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ORIGINAL ARTICLE

Productivity and agglomeration economies in the manufacturing of the metropolitan areas of Mexico, 1998–2018

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Abstract

Mexico has experienced intense urbanization in recent decades. Although all the metropolitan areas of the country have grown, the size generated by the megalopolis of the Valle de México is especially relevant since it is able to generate more intense *agglomeration economies* than those of the rest of the urban concentrations. This heterogeneity in the urban structure of the country makes the analysis of the effect of *agglomeration economies* on productivity for the Mexican case especially interesting. Through a panel model with fixed effects, we studied the effects of *agglomeration economies* on labor productivity of the manufacturing industry in the metropolitan municipalities of Mexico. We propose an adaptation of the model of Combes (2000) to isolate the effects of *localization economies* though a specialization index and *urbanization economies* though an index of economic diversity and occupational density. Our results indicate that specialization and the level of economic diversity clearly contribute to explaining the productivity levels of manufacturers among metropolitan municipalities.

KEYWORDS

agglomeration economies, manufacturing productivity, metropolitan areas and Mexico

JEL CLASSIFICATION
R11; R12; O47

1 | INTRODUCTION

Like what has happened all over the planet, Mexico has experienced an intense urbanization process in recent decades. Figure 1 shows the map of the large metropolitan areas in Mexico: a total of 74 metropolises includes 417 municipalities and represents an approximate population of 75 million inhabitants, which is 63% of the total population of the country. However, the urban structure of Mexico is very unbalanced. The metropolitan area of the Valle de México includes approximately 21 million inhabitants with an average density of 160 inhabitants per km^2, and this makes it one of the most relevant urban concentrations in the world. The rest of the metropolitan areas of the country present more standard figures.

This heterogeneous urban structure, with a huge urban concentration in the center of the country and many other metropolitan areas along the rest of the Mexican geography, will affect both the distribution of economic activities and the dynamics of the growth and development of the entire national territory. Numerous studies analyze how the urban agglomeration of the Valle de México affects the spatial distribution of economic performance throughout the territory. As an example, the works of Díaz et al. (2019), Gardiner et al. (2013), Garduño (2014), Rodríguez-Gámez and Cabrera-Pereyra (2017), and Sanchez Reaza (2010), among others, can be consulted.

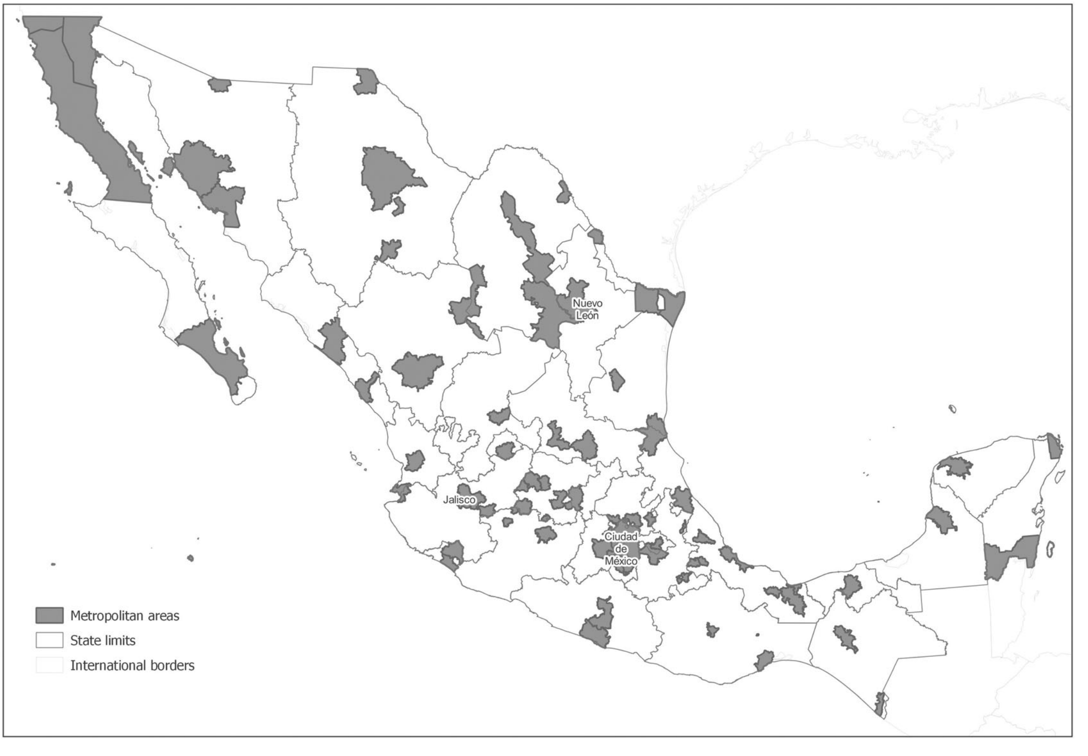

FIGURE 1 Metropolitan areas in Mexico
Source: Based on the National Geostatistical Framework (INEGI, 2013) and CONAPO et al. (2018)

However, the number of studies focused on how this urban structure and the effect of the *agglomeration economies* of the massive urban concentration of Mexico affect the productivity of economic activities is more limited.

The literature that explores the effects of agglomeration economies on productivity has studied, among other aspects, the relationship between the density of economic activity and increasing returns (Ciccone & Hall, 1993); the influence of the distance between economic units in large cities on productivity (Rice et al., 2006); and how the agglomeration of technological activities and distance influence product growth and productivity (Antonelli et al., 2011). Much more recently, there are attempts to distinguish more accurately, both theoretically and empirically, between the various types of agglomeration economies and their relation to growth and productivity (McCann & Van Oort, 2009). It has been specified, on the one hand, that the concept of related variety (described by Jacobs, 1973) measures the effects of agglomeration economies on regional growth best and, on the other hand, that the nonrelated variety can be a way to explain how a region it supports exhibits variations in its occupational levels in response to changes in its external demand (Frenken et al., 2007). Regarding the relationship between the related and unrelated variety and its effects on productivity, the work of Aarstad et al. (2016) stands out.

One of the most interesting contributions in the analysis of the agglomeration economies in the Mexican metropolitan areas was the OECD report, edited by Kim and Zangerling (2016). The authors argue that the metropolitan areas of Mexico, particularly the metropolitan area of Valle de México, were not able to take advantage of agglomeration forces. Kim and Zangerling (2016) state that 'compared to the international level, Mexican cities seem to benefit only weakly from the increase in size and economies of agglomeration to achieve higher levels of productivity, particularly Mexico City'. They also remarked that 'economic density may not be particularly relevant to the productivity of the manufacturing sector because most of the growth and productivity of the manufacturing sector are driven by the cost and quality of production factors such as land, labor and capital. In fact, the relationship between density and manufacturing productivity in Mexico shows a negative correlation, which means that the lower the density, the more productive will be the manufacturing sector in Mexico' (p. 47).

More recently, Rodríguez-Castelán et al. (2018) studied the potential impacts of competition on productivity in the manufacturing industry with a database for more than 70 metropolitan areas in Mexico disaggregated at the municipal level that contains data on concentration and productivity. These authors find an inverted U-shaped relationship between concentration levels and productivity. Garduño (2014) finds that productivity per worker in the areas closest to the northern border exhibited higher growth, and municipalities that also had a high population density, high schooling, and some provision of infrastructure. De León-Arias and Llamosas-Rosas (2016) try to figure out the association between a measure of agglomeration, say specialization, and productivity growth in the context of Mexican trade liberalization. Their main idea is that 'if trade liberalization implies, in regional terms, relocation or moving of the central market for 'national' firms, from the 'interior' to the 'foreign' market, new geographical economics anticipates that technological externalities would promote some productivity growth in places close to the new market' (De León-Arias & Llamosas-Rosas, 2016: 44). Nevertheless, up to 2003, the productivity in the northern border of Mexico has not been affected by the openness process; moreover, the concentrations in Center of Mexico showed a better performance. The shape of the urban concentrations in Mexico and its association with the economic performance has been studied by Monkkonen et al. (2020: 1), who evaluate if 'land-intensive manufacturing activities are more productive than services'. They found a negative association between compactness and productivity.

In addition to these papers and other previous contributions, such as Deichmann et al. (2004) and Braun and Cullmann (2008, 2011), there are a few additional works that analyze the spatial effects of *agglomeration economies* in Mexico Glaeser et al. (1992) and Escobar (2016), and they find some association between labor productivity and their spatial lag.

We believe that there is room for the study of the effects of *agglomeration economies* in this country. In particular, the aim of this paper is to analyze the relevance of the different types of *agglomeration economies* to the labor productivity of manufacturing activities. To reach more interesting conclusions from a spatial perspective, we use desegregated municipal-level data. This will allow us to observe the effects of the different types of *agglomeration economies* between and within metropolitan areas.

The *externalities* generated for a large concentration of population and economic activity in a limited area, the *agglomeration economies*, can be divided into two types: *localization economies* and *urbanization economies*. *Localization economies* describe the externalities caused by the interaction of activities of the same sector. This interaction attracts specialized workers, suppliers, and access to knowledge. *Urbanization economies* mean that the concentration of the activity triggers relationships between individuals – known as social capital – and infrastructure, such as railways, innovation centers, or hospitals. Parr (2002) summarizes this idea with a modern and clear delimitation of the *agglomeration economies* concept.

Our intention is to isolate the two types of *agglomeration economies* using three measures: first, an economic specialization index to evaluate the *localization economies*; second, an economic diversification index; and finally, a measure of the occupational density to capture different dimensions of the concept of *urbanization economies*. A model based on the seminal proposal of Combes (2000) is developed to identify the relationship among these three measures of *agglomeration economies* and manufacturing labor productivity. Locally (by municipalities) disaggregated data are taken from the economic census of Mexico for the years 1998, 2003, 2008, 2013, and 2018 and elaborated by the National Institute of Statistics and Geography (INEGI) of Mexico.

The structure of the remainder of this paper is as follows. In the next section, the model from which we started, inspired by Combes (2000), and all the empirical and dataset details are presented. In the third section, the main results are shown and discussed. The paper is completed with a final section of conclusions and policy recommendations.

2 | MODEL SPECIFICATION AND EMPIRICAL APPROACH: DATA SOURCES, SPATIAL UNIT OF ANALYSIS, AND VARIABLE DEFINITIONS

2.1 | Model specification

As stated in the previous section, the objective is to explain the differences in manufacturing productivity within and between the metropolitan areas of Mexico through three measures of *agglomeration economies* incorporated in the same specification. The model that we use is inspired by the seminal paper of Combes (2000).

Departing from information spatially desegregated at the local level, we define variable f as labor productivity. This variable can be calculated at the metropolitan level, f_z, where z is each of the metropolitan areas of the country; or at the local level, f_i, where i is each of the local areas (municipalities in our case). Here, we will use the labor productivity of manufacturing activities by municipalities, f_i.

The productivity of each municipality can be regressed with specific indicators of the different types of *agglomeration economies*. In this work, an economic specialization index (*loc*) is used to evaluate the *localization economies*, and an economic diversification index (*urb1*) and a measure of the occupational density (*urb2*) are constructed to capture different dimensions of the concept of *urbanization economies* (in the next section, all the indicators used will be explained).

The expression of this regression is given in the following equation:

$$f_i = \alpha_i + \beta_1 loc_i + [\beta_2 urb1_i + \beta_3 urb2_i] + u_i \tag{1}$$

Theoretically, there are several elements that explain the fact that *agglomeration economies* (whether *diversification* or *specialization*) influence employment growth or productivity levels. One of them is the so-called information spillovers that are explained by Glaeser et al. (1992), or those based on market interactions, as described by Abdel-Rahman and Fujita (1993). In addition, our referenced author refers to the size of the local economy and how it can be measured by the total employment density. The referenced author also explains how local competition influences the phenomenon of interest and how it is affected through the average plant size. The expected signs of our three measures of *agglomeration economies* are as follows:

- *Localization* (*loc*): a positive relationship is expected on labor productivity through economies of scale and the existence of Marshall economies
- *Diversity* (*urb1*) and *density* (*urb2*): as types of *urbanization economies*, well described by Frenken et al. (2007), these variables are expected to have positive effects on productivity through knowledge spillovers and complementarity among sectors

Consequently, in Equation [1]:

- If $\hat{\beta}_1$ is, as expected, positive, this would mean that an increase of one percentage point in the *specialization* of the metropolitan municipalities would increase the productivity level of that municipality by the value of $\hat{\beta}_1$
- If $\hat{\beta}_2$ is, as expected, positive, this would mean that an increase of one percentage point in the *diversification* of the metropolitan municipalities would increase the productivity level of that municipality by the value of $\hat{\beta}_2$
- Finally, if $\hat{\beta}_3$ is, as expected, positive, this would mean that an increase of one percentage point in the *urbanization* of the metropolitan municipalities would increase the productivity level of that municipality by the value of $\hat{\beta}_3$

2.2 | Dataset

The sources of information for this study come from the economic census with information on the economic activity of the metropolitan municipalities corresponding to the years 1998, 2003, 2008, 2013, and 2018 published by the National Institute of Statistics and Geography (INEGI) of Mexico. This is a very rich database that offers us the possibility of applying the modeling proposed in the previous section regarding the three key variables, although somewhat limited in the set of available control variables. In this section, the calculation of each of the variables used is explained.

2.3 | Spatial unit of analysis

The metropolitan areas of Mexico, delimited by the central government, are heterogeneous: there are those that are integrated by only one municipality (as in the case of Ensenada or Mexicali in northern Mexico) and those that contain a significant number of municipalities and population concentrations (such as those in the Valle de México, Guadalajara, or Monterrey). Since 2015, there have been 74 metropolitan areas in Mexico composed of 417 municipalities (CONAPO, et al., 2018: 35) (see Figure 1 presented in previous section). The average urban density (population/ha) of the metropolitan areas is 108.3. In addition, the metropolitan area with the highest average density is the Valle de México with 160 people/ha, followed by the metropolitan areas of León with 125.9 people/ha, Guadalajara with 123.4 people/ha, Monterrey with 108.3 people/ha, and San Luis Potosí with 105.6 people/ha.

The database used consists of 376 records of metropolitan municipalities, 41 municipalities less than the total in 2015. The records of those municipalities have not been considered due to one of the following reasons: (i) they did not have manufacturing activity registered in any of the census sections or they reported negative value added from manufacturing; (ii) the total economic activity reported negative added values, so that the coefficients of specialization and diversity do not make sense; or (iii) some of the control variables did not have a record.

2.4 | Dependent variable: Labor productivity of manufacturing activities

The labor manufacturing productivity of metropolitan municipalities, f_i, is defined as:

$$f_i = \frac{VA_i}{PO_i} \tag{2}$$

where VA_i is the gross value added of the manufacturing in municipality *i* (thousands of pesos at 2013 prices) and PO_i is the total number of people employed in manufacturing in that municipality (number of people). This productivity measure excludes the values corresponding to subsector 324, which is petroleum and coal products manufacturing, since this activity is usually located in places that do not respond to agglomeration forces but rather to the natural conditions of the territory.

It must be stated that the productivity measure that we use is not adjusted to consider some factors that influence its level, such as the work intensity, and it is not possible to consider the effective hours or days worked for each person hired. These factors undoubtedly would generate a bias in our estimation; however, it is not possible to correct them with the available information.

2.5 | Main independent variables: Measures of *localization* and *urbanization economies*

2.5.1 | *Specialization index for* location economies

The specialization index for *location economies*, the variable *loc*, is defined as the proportion of the value added of the manufacturing sector in the metropolitan municipality divided by this proportion at the national level:

$$loc_i = \frac{VAM_i / VAT_i}{VAMT / VAT} \tag{3}$$

where VAM_i is value added of the municipality's manufacturing (without the oil industry); VAT_i is total value added of the set of economic activities of municipality i (without the oil industry); *VAMT* is added value of manufacturing nationwide; and *VAT* is the total value added at the national level, all variables in real terms.

2.5.2 | *Diversity and density for* urbanization economies

Urbanization economies refer both to the existence of diverse activities in the environment and to the maximization of knowledge in the area or the potentialities due to a great population concentration. In the literature, it is common to measure diversity using a diversity index but also consider maximizing the knowledge and dimensions of the area using either size or density (see McCann & Van Oort, 2009 or Frenken et al. (2007), among others).

First, we measure the economic diversity of each area *i* using the Herfindahl–Hirschman Index (*HHI*) in Martin et al. (2018):

$$HHI_i = \sum_{j=1}^{N} s_{ij}^2 \tag{4}$$

where s_{ij} is the participation of the region *i* on the value added of sector *j* of each metropolitan municipality with respect to the total value added of the municipality.

The HHI compares the existing sectorial participation in an area with respect to a situation with equal shares of value added. The minimum value of the *HHI* is $1/N$ where *N* is the number of sectors considered in the economy. When the *HHI* takes this value, it means that all sectoral shares are equal, so there is maximum diversity in the economic structure. The maximum value that the *HHI* can take is 1, which would happen when an area is completely specialized in a single activity. That is, the nearer the *HHI* is to 1, the greater the degree of specialization of the area. Therefore, the larger the inverse of the *HHI* is, the greater the degree of diversity of the region:

$$urb1_i = \frac{1}{HHI_{i,j}} \tag{5}$$

In addition, it is possible to use a density measure to capture the effect of the other dimension of *urbanization economies* given by the density of the total employment with data from the economic census:

$$urb2_i = \frac{POT_i}{Area_i} \tag{6}$$

where POT_i is the total number of persons employed in the economy of municipality *i*, and *Area* is the area of the municipality in km^2.

2.6 | Control variables: Scale of production and capital density

Based on Combes (2000) and the later extensions of Frenken et al. (2007) and Witte (2012), we use several variables currently suitable as estimation controls. Among these variables, we calculate the following two controls: the scale of production and capital density.

First, to the extent that economies of scale are associated with higher productivity, the magnitude of the scale of production is a variable to be considered, which in this case we define as:

$$size_i = \frac{PO_i}{UE_i} \tag{7}$$

where UE_i is the number of manufacturing economic units in municipality *i*, and PO_i is the number of persons employed in manufacturing activities in municipality *i*.

Second, we also include a measure of capital density that is defined as:

$$kd_i = \frac{AF_i}{PO_i} \tag{8}$$

where AF_i is the net fixed assets of the manufacturing of municipality *i*, and PO_i is the total number of persons employed in the manufacturing in municipality *i* (number of people).

3 | RESULTS AND DISCUSSION

3.1 | Preliminary data analysis

Table 1 and Table A (in the appendix) present the descriptive statistics of the variables considered in our analysis: the *location (loc)* and *urbanization (urb1 and urb2)* indicators and the two added control variables, *size* and capital density (kd). Table 1 reports the descriptive statistics adding together all the observed years; meanwhile, Table A in the appendix shows these same descriptions for each year: 1998, 2003, 2008, 2013, and 2018. Apart from the significant increase experienced by productivity, the behavior of the independent variables is stable over time. Employment density, that is, *urb2*, experiences significant growth, and furthermore, it is the variable with the greatest dispersion, reflecting the existing heterogeneity between the metropolitan areas of Mexico.

This previous descriptive analysis was completed using correlation analysis, and the form distribution and scatter plots are presented in Figure 2. It is noteworthy that the variable that has the greater degree of association with productivity is capital density, (*kd*), which has a positive correlation coefficient equal to 0.54. Similarly, the degree of specialization measured using the localization quotient (loc) in the manufacturing of metropolitan municipalities shows a positive correlation equal to 0.51; furthermore, plant size (*size*) has a correlation equal to 0.27. However, the measure of diversity (*urb1*) shows a negative relationship equal to 0.28, and occupational density (*urb2*) shows a small positive association.

3.2 | Estimation results with a panel model with fixed effects and temporal dummies

As we do not have information to expand the control variables and have a data structure that allows it, the most appropriate estimation strategy for our analysis is a panel model with fixed effects (FE).[1] Table 2 presents the results of model I, which includes only our three measures of agglomeration economies, and model II, which shows the results of a fixed-effects model that includes the control variables plant size and capital density. Temporal dummies were included in both estimations to capture the temporal trajectory.

3.3 | Discussion of the results

Our attention will be focused on the results obtained with model II, which are more complete when including the two incorporated control variables. Both control variables are significant, with a positive sign for capital density and a negative sign for the size of production plants. The sign obtained for the coefficient of the *size* variable is contrary to what might be expected, although Combes (2000) obtained similar results. As Combes himself states, this result

TABLE 1 Summary of the base model variables, total observations

Variable	Means (unweighted)	Std. dev.	Min	Max
fi	224.09	320.60	0.051	3,222.45
loc	439.91	734.98	0.007	2,924.24
*urb*1	4.40	1.74	1.141	12.93
*urb*2	358.62	1,566.72	0.128	27,019.21
size	14.47	21.98	1.125	313.23
kd	241.81	586.86	0.011	8,796.67

Source: Based on the Economic Censuses of 1999, 2004, 2009, 2014 and 2019; INEGI.

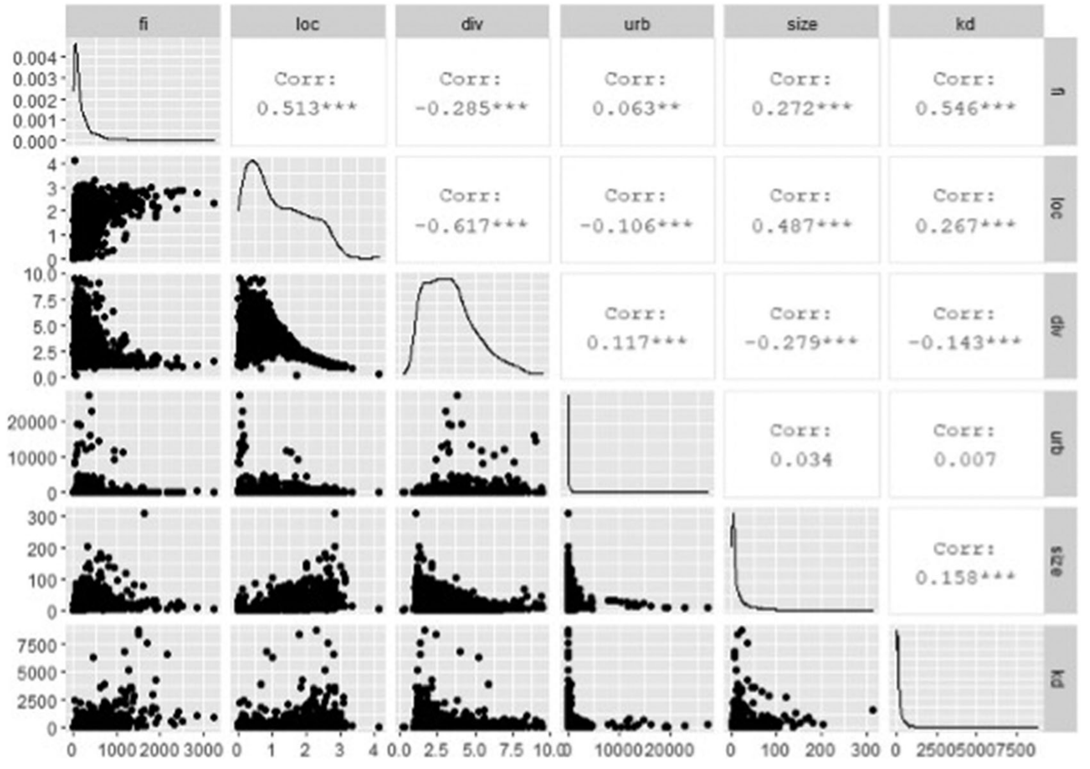

FIGURE 2 Distribution form, linear correlation and scatter plots of the model variables.
Note: Significance levels are: *** (0. 001), ** (0.01), * (0.05).
Source: Based on the Economic Censuses of 1999, 2004, 2009, 2014 and 2019; INEGI

should not be interpreted as a negative effect of scale but rather that larger activities are most likely more labor intensive and, therefore, capable of experiencing lower increases in productivity. Capital density is positive and significant, supporting the idea of the importance of the value of capital per worker for manufacturing productivity, this particular result was founded by Escobar (2016:1092) for Mexican economy.

Focusing on the key variables with which we intend to approximate the effect of *agglomeration economies*, we can see that they are all significant, although diversity (*urb1*) is negative. While the results are not directly comparable, Witt (2011) finds a similar effect of unrelated variety (kind of diversification) and labor productivity growth to the European regions.

The specialization indicator, *loc*, is positive; and the coefficient is the highest of the three variables considered. This indicates that the greater the concentration of similar companies (that is, the greater the specialization), the greater the capacity to experience productivity growth. This result is consistent with that obtained by Combes (2000) and that obtained by other more recent authors, such as Cortinovis and Van Oort (2015) or Witt (2011).

The employment density indicator (*urb2*) is equally significant and positive. This means that municipalities that are denser in terms of employment tend to obtain higher productivity in the manufacturing sector. Again, this result is consistent with those obtained by Combes (2000) and Cortinovis and Van Oort (2015); meanwhile, Witt (2011) obtained the same result but considering population density.

However, the urban diversity indicator (*urb1*), which we relate to *urbanization economies*, is negative and significant. Combined with the positive value of the coefficient that accompanies the variable *loc*, this indicates, as in the work of Witt (2011), that at this level of spatial disaggregation, by municipalities, it is better for labor productivity to be highly specialized, with lower levels of diversity, although in a context of high occupational density.

TABLE 2 Fixed effects model: Agglomeration economies and control variables

Variable	Model I	Model II
Intercept	5.955 (0.198)***	5.237 (0.199)***
loc	0.596 (0.017)***	0.625 (0.016)***
*urb*1	−0.512 (−0.034)***	−0.548 (−0.033)***
*urb*2	0.031 (0.044)	0.200 (0.046)**
size		−0.298 (−0.032)***
kd		0.120 (0.012)***
Temporal dummy 2003	−1.325 (−0.048)***	−1.060 (−0.050)***
Temporal dummy 2008	−0.889 (−0.040)***	−0.670 (−0.042)***
Temporal dummy 2013	−0.590 (−0.032)***	−0,059 (−0.057)
Temporal dummy 2018	−0.386 (−0.030)***	−0.345 (−0.029)***
Coefficient of determination		
Within	0.715	0.744
Between	0.3276	0.337
Both	0.442	0.456
Observations	1,880	

Note: Each column shows the value of the estimated coefficient of the variable, its standard error in parentheses and its level of significance (*** for 1%, ** for 5% and * for 10%).
Source: Own using the Economic Censuses of 1999, 2004, 2009, 2014, and 2019; INEGI.

In summary, the results obtained indicate that there is a significant relevance of *agglomeration economies* in the conformation of manufacturing productivity. This general result is in agreement with that of Garduño (2014), who finds that the most densely populated municipalities have higher levels of productivity, in line with De León-Arias and Llamosas-Rosas (2016), who find that the agglomeration forces of central Mexico explain its higher productivity.

The processes of the concentration of similar activities are especially valuable, even more so than the diversity, at least in the local context for the Mexican case. So, diversity negatively affects productivity. Additionally, the existence of a high occupational density boosts the growth of manufacturing productivity. This allows us to understand why the large metropolitan areas, which facilitate the occurrence of these processes of location or occupational density, and the great urban agglomeration of the Valle de México, act as a counterweight to other effects such as proximity to the northern border with the United States, as identified by Díaz et al. (2019).

Nevertheless, other works that we have mentioned before report results in a different sense, like Kim and Zangerling (2016), who mention that agglomeration economies do not notably affect productivity in Mexican cities, particularly in the manufacturing industry, but in fact they register a negative sign, or Monkkonen, et al. (2020: 1), who find that more agglomeration (more compact cities) is less productive. Meanwhile, Rodríguez-Castelán et al. (2018) state that there is an inverted U relationship between productivity and activity concentration.

4 | CONCLUSIONS AND POLICY RECOMMENDATIONS

From the viewpoints of the *urban economy* and *regional science*, it is affirmed that the population distribution throughout the territory can significantly affect economic performance. The mechanism by which cities affect economic development is *agglomeration economies*. The objective of this work is to study how *agglomeration economies* affect the productivity of the manufacturing sector using the case of Mexico. This country has one of the largest urban agglomerations in the world, in the metropolitan area of the Valle de México, together with a very heterogeneous network of metropolises. It has relevant industrial development but with significant inequalities in productivity and growth throughout the territory. All of this makes it a particularly interesting case study. We have applied a model proposed by Combes (2000) using various economic censuses and applied an estimation strategy based on panel data with fixed effects.

The results confirm the importance of *agglomeration economies* in shaping different levels of manufacturing productivity. The main way in which urban agglomerations affect productivity is through local concentration/specialization processes and *localization-type agglomeration economies*. The maximization of economic activity and knowledge that makes it possible to be located in an environment of high occupational density, *urbanization-type agglomeration economies*, also appears to be an important element of the final level of productivity. In contrast, local diversity tends to reduce manufacturing productivity.

Localization/specialization processes occur spontaneously in large population concentrations, such as the metropolitan area of the Valle de México, but it is more difficult for them to occur in other smaller environments. Our conclusions confirm the importance that urban/metropolitan planning processes can have. Through land use orientation policies, processes of the concentration of economic activities in the metropolitan areas can be promoted, as well as urban densification. According to the conclusions of our analysis, it is desirable to favor industrial concentration by promoting specialized industrial complexes and policies that promote the generation of industrial clusters. In this sense, the reinforcement of the regulatory institutional frameworks of metropolitan spaces and policies would be a very valuable element. Strengthened metropolitan planning and governance structures can guide the generation of mergers and promote occupational densification. One potential caveat of our analysis is the absence of explicit spatial autocorrelation effects in the empirical strategy, given the characteristics of our database. In this regard, an interesting line for enriching our analysis would be to expand the number of geographical locations considered and include process of spatial autocorrelation in the empirical modeling.

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ENDNOTE

[1] A traditional Hausmann test to check if a fixed effects or random effects estimator was preferable was applied, and the results of the test rejected the random effects approach.

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APPENDIX A.

TABLE A Summary of the base model variables, observations per year

Variable	Media	Std. dev.	Min	Max
f_{1998}	110.14	178.67	5.88	2,257.96
f_{2003}	161.73	232.24	3.59	2,153.57
f_{2008}	215.16	258.64	7.43	1,549.53
f_{2013}	254.58	346.37	16.03	2,404.05
f_{2018}	378.85	447.61	0.05	3,222.45
loc_{1998}	1.17	0.81	0.01	4.11
loc_{2003}	1.21	0.90	0.01	3.31
loc_{2008}	1.11	0.81	0.01	2.82
loc_{2013}	1.11	0.81	0.02	2.92
loc_{2018}	1.11	0.79	0.00	2.88
div_{1998}	3.12	1.58	0.27	8.18
div_{2003}	3.41	1.68	0.91	9.39
div_{2008}	3.55	1.88	0.84	9.56
div_{2013}	3.45	1.65	0.17	9.32
div_{2018}	3.29	1.50	1.00	9.05
urb_{1998}	270.89	1315.20	0.13	19,344.37
urb_{2003}	301.52	1,362.98	0.20	18,970.79
urb_{2008}	361.11	1,451.18	0.29	18,896.99
urb_{2013}	390.06	1,663.70	0.30	22,557.10
urb_{2018}	467.08	1,947.25	0.28	27,019.22

Source: Based on the Economic Censuses of 1999, 2004, 2009, 2014, and 2019; INEGI.