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Location Decisions of New Manufacturing Firms in Ecuador. Agglomeration Mechanisms

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Abstract: This investigation seeks to explore the importance of agglomeration mechanisms in the location decisions of new manufacturing firms in Ecuador, based on sector and canton level data for the 2000–2010 period. A model is proposed to explore the relative importance of agglomeration mechanisms in location decisions of new manufacturing companies, a regression is performed using instrumental variables, the econometric estimation is developed, and an identification strategy is proposed. The results of the empirical analysis show that the learning mechanism, and history, have a positive and significant impact on the creation of new firms. An increase of 1% in the transfer of knowledge in the industries and cantons of the country is correlated with the increase in the location of new firms in the order of 9.2%. In turn, history has a positive and significant effect on the creation of new firms, in industries and cantons characterized by a past industrial environment. Even when the learning mechanism and history are controlled by provinces, sectors, and cantons, they continue to be the most important determinants of the location of new firms. This evidence could be attributed to the public investment in Ecuadorian industry in recent years. In this sense, the contribution of this work is found in the empirical distinction of the mechanism that favors or inhibits the location decisions of new companies. The analysis was replicated for a three-digit sectorial disaggregation level, to verify whether the agglomeration mechanisms operate differently on a different industrial scale. The results suggested that there were no differences to be considered. When the analysis was done excluding the cantons of Quito, Guayaquil, and Cuenca, given their high representation in terms of the birth of industries and employment, the results were consistent with those previously mentioned. However, it is so only with respect to history, which in this case accounts for 38.8% of the birth of firms; whereas, matching accounts for an order of 38.9% in the period of analysis. This result is explained in the context of the country's industrial policy.

Keywords: agglomeration; location; agglomeration mechanism; agglomeration economies; new firms; cantons of Ecuador

1. Introduction

Urban agglomeration, understood as the spatial concentration of economic activity and population in cities, is an advantage in terms of efficiency in carrying out the different activities of society [1]. New firms are attracted by the possibility of achieving such efficiency in the context of externalities and network effects of the territory in which they decide to locate.

One of the potential benefits of agglomeration is ascribed to the geographic proximity of firms, from which Marshall [2] identified three location externalities (extensively examined in the academic literature). These are: (a) Input-output links, (b) labor market pooling, and (c) knowledge spillovers. In this line, the concepts of sharing, matching, and learning, proposed by Duranton and Puga [3] are more widely used today.

In the first of these “sharing”, the economies of scale or indivisibilities within the company stand out. A broader market allows a more efficient exchange of infrastructure and local facilities, a variety of intermediate input suppliers or a group of workers with similar skills [4]. The second mechanism “matching”, is related to the exchange of productive inputs. Krugman [5] explained how the availability of specialized workers in metropolitan areas leads to the reduction of firms’ costs. The third one, “learning” represents the benefits of agglomeration in terms of knowledge, skills, and technologies.

In the empirical literature, the evaluation of the magnitude of urban agglomeration techniques has prevailed over the works that have attempted to identify the mechanisms that support them. This is the objective of this work: Empirically distinguish the mechanism that favors or inhibits decisions to locate new companies based on sector and canton level data for the 2000–2010 period. The estimation of the benefits of different sources of agglomeration is of particular importance for the development of an effective industrial policy in the country that provides, among other aspects, to strengthen the current industrial sector and strengthen the bases for the appearance of new industries. To achieve this, the government of Ecuador has been generating a series of conditions that have demanded a high investment (approximately 1.88% of Gross Domestic Product (GDP) in technology and innovation in 2016). That should achieve the structural productive transformation of the country in the long term. The starting hypothesis is that sharing, matching, and learning mechanisms; and history encourages such decisions; however, the geographical and historical peculiarities of a developing economy such as that of Ecuador could yield different responses to the previous findings found.

Rosenthal and Strange [6] reviewed the studies that separately identify each of the mechanisms that explain agglomeration economies. Combes and Gobillon [7] updated this work and showed some of the attempts to separately identify the role of these mechanisms in the determination of other variables such as the spatial indices of concentration or co-agglomeration of the industrial subsectors; or, the location of new firms [7–38]. The studies differ as to the source of these positive externalities. The intensity and composition of production activity influences the mechanisms.

The motivation for this work is twofold. The first is that the estimation of the benefits of different sources of agglomeration is of particular importance for the development of an effective industrial policy in the country that provides, among other aspects, to strengthen the current industrial sector and strengthen the bases for the appearance of new industries.

The second motivation has to do with incorporating into the analysis an element such as history that permeates the reality of a developing economy, which, as will be demonstrated, is also important to understand the location of new firms in Ecuador. In fact, there is abundant evidence for the USA and European countries, but it is scarcer in developing countries. In this sense, Ecuador is an interesting case study to analyze the mechanisms through which agglomeration economies operate.

The multiple regression models used allow considering the interaction of the variables that intervene in the location of the companies, as well as their individual effects. Moreover, the use of dichotomous variables allows us to observe qualitative issues that make industries concentrate or not in a region; while when calculating several regressions considering the level of sectoral disaggregation, they allow observing characteristics and behaviors typical of each industrial activity. Robustness tests allow verifying the degree of sensitivity of the number of companies in a region with respect to the intensity (increase or decrease) of the factors considered to be influential. The organization of this paper is as follows. In the second section, a literary review is performed (agglomeration economies, the role of history). The third section provides information on the industrial dynamics in Ecuador, with an emphasis on the creation of new firms and relationships, or inter-sectorial links. In the fourth section, the data are presented and inter-sectorial relations are measured and the econometric estimation

is developed. In the fifth section, the results are presented. Finally, in the sixth section, the main conclusions are reviewed.

2. Literature Review

2.1. Agglomeration Economies

A part of the literature of agglomeration economies follows Marshall [2] by identifying the determinants of location, that is why the concepts input sharing, labor market pooling, and knowledge spillovers, are recurrent in the work on the mechanisms through which the agglomeration economies act. However, the concepts of sharing, matching, and learning, proposed by Duranton and Puga [3], are the most used today. This is explained by the fact that Duranton and Puga [3] developed, in relation to each mechanism, one or more models that they call “nuclear”, to theoretically support the economies of urban agglomeration.

With this objective in mind, Duranton and Puga are based on the works of Abdel-Rahman and Fujita [39], Helsley and Strange [40], Glaeser [41], Scotchmer [42], etc. According to these authors, the sharing mechanism is explained from four aspects. The first, relates to the indivisibility in the provision of certain goods whose cost is only possible to pay among several individuals or firms such as local infrastructure, which encourages the agglomeration of individuals in cities. The second is inherent to the possibility of obtaining gains from a wide variety of suppliers of inputs that can be sustained by a large industry of final goods. The third relates to the gains that result from the specialization of workers in a more limited set of tasks that can be sustained over time with greater production and sharing risks; and, the fourth with the possibility of sharing a common labor market i.e., a pool of workers with similar skills.

The matching mechanism relates to the expectation of correspondence in the relations between employers and employees that applies to those between buyers and suppliers or business partners [4]. Specifically, with respect to the labor market, it is the correspondence of the professional qualification demanded in the labor market with the one offered. The information asymmetries existing in both groups regarding the requirements in terms of skills for a vacancy that the employer offers, generates training costs and remuneration of salaries that do not correspond to workers' abilities. This incompatibility, according to the theory is reducible in an urban environment given that this (as a space of economic agglomeration) promotes the quality of each encounter and increases the opportunities for these to occur.

Finally, the learning mechanism attributes the gains from the generation, dissemination, and accumulation of knowledge. Duranton and Puga [3] argued that it is an important activity from two perspectives. For the resources that are allocated to it, and for its contribution to economic development. However, they indicate that there is not a sufficiently developed theoretical understanding of learning in cities.

For its part, in the empirical field, the evaluation of the magnitude of urban agglomeration economies has prevailed over the works that have tried to identify the mechanisms that support them. Rosenthal and Strange [6] and Combes and Gobillon [7] gave an account of this. Rosenthal and Strange [6] analyzed the empirical works related to the nature and sources of agglomeration economies, including among the latter, others not defined by Marshall [2] and which include the effects of domestic markets, consumer opportunities, and the search for rents.

More recently, studies emerged that focus on the mechanisms through which agglomeration economies operate. Combes and Gobillon [7] incorporated into their discussion of the empirical literature about agglomeration economies, those works that attempt to separately identify the role of the three types of mechanisms that underlie them, according to Marshall [2], distinguishing between those that define concentration or co-agglomeration indices as a variable of interest and the birth of new firms. It is possible to present the empirical literature from two perspectives. One that seeks to

demonstrate the existence of each of the micro foundations of agglomeration separately; and another in which what is sought to find the incidence of the three mechanisms jointly.

Regarding the sharing mechanism, the works of Holmes [43] highlighted the fact that for the US, a more intensive use of inputs purchased within the same industry is shown. Amiti and Cameron [44] showed that, for Indonesia, the benefits which come from the proximity of suppliers are quickly reduced with distance. López and Suedekum [45] showed that, in Chile, significant positive effects of intra industrial spillovers related to input-output links exist.

Regarding the matching, the work of Diamond and Simon [46], which showed for the US that individuals living in more specialized industrial cities face a higher probability of unemployment but in compensation earn higher wages, is relevant. Costa and Kahn [47] who showed that couples where both spouses have higher education are located in large metropolitan areas. Gautier et al. [48] used data from Denmark to contrast a model in which cities play an important role as marriage markets. According to their model, cities are dense areas where singles can meet more potential partners than in rural areas. To enjoy these benefits, they are willing to pay a premium in terms of higher housing prices. Once married, the benefits of meeting more potential partners fade and married couples leave the city. Gautier's empirical results confirm the predictions of his marriage market model. On the other hand, Freedman [49], Wheeler [50] and, Beakley and Lin's [51] studies focused on the gains of the agglomeration that comes from an increase in labor mobility and a better correlation between employees and firms.

Likewise, the authors who have investigated whether the matching between workers and firms is more productive in the large and dense areas are Wheeler [52] and Anderson et al. [53] for the US; Figueiredo et al. [54] for Portugal, and Andini et al. [55] from Italy. Complementarily, among the jobs that lead the specialization of tasks as a source of urban agglomeration economies are Duranton and Jayet [56] and Kok [57], for France and Germany, respectively. The first provides evidence that the division of labor is limited to the extension of the local market. The second argues that in large cities, workers focus more on their basic tasks and develop fewer subtasks than workers in small cities.

Finally, among the studies related to knowledge spillovers, is the pioneering work of Jaffe et al. [58] which determined that patent citations in the US are located geographically within the same state and metropolitan area. Audretsch and Feldman [59] suggested that the propensity of innovative activity to be concentrated is attributable to the role of knowledge diffusion rather than to the geographical concentration of production. Agrawal et al. [60] determined for the US that although spatial and social proximity increase the probability of knowledge flows between individuals, the marginal benefit of geographical proximity is greater for inventors who are not socially close. Agrawal et al. [61] established that the inventors, hired by the large firms of the 72 most highly innovative localities in North America, were more likely to be based on the same previous inventions year after year, and the scope of the geographical impact of these inventions is also narrow. In Europe, Combes and Duranton [62] for France, Brunello and Gambiarotto [63] and Serafinelli [64] for Italy, Brunello and De Paola [65] for the United Kingdom, Muehlemann and Wolter [66] for Switzerland, investigated whether such contagions arise from the mobility of workers between firms within the same labor market. They found results consistent with what the theory proposes. Serafinelli [64] showed that in the Veneto region, labor mobility can explain around 10% of the increase in productivity experienced by other firms, when new highly productive firms are incorporated into a local labor market.

With the aim of explaining the incidence of agglomeration mechanisms in spatial activity concentration patterns, agglomeration, and the birth of new firms, some works developed identifying mechanisms using different proxy variables. Rosenthal and Strange [67] examined the importance of micro foundations of agglomeration economies in determining the industry concentration for the US measured by the Ellison and Glaeser index (EG), at the level of postal codes, counties, and states. The results showed a positive effect of labor pooling in the spatial concentration of the industry, while the knowledge spillovers also have a positive effect but only at the postal code level. The input sharing mechanism was also important but only at the state level and not at smaller geographic scales.

An indirect, alternative measure of labor pooling was proposed by Overman and Puga [68] (they use the same proxies to measure the other agglomeration mechanisms that Rosenthal and Strange proposed [67]). This was based on the hypothesis that a pool of workers with adequate skills allows firms to absorb productivity shocks more efficiently. Using panel data from the United Kingdom, they measured the importance of the concentration of labor by calculating the fluctuations in the employment of individual establishments regarding their sector, and the sector average. The authors found that industries which experience more volatility are more spatially concentrated. Barrios et al. [69] determined that the concentration of industrial activity measured by EG, obeys different agglomeration mechanisms according to the country of analysis: Belgium, Ireland, and Portugal. In this case, their approaches to each mechanism differed from those described above. The sharing mechanism was approximated through the total purchases of goods and services. Matching was measured through the percentage of the total population that has obtained a higher education degree, and learning through total expenditure on research and development.

Other studies that use agglomeration mechanisms simultaneously to explain variables such as the growth of industrial employment, the entry of new manufacturing firms, the degree of co-agglomeration of the industry and the location of firms, correspond to Dumais et al. [70], Glaeser and Kerr [71], Ellison et al. [72] and Viladecans-Marsal [73], Jofre-Montsey et al. [74] and Artz et al. [75], respectively. The pioneering work of Dumais et al. [70] stated that knowledge spillovers are the mechanism with the greatest incidence in the growth of industrial employment. On the contrary, Glaeser and Kerr [71] concluded that the entry of new firms in an industry was higher in cities where industries that employ similar workers are more abundant. The co-agglomeration patterns of the industry as a function of the agglomeration mechanisms were examined in the work of Ellison et al. [72]. In doing so, they calculated an index of co-agglomeration between two industries and then explained it from variables that approximate the links between each pair of firms (input sharing, labor pooling, and knowledge spillovers). The result suggested a great input sharing effect, followed by labor pooling.

Kolko [76] and Kerr and Komines [36] conducted similar exercises. Kolko [76] used as additional measures of the links between industries, variables related to the volume of inter industrial trade, evidence among other aspects, that the concentration of labor did not affect the localization decisions of services as it does in manufacturing, as well as the information technologies encourage the co-agglomeration of services that carry out transactions among themselves at the postal code level and discourage it at the state level. While they encourage the co-agglomeration of manufacturing at the zip code and county levels, they have no effect at the state level. This suggests that services are more urbanized but less agglomerated than manufacturing. Kerr and Komines [36] calculated the spatial concentration index of Duranton and Overman (DO) for different industries and distances on which the incidence of work pooling and knowledge spillovers mechanisms was estimated. They suggested that establishments in industries with minor knowledge spillovers, or more labor pooling, are more concentrated. Specifically, for the case of Ecuador Torres et al. [38], a concentration index was calculated and they found that the economic activity tends to cluster in relatively few cities, mainly Guayaquil and Quito, those cities that since colonial times have maintained their supremacy over others and, therefore, perform important functions economic, regional, and international.

By objectively quantifying the incidence of external economies in the location of firms measured by industrial employment, Viladecans Marsal [73] added to the economies of location and urbanization, the analysis of technology transfers and the presence of suppliers. They determined that these two mechanisms are significant in explaining the location of industrial employment in Spain. By contrast, the work of Jofre Montsey et al. [74] focused its analysis on determining the effects of agglomeration mechanisms in the location of new firms. In particular, what was estimated was the number of new enterprises by industry and city as a function of local employment levels in industries that (a) share input—output (input) relations, (b) use similar workers (labor market pooling), and (c) use a similar technology (knowledge spillovers). The results indicated that all these mechanisms are determinant, although their incidence differs depending on the geographic scale of analysis.

Furthermore, Artz et al. [75] found that agglomeration economies matter in the decisions to locate new companies in the urban and rural markets of Iowa and North Carolina. Firms are more likely to locate in markets with an existing cluster of firms in the same industry, with greater concentrations of upstream suppliers or downstream customers, and with a larger proportion of college educated workers in the local labor supply. Their results also suggest that there is no additional advantage to agglomeration in urban areas relative to rural areas that have higher agglomeration endowments. However, rural communities that do not have a critical mass of firm clusters, upstream suppliers, downstream customers, and educated labor will find it difficult to attract new startups.

2.2. The Role of History

Externalities imply that history is important. According to the World Bank [77], modern location patterns for the industry are highly influenced by the historical industrial environment of cities and by localization economies. Such intangibles include the local stock of knowledge relevant to an industry or workforce with specific skills acquired. In this context, the role of history in locating industries in cities has been analyzed from different perspectives in the context of agglomeration economies. Krugman [5] illustrated past dependence on economic geography by describing the case of the US belt industry. He referred to history as a long shadow evident over location at all scales, from the smallest to the largest. According to Glaeser et al. [78], the historical industrial environments of cities are important. From a study for 170 American cities between 1956 and 1987, they determined that, in fairly mature cities, urbanization economies stimulate industrial growth. Rauch [79] argued theoretically that, in the post-World War II period, history reduces the mobility of industries from older, higher cost sites to new, low cost ones. Feldman and Florida [80] found that in the US, among other aspects, there are particular places that have acquired comparative advantages for innovation and economic development of a product with a historical legacy of sustained investment.

Henderson et al. [81] established the importance of preexisting conditions for industrial location. In this sense, cities with historical concentrations of an industry, and a related accumulation of local knowledge, offer a more productive environment for establishments in that industry than those without these preconditions. Consequently, such establishments will be able to compete better and eventually retain firms and employment in that industry. Henderson et al. [82] established, for Korea, that the localization patterns are not dominated by accidents of history, but that they obey a comparative advantage inherent in the geography and history of each city. This term, “accidents of history” refers to the fact that by accident a lower location, from the beginning, can attract a small concentration of industry, attracting henceforth more new firms due to the accumulated information environment, even though the location generally has poor local attributes for most firms Henderson et al. [82].

In Ecuador, as indicated above, the economic activity tends to agglomerate in relatively few cantons: Quito and Guayaquil, primary cantons since the mid nineteenth century a phenomenon that would not occur in any other Latin American country until the second half of the 20th century. Quito was an important urban center in the time of the Incas, which was further enhanced as such in the colonial era with the desire of the Spanish for control of space. In contrast, Guayaquil was used in the colony as a point of connection between Quito and Spain as a coastal city of the Pacific. It was not until the nineteenth century (with the establishment of the Republic, in 1830) when Guayaquil acquired a remarkable development, surpassing Quito in population volume. This trend continues to this day. Since then, these cities have important economic, regional, and international functions that suggest centuries of economic and political forces are intrinsic to them.

In this context, a natural question emerges, “Does history matter in decisions to locate new firms?”. Although it is not possible to examine in detail why such dynamism occurs in places with characteristics such as those described, it is possible to solve this question by introducing an inherent measure of productivity that reflects the access of the canton to the relevant markets for industries and other geographical, institutional, and cultural conditions. These affect attitudes towards the location of new firms. That is, each canton has a history with an inherent comparative advantage accumulated

by each industry, which is represented by a variable that equals 1; when industry j in city c has been located between 1570 and 1900, and is zero, if the opposite happens.

Between 1500 and 1900, according to the time when the cantons hosted the industrial location highlight: Santo Domingo (1570, elaboration of food products); Sigsig (1870, other manufacturing industries; 1875, manufacture of clothing); Cuenca (1882, manufacture of food products, 1900, manufacture of chemical substances and products); Ambato (1883, manufacture of machinery-and equipment n.c.p., 1884, repair and installation of machinery and equipment); Quito (1885, manufacture of fabricated metal products, except machinery and equipment); Yaguachi (1890, manufacture of food products); Ibarra (1896, manufacture of food products); Guayaquil (1900, manufacture of food products); El Empalme (1900, manufacture of textile products); Ambato (1900, manufacture of clothing); Loja (1900, manufacture of clothing); Azogues (1900, manufacture of metal products, except machinery and equipment), and Girón (1900, manufacture of furniture).

Henceforth, the decades 1901–1910 and 1911–1920 represent, until now, the periods of less localization of the industry, since in these, only two and three industries were formed, respectively. As of 1921, this number increased considerably every decade, among which, the analysis period 2001–2010 has been the most fruitful (Figure 1).

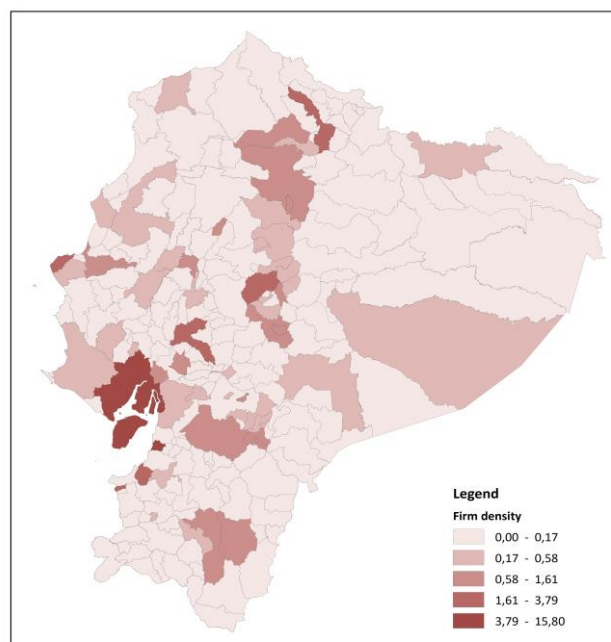


Figure 1. Firms density by canton 2000–2010. Source: Own elaboration based on data from Economic Census [83].

3. The Industrial Dynamics of Ecuador

Ecuador presents in line with the stylized observation in most countries regarding an urban hierarchy of few metropolises, and many smaller cantons with complementary economic functions. In this case, the cantons of Guayaquil and Quito are the ones that maintain their supremacy over the others since inception of the colony and, therefore, perform important economic, regional, and international functions. Although these cantons together account for only 3.3% of the total area, they contain 16.3% and 15.5% of the population; they generate 23.6% and 25.2% of the gross added value; and they represent 21.4% and 28.9% of manufacturing employment, respectively (Figure 2).

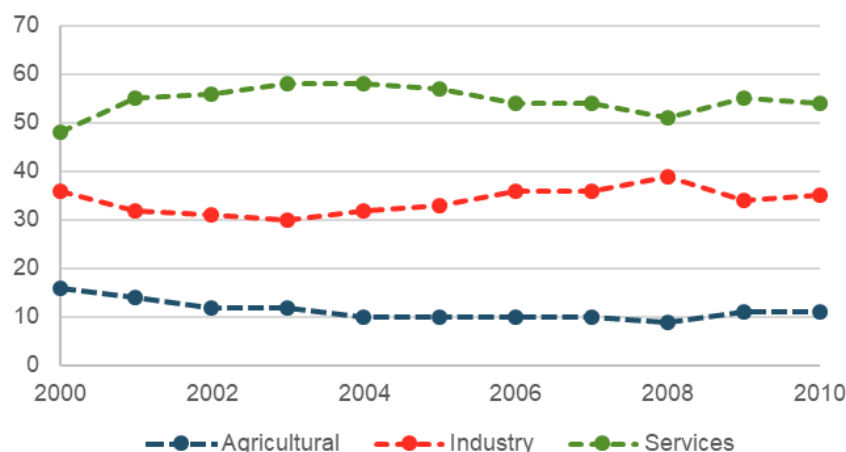


Figure 2. The representativeness of the economic sectors between 2000 and 2010 (as a percentage of Gross Domestic Product-GDP). Source: Own elaboration based on data from the World Bank [84].

As for the entrepreneurial activity in the country, the 2010 economic census presents data from 1570 that show that the first industry created was the elaboration of food products in Santo Domingo. From then until 1900, a total of 16 industries were created (in order of appearance) related to other manufacturing industries, manufacture of garments, manufacture of machinery and equipment n.c.p., repair and installation of machinery, manufacture of metallic products for structural use, manufacture of chemical substances and products, manufacture of furniture, and manufacture of textile products. The decade 2001–2010 has been the most fruitful in this area with the creation of 31,559 firms according to data from the National Institute of Statistics (INEC) [83]. Although the number of new firms between 1993 and 2011 increased by 6000, the rate of business creation (measured by the ratio between the number of new and active firms) has remained constant at around 10%. Between 1990 and 2012, only 7% of the new firms corresponded to manufacturing since the great majority belonged to the service sector.

The data of the firms, constituted until 1999 by industry and canton, allow verification of the manufacture of garments, except skin (19.14%); furniture manufacturing (12.09%); manufacture of metal products for structural use, tanks, metal containers and steam generators (11.20%), and the manufacture of other food products (10.44%) were the industries with the largest number of incorporated firms. In contrast, Quito (19.55%), Guayaquil (16.34%), Cuenca (6.91%), Ambato (4.35%), and Loja (2.61%) were the cantons in which they were located. However, this pattern in the constitution of firms and geographic location has not changed substantially for the year 2000 and 2010.

Data in Table 1 is presented for the five industries with the highest and lowest number of creations in this period. Those corresponding to the greatest creations ratify the aforementioned regarding the marked dependence on primary goods of low added value, given that they are all sectors traditionally existing in the country, a situation that configures a little diversified economy. The manufacture of products for domestic use has the average number of creations of new firms (69). The canton with the highest number of creations in this sector (18) is Quito. The last column shows the participation of cantons with zero births in the sector which reinforces the idea of the geographical concentration of the sectors with more and less creations in a few cantons.

In a complementary way, to illustrate the relationship between the number of new firms by sector and canton and the level of employment of the industry itself through Figure 3, it is possible to establish that there is a strong correlation between both of the order of 0.99, as well as a small amount of variation in the creation of new firms. Analysis for the Ecuadorian case was previously performed by Pontarollo et al. [85] who verified a special heterogeneity of the cantons; as well as it was found that in the period 1980–2010, the growth of employment in the industrial sector in Ecuador responds to localization economies and not to urbanization economies [38]. Therefore, it seems that there is a clear pattern of permanence in the location of new firms with respect to the location of employment

in the sector. Another issue indicated is the atypical behavior of the cantons of Quito, Guayaquil, and Cuenca, which together contain 44.6% and 58.4% of the new firms created between 2000 and 2010 and industrial employment in 2010, respectively.

Table 1. New firms in Ecuador, 2000–2010.

Industry	New Firms	New Firms (%)	Maximum	Canton	Cantons with 0 Births (%)
The Five Industries with the Highest Number of Creations					
Manufacture of other food products	7.233	20.39	1.549	Guayaquil	1.80
Manufacture of clothing, except fur garments	5.793	16.33	1.196	Quito	13.51
Manufacture of metal products for structural use, tanks, metal containers, and steam generators.	4.896	13.80	1.114	Quito	10.36
Furniture manufacturing	4.160	11.73	911	Quito	16.67
Manufacture of wood sheets for veneers and wood based boards	2.028	5.72	446	Quito	21.17
The Five Industries with the Least Number of Creations					
Manufacture of pharmaceutical products, medicinal chemicals, and botanical products for pharmaceutical use.	23	0.06	13	Quito	96.40
Metal melting	19	0.05	7	Quito	98.20
Manufacture of transport equipment n.c.p.	18	0.05	5	Quito	94.14
Manufacture of electric lighting equipment	14	0.04	7	Quito	98.20
Manufacture of motors, generators, electrical transformers, and electric power distribution and control devices.	13	0.04	5	Quito	98.20

Source: Own elaboration based on National Institute of Statistics (INEC) data. Economic Census, 2010 [83].

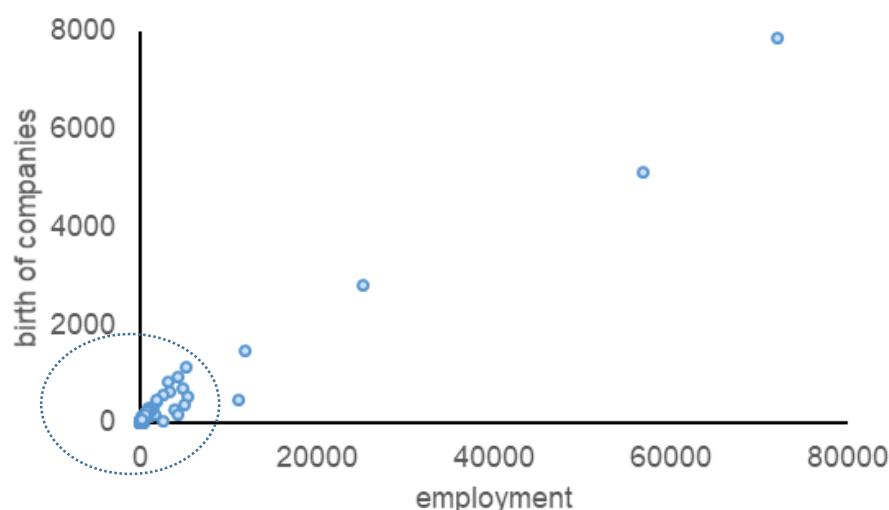


Figure 3. New firms by sector and canton as a function of the employment level of the industry itself.

Source: Own elaboration based on INEC data [83].

4. Methodology

4.1. Measurement of Inter Sectors Relations

In correspondence with what the theory proposes, inter-sectorial links are the basis used to identify the sources through which agglomeration economies act. To approximate them, measures are built for two sectors (i, j) that maintain links of the form: (a) Sharing, (b) matching, and (c) learning. Once these measures are constructed for each pair of sectors (i, j), the following is to weigh such measures by the employment level of each sector and canton. Consequently, the weighted sum of the employment of a specific sector can be interpreted as the employment in each canton in a sector that (a) supplies inputs

to sector i (inputic), (b) buys outputs from sector i (outputic); (c) uses workers with occupations similar to those used by sector i (laboric), and (d) uses the technological production used by sector i (technoic).

The calculation methodology of each agglomeration mechanism is detailed below:

4.1.1. Sharing

The geographical concentration of the firms entails the proximity to a wide market of suppliers and consumers whose links are captured through the input-output matrix. From these data, the following data sets are constructed for each pair of sectors:

$$W_{ij}^I = \frac{\text{inputs}_{i \rightarrow j}}{\text{totalinputs}_i} \quad (1)$$

$$W_{ij}^O = \frac{\text{outputs}_{i \rightarrow j}}{\text{totaloutputs}_i} \quad (2)$$

where W_{ij}^I is the participation of the inputs that sector i buys to sector j , including those which come from the agricultural sector and services. W_{ij}^O is the share of production made by sector i that is acquired by sector j . The most intense dependence of a single supplier is shown by the garment manufacturing sector in relation to the manufacture of textile products. The most intense dependence of a single client is the one that shows the cereals sector that sells 97% of its production to the production of food products. From these two sets of specific weights of the sector, it is possible to obtain the following variables:

$$\text{input}_{ic} = \sum_{j \neq i} (W_{ij}^I L_{cj}) \quad (3)$$

$$\text{output}_{ic} = \sum_{j \neq i} (W_{ij}^O L_{cj}) \quad (4)$$

These represent the weighted sums of the employment levels of sectors j and cities c where the industries with the most intense customer-supplier relationships have the highest weights. In this sense, input_{ic} measures local employment in the sectors that are the main input supplying sectors. In turn, output_{ic} measures local employment in the sectors that are the main sectors buyers.

4.1.2. Matching

Matching denotes the advantages that firms and workers obtain by locating in a dense labor market. According to the theory, industries that employ workers with similar skills should be co-located due to the high labor mobility that is possible to be carried out among them. The measure that is used is the following:

$$\text{imp}_{ij} = \frac{1}{2} \sum_o \left| \frac{L_{oi}}{L_i} - \frac{L_{oj}}{L_j} \right| \quad (5)$$

Here, o indicates the occupation. This index corresponds to the employment fraction of sector i in the occupation o . L represents the number of workers. Labor market pooling (imp_{ij}) is the inverse of the dissimilarity index of Duncan and Duncan [86]. This index between 0 and 1 is interpreted as the participation of workers in sector j who need to change occupation to imitate the distribution of occupations in sector i ; therefore, it is obtained for each pair of sectors ij . From its calculation, all the values of sectors j are in descending order based on this index, with the purpose of constructing the following weighting for each pair of sectors:

$$W_{ij}^L = 0, \text{ if } r > 10$$

$$W_{ij}^L = \frac{\text{imp}_{ij}}{\sum_{r=1}^{10} \text{imp}_{ij}}, \text{ if } r \leq 10 \quad (6)$$

Above, r identifies the r sectors more related in terms of the employees they hire. Given that they increase the weights assigned to the most related sectors, in the different econometric estimations, only the 5, 10 and 15 most related sectors are considered between 23 and 67, according to the sectorial disaggregation into two and three digits, respectively. The highest weight corresponds to the sectors of the manufacture of metal products (except machinery and equipment) and the manufacture of other types of transport equipment. Based on this set of sector weights, the variable is constructed $labor_{ic}$, in the following way:

$$labor_{ic} = \sum_{j \neq i} (W_{ij}^L L_{cj}) \quad (7)$$

This is the weighted sum of the employment levels of sector j in cities c where industries that use workers that are more similar to those used by industry i , receive higher weights. As a consequence, $labor_{ic}$ is a measure of local employment in sectors that use similar workers as those used by sector i .

4.1.3. Learning

The measurement of this mechanism is the one that presents the greatest difficulty according to the empirical literature. It implies that the industries that are collocated can share knowledge and ideas; therefore, if they use similar knowledge, they should be collocated.

The approach to learning is different in the studies developed. Rosenthal and Strange [67] used the innovation variable per dollar of boarding as a proxy for this mechanism. Ellison et al. [72] used patents and research and development as a measure of information flows capturing such flows at higher levels rather than workers. Jofre Monseny et al. [74] used the technological similarity in production processes between two sectors to measure the diffusion of knowledge that occurs between them. In this paper, such a mechanism is approached, given the limited data in this area for Ecuador as calculated through the research and development spending that each sector performs in each city a variable also used in the work of Jaffe et al. [58], Audretsch and Feldman [59], and Barrios et al. [69]. This is denoted as id_{ic} .

Expenditure on research and development is the indicator traditionally used to measure the intensity of innovation activities in an economy. According to the OECD [87], research and development (R&D) comprises the creative work carried out in a systematic way to increase the volume of knowledge, including the knowledge of man, culture, and society, and the use of knowledge to create new applications. In Ecuador, although firms only finance 1% of the total expenditure on research and development, they execute more than 58% of this activity, according to Schwartz and Guaipatin [88].

4.2. Data and Variables

Given that the objective of this paper is to explore the relative importance of the agglomeration mechanisms in the location decisions of new manufacturing firms, the use of data for Ecuador from different sources of information was required: National Accounts, the Manufacturing Survey and Mining (EMM), the VII Population Census and VI Housing, the Economic Census and the Ministry of Transport and Public Works [89].

The variable *sharing* required for its construction data from the input-output matrix of 2010, prepared by the Central Bank of Ecuador. The matrix originally contains 71 sectors, of which 35 correspond to the manufacturing sector, which means that the data for the two and three digit sector disaggregation levels according to the ISIC classification are approximated.

The data from the Manufacturing and Mining Survey and from the Population and Housing Census, are used for the construction of the *learning* variable, due to the fact that it reports data related to occupations. Specifically, the 2010 EMM contains data on personnel employed by sector and gender at the levels of: Executive and managerial workers, owners and partners, family workers, workers and employees. For its part, the Population and Housing Census conducted in 2010 accounts for twelve categories of occupation of these, the last three were not considered for this study, so it was possible to work with nine occupation categories. These data are reported only for the one digit sector

classification, so it is necessary to interpolate the data for the industrial disaggregation levels two and three.

The data of the expenditure made in research and development (R&D) carried out by each manufacturing industry in each canton of the country, during the year 2010, come from the Economic Census carried out in 2010 by the INEC [83]. This census provides industry information (ISIC 4.0) at a scale between one and six digits, and includes 31 variables for each company. In this paper, the industrial disaggregation levels two and three are used, which comprise 23 and 67 sectors, respectively. The oil sector is not included.

Among the variables provided by the economic census are the year of creation of each one of the firms surveyed, by sector and canton, in the sectorial disaggregation levels indicated above. The estimates do not include industries with less than 115 creations when working at two and three digits of industry disaggregation, respectively.

A variable of interest for the purpose of controlling the characteristics of cantons is inherent to infrastructure, that is, the availability of ports, airports, and access to high quality roads. This data was obtained from the Yearbook of Transport Statistics of the INEC 2012 [89] and the Ministry of Transport and Public Works.

As for the geographical units of analysis, it should be noted that this is information at the level of cantons, made up of urban and rural parishes, which also constitute the second level administrative division in Ecuador, after the provinces. These add up to a total of 219, except for the three corresponding to the Insular Region or Galapagos Islands which were not taken into account for this work (these contemplate three islands: San Cristóbal, Isabela, and Santa Cruz), and the areas not delimited (include territories whose boundaries are not clearly defined between provinces and cantons: Las Golondrinas, Manga del Cura, and El Piedrero). It should be clarified that in this study the data is considered at the cantonal level (and not at the city level), just as previous studies [38,85,90] on agglomeration economies carried out for the case of Ecuador did, this is due to the limitations of information and the need to use comparable data in the different years considered.

4.3. Specification of the Model and Econometric Estimation

Econometric models can be used efficiently to find the correlation and dependency between the variables considered; the regression estimated in line with the empirical works previously commented is the following:

$$N_{ic} = \alpha + \beta_{inp}inp_{ic} + \beta_{out}out_{ic} + \beta_{imp}imp_{ic} + \beta_{id}id_{ic} + \beta_h hist_{ic} + \sum \lambda_{ic} + \partial_p + \partial_s + \partial_{cr} + \varepsilon_{ic} \quad (8)$$

where N_{ic} is the number of firms created between 2000 and 2010 in sector i in the canton, c ; β_{inp} , β_{out} , β_{imp} , y β_{id} are the coefficients of the variables of the sectors (i and j) that: (a) Share input-output links, (b) use workers with the same occupations as those used by the industry, and (c) spend on research and development, respectively. β_h is a dummy variable that denotes the creation of the sector in the canton between 1570 and 1900; $\sum \lambda_{ic}$ represents the control variables: Employment of the sector itself, employment of the canton without the sector, and infrastructure in terms of access to ports, airports, and high ranking roads, in order to control the unobservable heterogeneity of the cantons.

The surface of the canton is also incorporated as a control, in correspondence with Bartik [91] who indicated that geographic units with greater availability of land are more likely to be chosen. The provincial fixed effects (include twenty-three provinces of the country, except for Galapagos), by industry and by canton are collected in ∂_p , ∂_s , ∂_{cr} , respectively. The variable ∂_p corresponds to the twenty-four provinces that make up the country, which controls the determinants that are common to all cantons within each province. ε_{ic} is the error term. Fixed effects are used to try to control external influences in the relationship of the variables, in addition, the empirical evidence in the reference works on this topic use fixed effects to counteract endogeneity [7,38,73,74].

The explanatory variables are measured in logarithms and therefore the estimated coefficients are interpreted as elasticities. The explanatory variables are 0 for some industries and cantons. Following Crépon and Duguet [92], 1 is added to the observations that are 0 and the logarithm of this transformed variable is calculated. Additionally, a dummy variable is included to indicate if the source variable was 0. The model is constructed in a similar way to that of Jofre Monseny et al. [74], who in turn did so assuming that the probability that a company k is located in a geographical unit c has the form of a logically conditional distribution whose coefficients can be equivalently estimated using a Poisson regression with a function of exponential form. To expand this approach, review Jofre Monseny et al. [74].

4.4. Identification Strategy

In the aforementioned specification, two common difficulties arise in this type of approach, referred to the bias of simultaneity and omitted variables.

Simultaneity bias corresponds to the fact that the benefits that are derived between a pair of sectors by maintaining client provider links, or sharing workers with similar skills, or similar technologies, imply that inter-sectorial relationships can be considered as the result and not the cause for the collocation of these. On the other hand, it is possible for industries to collocate due to a common dependence on a natural advantage not observed, and consequently become employers of similar workers, establishing input-output links or using similar technologies. As a whole it implies a bias of omitted variables.

To minimize the possible effect of omitted variables related to natural advantages, Ellison et al. [93] constructed an estimated spatial distribution of industries based on 16 natural advantages studied by them in Ellison et al. [93]. From this procedure, the authors constructed an index that reflects the co-agglomeration that arises from the natural advantages and that they then introduce in their regressions as a control variable. However, this control is not perfect due to the difficulty of measuring some natural advantages.

To lead with the simultaneity bias indicated above, that is, the fact that inter industrial relations are the result and not the cause of the agglomeration, Ellison et al. [93] resorted to an instrumental variables approach which they acknowledged will not mitigate such a bias, if there are similarities in the ways in which natural advantages drive the collocation of industries in the US and UK. This is because, in the construction of instrumental variables, they use data from the United Kingdom to construct measures of inter sectorial relations that are then used to instrument their American counterparts.

Similarly, Jofre Monseny et al. [74] used the counting of new firms as a dependent variable; it is possible to partially correct both the bias of omitted variables and the simultaneity. Regarding the potential bias that arises from the unobservable natural advantages, the approximation that follows conditions the number of new firms in year t to the employment stock of the industry itself in the year $t - 1$. With this approach, the stock of employment in year $t - 1$ acts as a global control variable for sector specific location determinants (observed or not observed). It is pertinent to take into account that the omitted factors that drive the location of new firms in year t are very likely to have driven the decision to locate new firms in the past.

In this regard, Rosenthal and Strange [94] argued that location attributes are fixed at the time of commissioning, as a result of a study that examined the location decisions of new firms in the US, which suggested that the characteristics of cities are considered fixed from the point of view of a single entrepreneur. The specification (8) includes fixed effects that allow controlling all the determinants of the observed and unobserved localization that do not vary according to the industry, including wages, the composition of the labor force, income, climate of business, and the regulation of land use.

Despite this, it should be taken into account that a local shock in the creation of firms in the industry could be correlated with local shocks that affect the employment levels (predetermined) in the industries that maintain client-supplier links, use similar workers and similar technologies. Such a correlation could arise from cluster policies implemented at the local level in order to promote the

creation of firms in specific industries, in areas where employment levels (predetermined), in the priority industries, are already high.

Other difficulties that arise in this type of cross sectional models are the presence of multicollinearity, as well as problems of heteroskedasticity. Indeed, in the base model (8), the following Variation Inflation Factor values were obtained: Input sharing 3.98; output sharing 27.08; matching 24.83; learning 1.33; and history 1.02. However, it was decided to continue with the variables established for the following reasons: Nature of the variables, being variables that are shared (input and output) between companies, workers with the same occupations as those used by the industry, it is normal that these types of relationships are found; there is no exact relationship between the regressors, so ordinary least squares estimators will retain the property of best unbiased linear estimators; the modeling that is proposed is not structural analysis but estimation, so multicollinearity would not have a greater effect since the relationship between the variables remains both in the historical horizon and in the future of the variables. While robust regressions were performed for the correction of heteroscedasticity in all models.

5. Results

The estimates that are made by ordinary least squares include different specifications, from Equation (8), depending on the incorporation of control variables and fixed effects. The results shown correspond to the level of disaggregation of the industry to two digits.

The first column of Table 2 shows the coefficients for each mechanism of the agglomeration economies when only the variables that approximate them are included in the specification, plus the one that captures the history; that is, the past industrial environment of the cities. In that case only, the learning mechanism and the precise history are significant to explain the location of new firms.

In the same way, the second column allows verification of results obtained when the previous specification adds controls related to the employment of the city, excluding the one that corresponds to the industry in analysis, the employment of the industry contained in the canton, the area of the canton, and the available infrastructure with respect to ports, airports, and access to highways.

In this case, with the exception of the matching variable, all the rest modify the value of its parameters. Such behavior is reiterative in the third and fourth columns, although in these cases, the fixed effects of the province and also of the sectors are added to the controls described above. This results in sectors that maintain input-output links having an impact in the creation of firms between 2000 and 2010 in the order of 1.4% and 0.6% in each column, respectively. The fifth column of Table 2 is considered to be the best estimate because it no longer incorporates only the fixed effects of province and sector, but also those of cantons, which denotes that a 1% increase in the R&D expenditure of the sectors and cantons of the country occurred, which, in turn, increase the creation of new firms by 9.2%.

Otherwise, the industries and cantons with greater tradition, which were constituted between 1570 and 1900, favor an incidence of creation of 185 firms in those sectors and cantons. That amount that is above the average of 162 firms created between 2000 and 2010. The data from this column, as a whole, suggests that there are characteristics of cantons, which is the fixed effect ultimately incorporated, have had a significant influence on the decision to locate new businesses in Ecuador, given the evident change in the size of the coefficients with regard to previous estimates. In general, in this group of estimates, spending on R&D, and history are the variables that explain the location of new firms in the country.

Table 2. Estimates of agglomeration economies: Two-digit industry codes. Dependent variable: Number of new firms created by industry and city.

	I	II	III	IV	V
input sharing	0.444 (1.780)	1.113 (1.806)	1.428 (1.971)	0.939 (1.908)	−2.276 (7.288)
output sharing	5.725 (5.299)	3.450 (5.419)	4.497 (6.437)	3.904 (6.234)	−6.911 (27.048)
matching	3.174 (4.898)	13.431 (6.273)	13.221 (6.944)	10.889 (6.741)	32.93 (23.427)
learning	26.23 *** (1.939)	25.69 *** (1.953)	24.03 *** (2.005)	24.36 *** (1.956)	9.206 *** (2.286)
history	187.97 *** (17.838)	187.97 *** (17.829)	188.09 *** (17.981)	172.43 *** (17.476)	185.21 *** (17.830)
CONTROLS					
City employment (excluding the industry i)	No	Yes	Yes	Yes	Yes
Employment of the industry itself in each city	No	Yes	Yes	Yes	Yes
Area of the city	No	Yes	Yes	Yes	Yes
Infrastructure	No	Yes	Yes	Yes	Yes
FIXED EFFECTS					
Province	No	No	Yes	Yes	Yes
Sector	No	No	No	Yes	Yes
City	No	No	No	No	Yes
Prob > F	0.000	0.000	0.000	0.000	0.000
R ²	0.322	0.329	0.339	0.389	0.472
Adj R ²	0.320	0.325	0.326	0.380	0.393
No. of industries	19	19	19	19	19
No. of cities	219	219	219	219	219
No. of observations	1.845	1.845	1.845	1.845	1.845

(1) Standard error between parentheses. (2) *p*-values: *** *p* < 0.01. (3) All the explanatory variables are expressed in logarithms.

Similarly, Table 3 contains the results of the base model but at a three-digit sectorial disaggregation level. This increases the number of sectors by 24, as an alternative way of presenting and validating the previous results. However, since it does not, it is possible to carry out estimates at a different geographical scale. As noted earlier, Ecuador has only 24 provinces and, therefore, an insufficient number of observations to make the estimates. The results affirm the significance of the learning mechanism in the industrial location of new firms in Ecuador. At the same time, firms with historical tradition are also significant in all the specifications that are made. As before, different estimations are shown according to the incorporation of control variables and fixed effects, in a gradual manner.

It should be noted that, with the fixed effects added in these models, the adjusted R² value oscillates in a range between 0.32 and 0.47 in the two-digit sector disaggregation, and between 0.20 and 0.31 in the three digits. This permits the inference that the inclusion of the provincial, sectorial, and canton fixed effects control a series of potentially important determinants omitted from the location of the new firms.

Table 3. Estimates of agglomeration economies: Three-digit industry codes. Dependent variable: Number of new firms created by industry and city.

	I	II	III	IV	V
input sharing	−11.230 *	−7.937	−7.201	−3.898	10.729
	(5.208)	(5.344)	(5.943)	(5.743)	(17.710)
output sharing	17.404 **	11.99 *	9.353	9.709	18.994
	(6.447)	(6.709)	(7.042)	(6.790)	(21.122)
matching	−0.051	8.109	10.74 *	4.772	−4.854
	(3.881)	(5.595)	(6.174)	(5.999)	(26.009)
learning	11.80 ***	11.62 ***	10.67 ***	12.53 ***	7.573 ***
	(1.545)	(1.552)	(1.577)	(1.539)	(1.699)
history	165.68 ***	166.11 ***	166.05 ***	152.34 ***	164.68 ***
	(15.291)	(15.304)	(15.408)	(14.954)	(15.617)
CONTROLS					
City employment (excluding the industry i)	No	Yes	Yes	Yes	Yes
Employment of the industry itself in each city	No	Yes	Yes	Yes	Yes
Area of the city	No	Yes	Yes	Yes	Yes
Infrastructure	No	Yes	Yes	Yes	Yes
FIXED EFFECTS					
Province	No	No	Yes	Yes	Yes
Sector	No	No	No	Yes	Yes
City	No	No	No	No	Yes
Prob > F	0.000	0.000	0.000	0.000	0.000
R ²	0.199	0.203	0.208	0.282	0.312
Adj R ²	0.197	0.199	0.198	0.256	0.309
No. of industries	43	43	43	43	43
No. of cities	219	219	219	219	219
No. of observations	9.417	9.417	9.417	9.417	9.417

(1) Standard error between parentheses. (2) p -values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. (3) All the explanatory variables are expressed in logarithms.

Based on the atypical behavior of the cantons of Quito, Guayaquil, and Cuenca (Figure 3), Table 4 contains the summary of the results of the estimates made when these cantons are not considered in the analysis. The objective was to explore whether the behavior of the agglomeration mechanisms observed up to now is modified by isolating the large cantons of the country. As before, each column shows different results because different controls and fixed effects are incorporated. Thus, column one shows that when none of these are imposed, matching, learning and history, determine the location of new firms between 2000 and 2010. This behavior is maintained until the provincial fixed effects are incorporated into the specification (columns two and three).

After introducing the fixed effect of the sector, learning stops explaining such location. This situation is maintained when, in addition to the fixed effects of the sector, the fixed effects of the city are added (columns four and five). Therefore, the results of the last column are considered to be the most robust if the value of R^2 in column five is also taken into account.

As can be verified, sharing, matching, and history explain the birth of firms between 2000 and 2010, when the largest cantons in the country are isolated from the analysis. Such behavior is affirmed in the estimations the intensity of the matching relationships between the five and fifteen closest sectors is considered, as in (6). However, when technologically related sectors are taken into account in their place, the results suggest that there is no incidence of the sharing mechanism, although matching and history persist as explanatory variables of the birth of firms in the study period. These results

are consistent with Rosenthal and Strange [67], Barrios et al. [69], Ellison and Glaeser et al. [72], and Jofre-Monseny [74].

Table 4. Estimates of agglomeration economies: Three-digit industry codes. Alternative definition of the number of cantons. Dependent variable: Number of new firms created by industry and canton.

	I	II	III	IV	V
input sharing	−0.570 (5.959)	0.257 (1.626)	0.539 (1.801)	2.178 (1.601)	−16.15 ** (7.396)
output sharing	−0.135 (8.495)	−1.968 * (2.057)	−2.152 (2.149)	−1.619 (1.907)	3.807 (4.185)
matching	4.192 *** (6.983)	8.289 *** (1.693)	9.076 *** (1.874)	5.889 *** (1.674)	38.87 *** (8.214)
learning	−0.848 *** (3.320)	−1.731 *** (0.612)	−1.834 *** (0.613)	−0.532 (0.559)	−0.848 (0.582)
history	38.78 *** (4.968)	48.16 *** (5.298)	46.09 *** (5.323)	38.34 *** (4.737)	38.78 *** (4.968)
CONTROLS					
City employment (excluding the industry i)	No	Yes	Yes	Yes	Yes
Employment of the industry itself in each city	No	Yes	Yes	Yes	Yes
Area of the city	No	Yes	Yes	Yes	Yes
Infrastructure	No	Yes	Yes	Yes	Yes
FIXED EFFECTS					
Province	No	No	Yes	Yes	No
Sector	No	No	No	Yes	Yes
City	No	No	No	No	Yes
Prob > F	0.000	0.000	0.000	0.000	0.000
R ²	0.166	0.171	0.183	0.373	0.406
Adj R ²	0.157	0.169	0.179	0.370	0.401
No. of industries	43	43	43	43	43
No. of cities	219	219	219	219	219
No. of observations	9.417	9.417	9.417	9.417	9.417

(1) Standard error between parentheses. (2) p -values: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. (3) All the explanatory variables are expressed in logarithms.

Robustness of Results

To verify the robustness of the results described so far, their sensitivity to a definition of greater or lesser intensity in the inter-sectorial relations of i, j is evaluated regarding the matching variable, which is measured by the number of sectors at two levels: The 5 and 15 most related when the intensity of the relationship increases or decreases, respectively. Therefore, this definition implied modifying the initial number of the 10 sectors most related, first to 5 and then to 15, in the two levels of sectorial disaggregation.

Alternatively, and as an additional robustness test, the initial database is divided into two groups of sectors classified as medium and low technology, according to the OECD Directorate for Science, Technology, and Industry [87]. Within these categories, eighteen and twenty seven sectors were identified, respectively; while only three sectors, out of 67 initially considered on a three-digit scale classified as high tech, which is why they were not taken into account in this analysis.

This section shows new estimates that consider the two criteria indicated: Measures with greater and lesser technological intensity, and sectorial classification according to technological use. These results in Table 5, (where the first four columns show the values of the coefficients when the intensity levels of the matching relationships are modified) evidence the significance of the

learning mechanism and the history, in the location of new firms, even though the scales of sectorial disaggregation are different. Table 6 collects these results for the alternative definition of the number of cantons without considering Quito, Guayaquil, and Cuenca.

The coefficients of these variables are clearly consistent and stable in both cases. Columns five and six present the results obtained when two groups of different industries are used according to the degree of technology they use. The results confirm the previous findings regarding the significance of the learning and history variables in the location of new firms. However, the first of these variables is relatively more important in the low technology sectors, while the second is more important for the medium technology sectors.

These results are consistent with those found by Rosenthal and Strange [94] who used innovation as a proxy for spending on research and development in their study. They found there to be a positive and significant effect of this variable on the spatial concentration of industry for large US firms, although only at the zip code level.

Likewise, Barrios et al. [69] found a significant positive effect of knowledge spillovers for Portugal, using the same variable as in this work. Conversely, in Ellison et al. [93], all mechanisms are significant to explain industrial co-agglomeration, although knowledge spillovers are weak in some specifications, but are of comparable magnitude in other estimates.

Table 5. Estimations of the economics of agglomeration robustness of results. Dependent variable: Number of new companies created by industry and canton.

	2D5I	2D15I	3D5I	3D15I	3DMT	3DBT
input sharing	−2.01 (7.094)	−2.06 (6.809)	10.23 (17.841)	21.55 (21.426)	4.02 (42.361)	26.70 (28.506)
output sharing	13.19 (26.297)	18.75 (17.662)	19.32 (21.758)	−1.31 (25.880)	18.09 (46.779)	3.28 (49.714)
matching	10.68 (19.321)	9.38 (12.145)	−4.94 (26.461)	−1.34 (13.057)	7.21 (37.922)	4.21 (33.822)
learning	9.20 *** (2.289)	9.21 *** (2.286)	7.57 *** (1.699)	7.57 *** (1.699)	8.25 *** (3.199)	11.31 *** (2.355)
history	185.21 *** (17.850)	185.21 *** (17.830)	164.68 *** (15.617)	164.68 *** (15.617)	254.95 *** (26.663)	146.38 *** (21.683)
CONTROLS						
City employment (excluding industry i)	Yes	Yes	Yes	Yes	Yes	Yes
Employment of the industry itself in each city	Yes	Yes	Yes	Yes	Yes	Yes
City area	Yes	Yes	Yes	Yes	Yes	Yes
Infrastructure	Yes	Yes	Yes	Yes	Yes	Yes
FIXED EFFECTS						
Province	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes	Yes	Yes
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000
R ²	0.472	0.472	0.312	0.312	0.378	0.355
Adj R ²	0.470	0.469	0.309	0.309	0.375	0.353

(1) The notation: 2D5I and 2D15I corresponds to the sectors whose relations in the matching is with the five and fifteen sectors most related, respectively, to two digits of sectorial disaggregation. (2) The same thing happens with the notation 3D5I and 3D15I, only in this case, they correspond to the three-digit disaggregation. The notation 3DMT and 3DBT corresponds to the abbreviations of the sectors of medium and low technology, to three digits of sectorial disaggregation. (3) Standard error between parentheses. (4) p -values: *** $p < 0.01$. (5) All the explanatory variables are expressed in logarithms.

Table 6. Robustness test: Alternative definition of the number of cantons. Dependent variable: Number of new companies created by industry and canton.

	3D5 _i	3D10 _i	3DMT	3DBT
Input sharing	−18.93 ** (7.738)	9.32 ** (7.396)	−24.83 (12.838)	−119.97 (72.562)
Output sharing	−7.52 (6.218)	6.51 (4.503)	−2.27 (7.355)	81.86 (60.412)
Matching	41.80 *** (8.804)	15.77 *** (8.214)	62.89 *** (16.900)	63.23 *** (23.033)
Learning	−0.85 (0.582)	−0.85 (0.582)	−3.24 (1.697)	−0.55 (0.725)
History	38.78 *** (4.968)	38.78 *** (4.968)	2.65 (12.987)	46.94 *** (6.169)
CONTROLS				
City employment (excluding industry i)	Yes	Yes	Yes	Yes
Employment of the industry itself in each city	Yes	Yes	Yes	Yes
City area	Yes	Yes	Yes	Yes
Infrastructure	Yes	Yes	Yes	Yes
FIXED EFFECTS				
Province	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes
City	Yes	Yes	Yes	Yes
Prob > F	0.000	0.000	0.000	0.000
R ²	0.534	0.406	0.401	0.459
Adj R ²	0.531	0.402	0.398	0.455
No. of industries	19	43	16	26
No. of cities	216	216	216	216
No. of observations	4.104	9.288	3.456	5.616

(1) The notation: 3D corresponds to the three-digit disaggregation. (2) The notation MT and BT corresponds to the abbreviations of the sectors of medium and low technology, to three digits of sectorial disaggregation. (3) Standard error between parentheses. (4) *p*-values: ** *p* < 0.05, *** *p* < 0.01. (5) All the explanatory variables are expressed in logarithms.

In the work of Jofre Monseny et al. [74], when the analysis is done between cities, the significant mechanisms for locating new firms are matching and input sharing; while when the analysis is conducted within the cities, this is at the municipal level, is added to them, learning as a significant variable, what the authors explain in terms of the geographical unit of analysis that best captures these effects.

6. Conclusions

The contribution of this paper, in theoretical terms, is the identification of the location factors of the new manufacturing companies in Ecuador, based on research and theories [2–9] at the world level; this study is the first in Latin America and Ecuador related to this topic, it contributes to closing the knowledge gap with respect to developed countries in this field of research. As for the formal terms, related to methodologies and mathematical methods, their contribution lies in the econometric modeling used, which constitutes an important way to approach the rigorous study of

economic phenomena, in this case agglomerations; this based on the reviewed literature and previous studies [73,74,91,92] that have verified that the agglomeration economies can be observed and explained through the use of regression models.

The first result indicates that, in Ecuador, only the learning mechanism affects the location of new firms in space. This could be explained in the context of the public policy that the country is developing in order to promote a productive model sustained mainly in the incorporation of production with added value and intensity in local knowledge. Ecuador has committed a very significant amount of its resources to these factors, since it seeks to stimulate innovation through spending on research and development. Among other aspects, a series of tax incentives has been generated for innovation and entrepreneurship, according to the type of company and the territorial area. Due to its promotion of the Internet, Ecuador has become the Latin American country where Internet use has grown most rapidly. In recent years, Internet use grew 33% between 2007 and 2012. The training of human talent, whose investment represents an expansion from US 11.2 million between 1993 and 2006 to US 578 million between 2007 and 2012 [94].

This data, denotes Ecuador's effort in terms of innovation being made in the country, although its low starting point, compared to the other countries in the region, still formed a situation of delay. This is mainly evident in the contraction of more than five percentage points in high-tech exports, in the last ten years [95].

From these results, it seems evident that the country's approach to innovation is boosting industrial activity. However, innovation cannot be seen as the exclusive result of the operation of a firm, but rather as the consequence of the use of various complementary assets and a set of inter-relationships. The result is that when these cities are not included in the estimates, outcomes are substantially modified and the learning mechanism loses significance in explaining the birth of firms between 2000 and 2010, in favor of sharing and matching.

This suggests that public investment in research and development is concentrated precisely in these cities. In their absence, the birth of new firms is determined instead by sharing and matching mechanisms.

The second result is akin to the significant role of history in locating new firms. The colonial history of Ecuador gives an account of the urban primacy of Quito, Guayaquil, and Cuenca over the rest of the cantons. This continues to this day because these three cantons represent a wealth of previous information on productivity. Consequently, employment is fostered by a history of interactions and long-term cultivated relationships. This leads to an accumulation of knowledge available to firms only in a local area. In this sense, historical environments, as Henderson [96] pointed out, offer an advantage to attract new ventures, as the results obtained maintain.

The third result is that when these three cities are not included in these estimates, the results are substantially modified and the learning mechanism loses significance in explaining the birth of firms between 2000 and 2010. Sharing and matching then become the more significant mechanisms for agglomeration. This suggests that public investment in research and development is concentrated precisely in these cantons, and in their absence, the birth of new firms is determined by sharing and matching mechanisms rather than the learning mechanism.

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