W. and van den Broeck, J. (1977), “Efficiency Estimation from Cobb- Douglas Production Functions with Composed Error”, *International Economic Review*, 18.

Melo, S., Graham, D. J. and Noland, R. B. (2009), “A Meta-analysis of Estimates of Urban Agglomeration”, *Economies Regional Science and Urban Economics,* vol. 39, no. 3, pp. 332-342.

Mundula, L. and Auci, S. (2013), “Smart Cities and a Stochastic Frontier Analysis: A Comparison Among European Cities”. MPRA Paper No. 51586, 1-40, posted 20. November 2013 15:57 UTC. Available at <http://mpra. ub.uni-muenchen.de/51586/>

______, Auci, S. and Vignani, D. (2016), “Defining Smart Cities: a Relative and Dynamic Approach”. Available at <http://www.corp.at/archive/ CORP2016_10.pdf>

Nishimizu, M. and Page, JM. (1982), “Total Factor Productivity Growth, Technological Progress and Technical Efficiency Change: Dimensions of Productivity Change in Yugoslavia, 1965-78”, *Economic Journal*, 92.

OECD (2001), *Measuring Productivity, Measurement of Aggregate and Industry- level Productivity Growth* (Manual).

Pratt, A. C. (1997), “The Cultural Industries Production System: a Case Study of Employment Change in Britain, 1984-91”, *Environment and Planning A* 29.

Sedesol (2010), “Delimitación de las zonas metropolitanas”. Available at <http://internet.contenidos.inegi.org.mx /contenidos/productos/prod_ serv/contenidos/espanol/bvinegi/productos/geografica/publicaciones/deli-mex10/DZM20101.pdf>

Solow, R. M. (1957), “Technical Change and the Aggregate Production Function”, *Review of Economics and Statistics*, 39.

UNCTAD (2008), “Creative Economy, United Nations” UNCTAD. Available at: <http://unctad.org/es/docs /ditc20082cer_en.pdf>

______ (2010), “Creative Economy Report 2010”. Available at <http:// unctad.org/es/Docs/ditctab20103_en.pdf >

______ (2015), “Creative Economy Outlook and Country Profiles: Trends in International Trade in Creative Industries”.

Disponible en <http://unctad. org/en/PublicationsLibrary/webditcted2016d5_en.pdf>

Yencken, D. (1988), *The Creative City* [online]. Meanjin, vol. 47, no. 4, Summer. Available at: <https://search.informit.com.au/documentSummar y;dn=582212487737872;res=IELLCC>

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[2] Works have abounded in the Solow vein under the term growth accounting, which is the methodology the OECD (2001) and INEGI (2013) use. In their framework, productivity is determined by total factor productivity (TFP) and is measured as a residual term not explained by the growth of production factors (inputs). The term is moreover associated with technical progress (incorporated and otherwise).

[3] In general, we're talking about the ith unit under observation, which may be: individual, company, economic activity sector, country, region, state, municipality, city, or metropolitan zone.

[4] The vectors may include: i) the first element equal to one, ii) include some input variable required for the production function, and/or iii) interactions between variables specific to the metropolitan zone and input variables; whatever the case may be (See Battese and Coelli, 1993, p. 5).

[5] Because γ provides asymptotically efficient estimates, it is necessary to have a significance test for this parameter; a significance test of the specification of the stochastic frontier where accepting the null hypothesis that the true value of the parameter is equal to zero implies that the non-random component of the residual of the production function () is zero.

[6] In Mexico, the metropolitan zones are delimited by the Secretariat of Social Development (Sedesol). At present, there are 59, defined as "…a set of two or more municipalities where a city of 50,000 inhabitants or more is located, whose urban area, functions, and activities exceed the borders of the municipality originally containing them, incorporating as part of itself or as its area of direct influence its neighboring municipalities, predominantly urban, thereby maintaining a high degree of socioeconomic integration. It also includes any municipalities which, due to their unique characteristics, are relevant to urban planning and policy in the metropolitan zones in question. Additionally, metropolitan zones are defined as any municipality containing a city of one million or more inhabitants, or those cities with 250,000 or more inhabitants sharing conurbation processes with cities in the United States" (Sedesol, 2010).

[7] In an attempt to eliminate or ameliorate the potential problems pertaining to heteroscedasticity, multicollinearity, and product measurements (Hay and Liu, 1997).

[8] When the information is not a limiting factor, in general, this type of stochastic frontier model linked to an inefficiency model is structured with a set of different types of variables: variables pertaining to the productive structure (conventional inputs and outputs for the production function), variables driving the level of technical inefficiency, institutional and location variables, and, when the panel is long, the variables of control due to effects from the economic cycle or other sorts of external shocks.

[9] The calculations were performed in STATA with the Belotti et al. (2013) software.

[10] Bear in mind that, for example, the fixed effects model requires estimating as many α_i parameters as cross-section units present in the data ($i=1,\ldots, N$) and they go up with the size of N, which emerges as the problem of incidental parameters and in this situation, consistency cannot be guaranteed and the estimate is biased, so long panel databases are needed, $T>10$ (Parmeter and Kumbhakar, 2014; Belotti et al., 2013; Greene, 2005). We believe that this is the case here, our data panel is short: N (=59) is relatively big with respect to the periods T(=3). Nevertheless, the standard random and fixed effects models were run, but with the latter, no solution was reached.

[11] The Moran index was calculated using the GeoDa program and a matrix of spatial weights considering the four closest neighbors. For details about how it is calculated, see Yencken and Mendoza (2009).

[12] Specialization is measured using a location index relating the weight of creative employment in a metropolitan zone to total employment in that zone. That coefficient is divided by the share held by creative employment in the country total.

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