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ORIGINAL ARTICLE

A geospatial analysis of concentrations of technological sectors in the Valencia Community region

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Abstract

A geographical concentration of businesses enables them to mitigate the drawbacks arising from their small size. It is therefore important to highlight the existence of such zones and their location in regions where most businesses are SMEs, such as the Valencia Community region. Moreover, it is particularly important for technological companies, since such concentrations act as a means of increasing their productivity. By using georeferencing software, SatScan, four zones with a high concentration of technological companies are identified superimposed on zones with a very industrial tradition. The profile of the companies analysed could be of interest in implementing suitable industrial policies.

KEYWORDS

agglomeration, industrial districts, SatScan, technological companies

1 | INTRODUCTION

Growth in high-tech sectors is one of the main factors behind business development, especially in advanced economies, since it is one of the principal competitive advantages on an international level. In fact, maintaining high salaries while increasing the quality of life without causing a rise in unemployment is directly related in certain regions to the existence of these kinds of sectors. For instance, Mas, Fernández de Guevara, Robledo, and López-Cobo (2019) provide empirical evidence about the higher productivity of the EU ICT sector. From 1995 to 2016, the value added

increment in real terms is three times greater when compared to the general economy. As mentioned by Martín, Núñez, Turrón, and Velázquez (2011), the last financial crisis revealed the vulnerability of economies with fewer technological advantages such as the Spanish economy, and more specifically the Valencian economy, which concentrate on a labour-intensive production model like construction and tourism that provides the main drive behind their economic growth. In this sort of economy, consequences of the crisis had a higher impact, as explained in the report "Economic crisis in Europe: Causes, consequences and responses" (2009) by the European Commission. Directorate-General for Economic and Financial Affairs.

Another factor that fosters business development is the extent of agglomeration in the production activity. Companies that operate in zones with a high concentration benefit from the tangible and intangible externalities that foster economic development, as pointed out by Marshall (1920). This geographic concentration is particularly evident in technological activities, because it is how greater levels of production are achieved (Ciccone, 2002; Ciccone & Hall, 1996), as is clearly seen in Silicon Valley and the Emiglia-Romagna region in Italy. Marshall (1920) distinguishes between three types of factors that generate the externalities that are fostered by the geographic concentration of companies: intra-industrial "knowledge spillovers," inter-industrial ties (externalities associated with the size of the market) and the formation of a specialized job market shared by companies located in the same territory. The economic literature stemming from the work by Marshall (1920) has grown, adding new approaches to production externalities. For Jacobs (1969), inter-industrial externalities are more important than intra-industrial ones; that is, companies benefit more from diversity in their immediate surroundings than from a concentration of their own industry. There are three main models that persist today. First, when we talk of agglomeration economies there are the theories of Marshall (1920), Arrow (1962) and Romer (1986), whose general idea can be summed up in the work by Glaeser, Kallal, Scheinkman, and Shleifer (1992) known as the Marshall–Arrow–Romer (MAR) model. This model states that the concentration of an industry in a specific region fosters knowledge spillovers among companies and generates innovation in that industry in particular. Second, Jacobs (1969) places more importance on the sources of inter-industrial knowledge spillovers, pointing out that cities are a source of innovation due to the business fabric they contain.

These advantages of concentrating production activities are especially significant in an economy such as Europe, since one of the main handicaps faced by European companies is their small size. This geographical agglomeration gives them a chance to combine their strengths and thus get around the disadvantages of their size.

This study analyses spatial concentrations of businesses in medium to high-tech companies, since the companies in these sectors not only provide a competitive edge for themselves, but also transmit new technologies and products to the rest of the business fabric. Hence, a concentration of businesses considered to be technological may on the one hand help increase their own productivity (i.e., the economy of intra-industrial localization), but also provide support for other sectors (i.e., inter-industrial localization). It is precisely for this reason that the level of spatial concentration attracts the attention of public policies geared towards fostering technological innovation (Fariñas & López, 2006).

The territory where we have analysed the location of possible business concentrations is the Valencia Community region. This territory is worth special attention for various reasons. First, there is a strong business mentality here, and second, a deep industrial tradition. As indicated by Boix and Galletto in 2006, the Valencian economy is especially interesting for studying industrial districts, since it has a great diversity of sectors that are concentrated geographically. These characteristics have led it to be studied by several authors. We could highlight, for example, the studies by García and Alamá (2000), Soler (2000), Giner and Santa María (2002), Boix (2008), Miret-Pastor, Segarra-Oña, and Peiró-Signes (2011) and others. Lastly, there is the current concern shown by public bodies for developing and fostering business fabric especially linked to more technological activities.

So, the purpose of this paper is to study the existence of geographical concentrations of technological companies in the Valencia Community region, with "technological companies" understood to mean those that belong to medium and high-tech companies according to INE (the Spanish National Statistics Institute). To identify the companies, a geolocalization tool has been used that enables the locations of business concentrations to be detected, and to compare the statistical significance of these concentrations. Once detected, the relevant characteristics of companies in these zones were identified and analysed, such as their size, export activity and the existence of technological institutes

nearby. In line with some research, like Filippetti and Archibugi (2011), it is tested if the specific national factors, as technological institutes, affect the innovations activities aggrupation's in this case. This work also analyses the evolution of these zones over time, comparing their existence and characteristics at two moments in time separated by 20 years.

Our work aims to detect and analyse geospatial groupings of medium-to-high-tech companies that could provide greater economic productivity for the region. The paper is divided into the following stages. Following this introduction, there is a review of the bibliography. Then tSection 3 describes the data and method used. The results obtained are presented in Section 4, followed by the discussion and finally the conclusion.

2 | THE CURRENT STATE OF AFFAIRS

The importance of a concentration of high-tech activities for the growth of regions becomes clear on reading the existing literature on the matter. There are studies that demonstrate it, such as the one by He and Fallah (2011) analysing the evolution of high-tech industry clusters in the United States, and the one by Antonelli, Patrucco, and Quatraro (2011) studying the effects of the agglomeration of technological activities on growth in European regions. Furthermore, the externalities of agglomeration appear more intensely in industries with a large technological content, as proven by Caragliu, de Dominicis, and de Groot (2016) for the region of Europe. For Spanish companies in particular, Martín et al. (2011) found similar results, showing a high concentration of knowledge-generating activities and that the agglomeration process increases in more technological sectors. The geographical concentration of companies with the specific characteristics of any sector (in this case medium to high-tech sectors) can bring them indirect effects such as access to external economies of scale, a reduction in transport costs, greater availability of qualified workers and suppliers, and lower transaction costs, thereby helping growth in such regions.

Given the importance of the location of geographical concentrations of businesses, there have been many studies to date in Spain. Nationwide, we could highlight the works by Boix and Galletto (2006), Santa María, Giner, and Fuster (2004), and Costa (1992). As we have mentioned above, the Valencia Community region's diversity of industrial sectors and their geographical concentration have attracted special attention when identifying business concentrations. Proof of this diversity is given by the results obtained by Boix and Galletto (2006), which show that the Valencia Community region is the Spanish region with the most industrial districts, with a total of 54, all of which belong to traditional industry. However, the extensive bibliography on business concentrations in the Valencia Community region focuses very much on analysing industrial clusters or districts that belong to traditional manufacturing with typically low technology. Although the Valencia Community region is one of the five regions in Spain with the most technological activity, as indicated by Martín et al. (2011), the bibliography on this activity is scant. One such study is by Miret-Pastor et al. (2011), which extends the study of clusters in the Valencia Community region to medium and high-tech sectors and the services sector, not only to traditional industry. Our work differs from previous studies in both the subject under study and the method used. As regards the subject under study, the aforementioned bibliography for the Valencia Community region focuses on the location of industrial clusters or districts, mostly with traditional industry. However, this work concentrates on the spatial location of concentrations of companies with the common characteristic of belonging to medium and high-tech sectors of activity. The method uses georeferencing co-ordinates to locate the companies. This is an alternative to the solution suggested in the literature in order to avoid the problems arising from using an artificial territorial demarcation.

3 | METHOD AND DATA

3.1 | Method

Our study is concerned fundamentally with aspects of agglomeration, using a statistical measurement of concentration that meets the condition of anonymity for individuals, while being aware that there is a latent effect of spatial

dependence that is not being analysed in this case. According to Arbia (2001), overlooking the spatial characteristics of the data can lead to serious biases on quantifying industrial agglomerations, because one has to take into account both the spatial dependence and the concept of agglomeration.

In order to detect spatial agglomerations in the location of technological companies, we have used the test by Kulldorff (1997). To evaluate the test, SatScan[1] free software has been used (https://www.satscan.org/), which identifies if there are spatial agglomerations (and even in the space over time) that are statistically significant. It has three characteristics of interest (López & Páez, 2017). First, it allows micro-information to be processed, considering the space to be continuous since it uses each company's geographic co-ordinates. Second, it enables hypotheses to be compared, thereby enabling an analysis of statistical significance. Lastly, this software is able to identify the location of technological companies in the possible agglomerations (each time it does so is called an "event"). We can thus determine and geographically locate the statistically significant concentrations based on the initial locations of all the companies in technological sectors in the Valencia Community region.

The spatial analysis was carried out for different statistical distributions. In our case, we have assumed that the distribution of variables follows a Bernoulli distribution[2] in order to carry out the analysis.

The underlying principle of this statistical spatial measurement is as follows. Basically, a test has been designed to enable zones to be identified where the intensity of a specific event (in this case, the appearance of technological companies) within the space is greater or lesser than expected using a specific null hypothesis.[3] To test the hypothesis, we defined a predetermined type of one. The statistical software progressively changes the size of this zone, and each time it changes, the intensity of the event is measured inside and outside the zone, thus identifying the zones where the intensity is different. Concentration of technological companies inside the zone is measured compared to outside it, thus identifying the zones where the concentration is different. The process was repeated to cover the entire surface area under study (the Valencia Community region). Lastly, the values observed for the event (the identification of technological companies) in each zone were compared with the values predicted by the null hypothesis posited. (López and Páez (2017) explain this process in detail).

On carrying out the spatial analysis with the SatScan free software, it was necessary to set out three parameters: the geometric shape of the zone (agglomeration), the type of zone and its maximum size. In our study, we have analysed the existence of circular zones and concentrated solely on zones with a high concentration of technological companies, given that we are concerned with high levels of concentration and not a lack of them. In order to select the size of zone, we specified a maximum of 15% of the total population within said zone. On the one hand, we were seeking high concentrations, and on the other, zones that were not too big, given that the possible reasons explaining the concentration of companies include economies of proximity and scale, so the distances between companies could not be too big.

As indicated by Santa María, Giner, and Fuster (2005), one of the problems in identifying concentrations of companies is the territorial delimitation. We can see, for example, how Santa María et al. (2005) segmented the territory by municipalities, as did Viladecans (2000). However, García and Alamá (2000) used counties (*comarcas*) as the geographical division. Callejón (1997), Costa and Viladecans (1999) and Alonso, Chamorro, and González (2003) used the larger provinces. Subsequent authors have preferred to use local job markets to identify industrial districts as a way of avoiding such artificial territorial barriers. Such authors include Casado (2000), Giner and Santa María (2002), Boix and Galletto (2006), Boix (2008), Miret-Pastor et al. (2011) and others. In this

[1]Other identification algorithms such as K-means (MacQueen (1967)) and K-modes (Chatuverdi, Foods, Green, and Carroll (2001)) are not applicable in this study. The K-means algorithm uses quantitative variables to calculate the minimum Euclidean distance in order to detect behaviour patterns, whereas our variables are quantitative. The K-modes, albeit designed to be used with qualitative (or categorical) variables, does not identify the individuals (companies) that belong to each cluster. It only identifies behaviour patterns, which makes it impossible to geographically locate the companies in each of the clusters, which is the main aim of this study.

[2]The Bernoulli distribution deals with random variables that have exactly two possible outcomes. And in this case if the firm (the variable) is techconological takes value 1, and if it is not technological than is 0.

[3]If P_A denotes the likelihood of finding a technological firm in a specific zone and $P_{\bar{A}}$ denotes the likelihood of finding a technological firm outside a specific zone. The null hypothesis is H_0: $P_A = P_{\bar{A}}$: and H_A: $P_A > P_{\bar{A}}$. (or $P_A < P_{\bar{A}}$).

study, the postcodes and their geo-localization co-ordinates have been used in order to refine the location of the concentrations.

3.2 | Data

The sample of companies used comes from the SABI database,[4] which is widely used in the academic world. The criteria for choosing the companies were based on data from individual companies active in July 2019, identifying whether they were technological ones or not. This data was complemented with external data (co-ordinates and/or postcodes).[5]

This enabled us to draw up a preliminary database with 3,813 companies in the Valencia Community region with a technological CNAE (Spanish National Classification of Economic Activity), GPS co-ordinates, postcode and complete financial data. A second database was created with all of the companies in the Valencia Community region (187,891 companies), distinguishing between those with a technological CNAE classification and those without.

To identify companies from a technological sector, we used the same criteria used by the INE (n.d.)[6]. The INE (Spanish National Statistics Institute) establishes a correspondence between NACE (Statistical Classification of Economic Activities in the European Community) and CNAE-09 classifications and the indicators from the medium and high-tech sector. The CNAE sectors proposed by INE are shown in Table 1 together with the distribution of the companies in the Valencia Community region in July 2019.[7] It should be noted that we are considering all sectors in the CNAE classification that the INE classifies as medium and high technology ones, not only activities that act as technological support for other production activities or services.

In order to properly interpret the table, we have to take into account that one company can be linked to several CNAEs. For this reason, the total number of companies in the sample (3,813) does not coincide with the total CNAEs declared by them (4,053).

It is noticeable that sector 28 (manufacture of other machinery and apparatus) and 62 (programming, consultancy and other activities related to IT) take up 46.2% of technological activity. Table 2 shows the distribution of technological companies by province and size.[8]

We can see that small companies account for 76.7% of all the technological companies. The province of Valencia takes up 59.4% of all technological companies in the Valencia Community region.

4 | RESULTS

This section first analyses the results obtained for companies existing in 2019, then compares them to those from the year 2000.

[4]SABI (Iberian Balance sheet Analysis System) Database is developed by INFORMA D&B in collaboration with Bureau Van Dijk. It contains comprehensive general information and annual accounts of over 2.7 million Spanish companies and more than 800,000 Portuguese ones. It is defined by its extensive coverage, the standardization of financial statements, and it serves as a classified companies' searcher by a combination of balance sheet criteria with a historical record of more than 25 years to know the positioning of any company.

[5]Websites for converting postcodes into GPS coordinates were used (such as https://www.coordenadas-gps.com and https://csv2geo.com/) and the Google maps option *What's here* in the drop-down menu.

[6]All companies that report at least one CNAE technological classification have been included.

[7]Last taken from SABI on 15 July 2019.

[8]The size of companies is determined according to Article 2, Annex I of EU Commission Regulation no. 651/2014 of 17 June 2014. Micro-companies are defined as those with fewer than ten employees and whose annual turnover or total assets in the balance sheet is no more than €2 million. Small companies are defined as those with fewer than 50 employees and whose annual turnover or total assets the balance sheet is no more than €10 million. Lastly, medium-sized companies are defined as those with fewer than 250 employees and whose annual turnover is no more than €50 million or whose total the balance sheet does not exceed €43 million.

TABLE 1 Distribution of the amount of companies by technological sectors of activity according to the CNAE classification

CNAE	Description	Amount of CNAEs declared	% of CNAEs declared
	High technology sectors	187	4.61%
21	Manufacture of pharmaceutical products	26	0.64%
26	Manufacture of I.T., electronic and optical products.	159	3.92%
303	Aerospace construction and its machinery	2	0.05%
	Medium-high technology sectors	1,587	39.16%
20	Chemical industry	493	12.16%
254	Manufacture of arms and ammunition	1	0.02%
27	Manufacture of electrical material and apparatus	219	5.40%
28	Manufacturer of other machinery and apparatus	604	14.90%
29	Manufacture of motor vehicles, trailers and semi-trailers	133	3.28%
302	Manufacture of locomotives and railway materials	2	0.05%
304	Manufacture of military combat vehicles	1	0.02%
309	Manufacture of other transportation materials	6	0.15%
325	Manufacture of medical and orthodontic supplies and instruments	128	3.16%
	High-tech services	2,279	56.23%
59	Activities involved in cinema, video and television programmes, sound recording and musical editing	243	6.00%
60	Activities involved in creating programmes and broadcasting for radio and television	99	2.44%
61	Telecommunications	301	7.43%
62	Programming, consultancy and other activities related to I.T.	1,269	31.31%
63	Information services	197	4.86%
72	Research and development	170	4.19%
Total		4,053	100.00%

Source: The authors, with data from SABI

4.1 | Results from 2019

Once the database had been created and the type of agglomeration estimated by using SatScan, we were able to identify four significant zones:[9] two in the province of Valencia, one in the province of Alicante, and another in the province of Castellón, as can be seen in the table of results (Table 3) and their location on the map of the Valencia Community region (Figure 1) using Google Maps. It is important to mention that the zone founded in Alicante is ubicated in the same place where there is a traditional textile cluster and the Castellón zone correspond to the ceramic cluster, as shown for instance by Miret-Pastor et al. (2011).

Figure 1 shows us the location on the map of the four significant zones (representing a p-value of over 5%). In the image we can see that zone 1, hereinafter Valencia Interior Zone, has a radius of 27.56 km and is found within the province of Valencia. It includes the industrial estate in Paterna, the Ford industrial estate in Almussafes, and the municipalities of Turis, Buñol, Torrent, Picassent. The second zone, hereinafter the Southern

[9]We used a p-value lower than 0.05 as the criterion for significance.

TABLE 2 Number (Abs and %) of technological companies by province and size

Province	Large	Medium	Small	Micro	Total
Alicante	4 (8.33%)	41 (20.40%)	835 (28.56%)	191 (29.84%)	1,071
Castellón	14 (29.17%)	26 (12.94%)	366 (12.52%)	71 (11.09%)	477
Valencia	30 (62.50%)	134 (66.67%)	1723 (58.93%)	378 (59.06%)	2,265
TOTAL	48 (100.00%)	201 (100.00%)	2,924 (100.00%)	640 (100.00%)	3,813

Source: The authors, with data from SABI.

TABLE 3 Results from identifying zones[a] using StatScan

Zone	TNC	TNTC	TNTC (E)	O/E	Relative success	% Cases	P-value
1	27,239	927	552.78	1.68	1.89	3.40	<1E-17
2	5,897	208	119.67	1.74	1.78	3.50	5.9E-10
3	3,730	129	75.7	1.7	1.73	3.50	5E-05
4	9,220	251	187.11	1.34	1.37	2.70	0.01

Notes:
[a]"Zone" is the number assigned to the zone. For each zone: TNC is the total number of companies; TNTC is the total number of technological companies; TNTC(E) is the expected number of technological companies; O/E is the relationship between the amount of technological companies that actually exist in a zone and the amount there would have been if the companies had been distributed without any zone existing in the territory; relative success is the proportion of technological companies in a zone compared to the proportion of other technological companies in the rest of the territory $[TEC_c/total_c] / [(TEC_t\text{-}TEC_c)/(Total_t\text{-}Total_c)]$; % cases is the percentage of technological companies in the zone; p-value gives the significance of the area according to the null hypothesis of non-existence. See Appendix C.
Source: The authors.

Castellón Zone, has a radius of 9.18 km and is located within the province of Castellón. Most of the province's ceramic tile industry is in this zone, which includes the municipalities of Villareal and Onda. The third zone, the Ibi Zone, is located inside the province of Alicante. It measures 13.83 km in radius and includes the municipalities of Ibi, Castalla, Onil and Alcoy, all of which have a deep industrial tradition. Lastly, the fourth zone is the Northern Valencia Zone with a radius of 11.29 km. It is also located in the province of Valencia and includes the port of Sagunto and the industrial estates of Sagunto, Moncada, Alboraya and others. Each of the zones can be seen in Appendix A.

We can see in Figure 1 that the amount of territory that the zones occupy differs greatly, as well as the amount of companies within them. It is therefore convenient to analyse the density of companies[10] in order to assess whether there are notable differences. The results are shown in Table 4. Indeed, very different densities can be seen in them. The Northern Valencia zone has the greatest concentration of companies, whereas the Ibi zone (Alicante) has the lowest.

Once these zones were identified, we analysed their characteristics. First, we studied the size of the companies in each of the zones; then their level of internationalization (measured with variables such as foreign trade, whether with imports or exports); and lastly, their proximity to technological institutes.

Table 5 shows the distribution of the companies by size and zone. In all of them, one can see a greater amount of small and micro-companies, reaching about 90% of the companies in each zone.

As for the level of internationalization, we defined this variable according to whether the company has some kind of foreign trade, whether importing, exporting or both. We can see a summary in Table 6.

[10]Amount of companies per km^2.

FIGURE 1 Location of the technological zones in the Valencia Community region in 2019
Source: The authors

TABLE 4 Density per zone

Zone	Surface area (km^2)	Density
1 Valencia Interior	2386.21	11.42
2 Castellón Interior	264.75	22.27
3 Ibi	600.89	6.21
4 Northern Valencia	400.44	23.02

Source: The authors.

TABLE 5 Distribution of companies by zone and size

Zone	Large	Medium	Small	Micro	General total
1 Valencia Interior	21 (61.76%)	78 (66.67%)	710 (60.48%)	118 (62.11%)	927
2 Castellón Interior	7 (20.59%)	15 (12.82%)	161 (13.71%)	25 (13.16%)	208
3 Ibi	1 (2.94%)	8 (6.84%)	109 (9.28%)	11 (5.79%)	129
4 Northern Valencia	5 (14.71%)	16 (13.68%)	194 (16.52%)	36 (18.95%)	251
Total companies inside a zone	**34** (100.00%)	**117** (100.00%)	**1,174** (100.00%)	**190** (100.00%)	**1,515**

Source: The authors.

TABLE 6 Companies with foreign trade

Zone	Percentage of companies that have foreign trade compared to the total amount of companies in their zone
1 Valencia Interior	28.91%
2 Castellón Interior	28.37%
3 Ibi	23.58%
4 Northern Valencia	23.11%
Total technological companies	20.64%

Source: The authors.

Out of a total of 3,813 technological companies, we detected 787 companies (20.64%) engaging in foreign trade, that is, they import, export or both. In Table 6 we can see the distribution of this foreign trade depending on the zone to which the companies belong. The companies in the Valencia Interior Zone, located in Paterna, show greater internationalization.

TABLE 7 Companies in a zone (columns)[a] and in the same postcode as a technological institute (rows)[b]

Zones						
Technological institute	**1**	**2 Interior of Valencia**	**3 Castellón Interior**	**4 Ibi**	**5 Northern Valencia**	**General total**
1	2,186	739	154	73	215	3,367
2	44					44
4	26					26
5/8/11/12/15/16		188				188
6	15					15
79					36	36
10	27					27
13				22		22
14				34		34
17			54			54
General total	2,298	927	208	129	251	3,813

Notes:

[a]Column 1 contains the companies outside the zones identified

[b]Row 1 indicates companies within the zones identified that do not have technological institutes (TI) in their proximity. For the cross-referenced search for companies belonging to a zone near a TI, it should be noted that if several TIs share the same postcode, they were considered as only one for the count. Hence, the list of 16 ITs in the Valencia Community region in Appendix B has been grouped by the locations in Table 7. For example, location 5 (PATERNA) contains the following institutes: C.E.E.I. (EUBIC) VALENCIA, ITE: *Instituto Tecnológico de la Energía* (Energy Technological Institute), ITENE: *Instituto Tecnológico del Embalaje*,
Transporte y Logística (Packaging,
Transport and Logistics Research Center), AINIA: *Instituto Tecnológico Agroalimentario*, (Agrifood Technological Institute) AIDIMME: *Instituto Tecnológico*
metalmecánico, *mueble*, *madera*,
embalaje y afines (Technological Institute
of metalworking, furniture, wood, packaging and related) and AIMPLAS: *Instituto Tecnológico del Plástico* (Technological Institute of Plastics), all of which have the postcode 46980.

Source: The authors.

Another relevant characteristic to be studied is the possible relationship between a company belonging to a zone and the existence of a technological institute in its proximity. Here, proximity is understood to mean that a technological institute's postcode is within the list of postcodes associated with the zone. This information is summarized in Table 7.

According to IVACE, there are 16 technological institutes and parks in the Valencia Community region. Comparing the information from said institutes' postcodes with the postcodes of the 3,813 technological companies analysed in this study, a concentration of technological companies can be seen near an institute in three cases. Out of the 927 companies in the Valencia Interior Zone, 188 (20%) were found to be in the proximity of the institutes in Paterna. In the Southern Castellón Zone, approximately 26% are in the same location as Institute 16, namely the *Instituto Tecnológico de Cerámica* (Ceramics Technology Institute). In the Ibi Zone, almost 17% (22 out of 129) are near Institute 12, AITEX (*Instituto Tecnológico del Textil*, the Textiles Technology Institute); 26% are near Institute 13 (AIJU - Ibi); and 14% of Zone 4's companies (36 out of 251) are near the ITI: *Instituto Tecnológico de Informática* (IT Institute) and IBV (*Instituto de Biomecánica de Valencia*, Biomechanics Institute of Valencia).

It should be noted that 88.3% of the technological companies in the Valencia Community region (3,367 out of 3,813) are not near a technological institute, whereas 74.89% of those that are near one belong to one of the zones.

In Table 8 we can see the most representative activities carried out by the companies located in each zone.

In the Valencia Interior Zone and Northern Valencia Zone, a quarter of the companies (25.08% and 25.19% respectively) are engaged in activities related to programming, consultancy and other IT-related activities (CNAE 62). The next most significant activity is the manufacture of other machinery and apparatus (CNAE 28), with 16.65% and 16.92% respectively in the aforementioned zones. On the other hand, in the Castellón Interior and Ibi Zones the manufacture of other machinery and apparatus (CNAE 28) is most noteworthy, with about a third of the companies engaged in this activity (33.49% and 32.35% for the respective zones). About a quarter (23.72% and 25%) are engaged in activities related to programming, consultancy and other IT-related activities (CNAE 62). Taking into account the location of the zones, the low level of internationalization and the main activity carried out by the companies located in these zones, one might think that they are companies that support a well-established industrial sector in these geographical areas. This data is in keeping with the CNAE distribution of companies shown in Table 1, where we can see that the aforementioned CNAEs (28 and 62) are the most common in the sample of companies analysed.

4.2 | Comparison of the results with the year 2000

We thought it would be worthwhile to analyse the evolution of the zones detected over time. To do so, we compared the presence of agglomerations in the Valencia Community region at two moments in time in order to discover

TABLE 8 Frequency of activities by sector carried out in each area

Zone	20	21	254	26	27	28	29	302	303
1	16.14%	0.20%	0.10%	5.79%	9.54%	16.65%	4.57%	0.00%	0.00%
2	13.49%	0.47%	0.00%	3.72%	3.26%	33.49%	5.58%	0.00%	0.00%
3	10.29%	1.47%	0.00%	2.21%	8.09%	32.35%	2.94%	0.00%	0.00%
4	12.03%	0.38%	0.00%	3.01%	7.52%	16.92%	6.77%	0.38%	0.00%
Zone	**304**	**309**	**325**	**59**	**60**	**61**	**62**	**63**	**72**
1	0.10%	0.10%	2.64%	4.37%	0.81%	4.47%	25.08%	4.06%	5.38%
2	0.00%	0.00%	1.86%	5.12%	0.00%	4.65%	23.72%	2.33%	2.33%
3	0.00%	0.00%	0.00%	3.68%	2.94%	4.41%	25.00%	2.21%	4.41%
4	0.00%	0.00%	2.26%	9.02%	0.38%	5.64%	25.19%	3.38%	7.14%

Source: The authors.

whether they have maintained their number of companies, geographical size and location over the last 20 years. The significance analysis was replicated for companies existing in the Valencia Community region in the year 2000. For that year, also using information from the SABI database, 1,331 companies in high and medium technology sectors were found, from a total sample of 48,585 companies in the Valencia Community region.

Table 9 shows the relationship between the medium and high-tech companies by province and by size. We can see that most of the companies are considered to be small, as in 2019.

This data shows us that the rate of growth for technological companies in the Valencia Community region is lower than for companies in general, since the total number of companies has grown in that time by 3.8 times whereas the number of technological companies has only grown by 2.8 times.

On carrying out the spatial analysis for 2000, we get two significant zones, as seen in Table 10. Figure 2 shows their locations.

Zone 1 coincides approximately with the area of the Valencia Interior Zone in 2019. However, Zone 2 covers both the areas in which the Northern Valencia and Southern Castellón Zones are located in 2019.

Zone 1, measuring 32.3 km in radius, includes the municipalities of the Valencia Interior Zone in 2019 and includes other areas such as Cofrentes (near a nuclear power station) and Requena. Zone 2, measuring 28.82 km in radius, includes municipalities from both the Southern Castellón Zone and the Northern Valencia Zone for 2019 (since it stretches from the municipality of Moncada to the industrial estate of Castellón de la Plana). In the province of Alicante, however, no significant zone was detected for 2000 (Table 11).

As regards the analysis of dominant activities by zones, in Zone 1 half of the activity was found in the chemical industry (CNAE 20) and the manufacture of other machinery (CNAE 28), with 25.64% and 24.62% respectively. In Zone 2, the dominant activity was the manufacture of machinery at 36.49%, followed by the chemical industry at 27.03%.

As for foreign trade, in 2000 there were 485 of the 1,331 companies carrying out some form of foreign trade (i.e., 36.44% of the technological companies were exporting and/or importing, compared to 20.64% in 2019). This indicates that the current technological companies are less dependent on foreign trade in terms of both clients and suppliers. The data can be seen in Table 12.

It can be seen that the companies in a zone are far more dependent on foreign trade than the mean average for the technological sector, especially in Zone 1, with a difference of greater than 11%. On the other hand, in 2019 the greatest difference is no more than 9% between the sector's average and the average for companies located in the zone most dependent on foreign trade.

TABLE 9 Technological companies by size and province in 2000

Province	Large	Medium	Small	Micro	Total
Alicante	4 (10.26%)	33 (21.29%)	263 (25.86%)	23 (19.17%)	323
Castellón	13 (33.33%)	23 (14.84%)	133 (13.08%)	21 (17.50%)	190
Valencia	22 (56.41%)	99 (63.87%)	621 (61.06%)	76 (63.33%)	818
Total	39 (100.00%)	155 (100.00%)	1017 (100.00%)	120 (100.00%)	1331

Source: The authors.

TABLE 10 Results from identifying zones using StatScan for 2000

Zone	TNC	TNTC	TNTC (E)	O/E	Relative success	% Cases	p - Value
1	7278	383	199.38	1.92	2.29	5.30	<1E-17
2	4928	216	135	1.6	1.72	4.40	2E-8

Source: The authors.

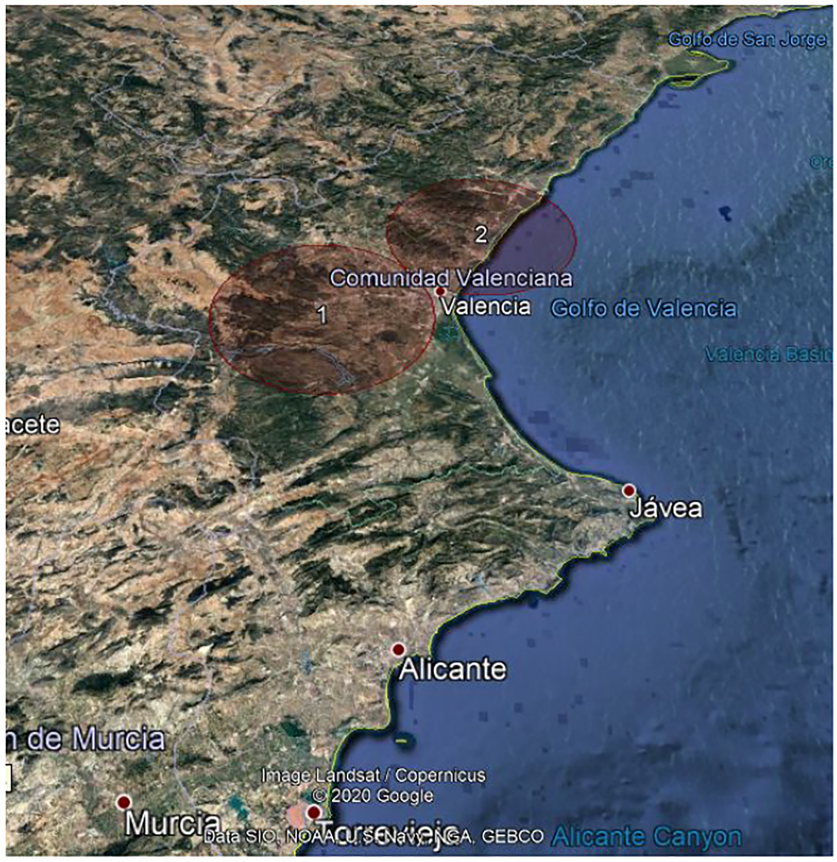

FIGURE 2 Location of the technological zones in the Valencia Community region in 2000
Source: The authors

TABLE 11 Frequency of activities by zone (2000)

Zone	20	21	254	26	27	28	29	302	303
1	25.64%	0.26%	0.00%	7.44%	13.33%	24.62%	69%	0.00%	0.00%
2	27.03%	0.90%	0.00%	4.50%	5.86%	36.49%	9.01%	0.00%	0.00%
Zone	**304**	**309**	**325**	**59**	**60**	**61**	**62**	**63**	**72**
1	0.00%	0.26%	2.05%	2.31%	0.77%	1.28%	13.33%	1.03%	4.36%
2	0.00%	0.00%	0.45%	0.90%	2.25%	2.25%	8.56%	1.80%	1.35%

Source: The authors.

TABLE 12 Companies engaged in foreign trade in 2000

Zone	Percentage of companies that engaged in foreign trade compared to the total amount of companies in their zone
1	47.52%
2	40.74%
Total technological companies	36.44%

Source: The authors.

5 | DISCUSSION

The results of our analysis present four significant zones. Two in Valencia, one in Castellón and the other in Alicante (Ibi). The main activity of the two Valencian agglomerations is the manufacture of other machinery and apparatus. These sources of activities are usually located on those areas which higher cities and a diversified economy, like in this case. So, we could find here Jacob or interindustrial externalities.

Moreover, in the Castellón zone is where the ceramic industry is focused, and, in Ibi there is a traditional area of textile industry, as mention by several studies such as Morales and Vázquez (2007); Hervas-Oliver, Estelles-Miguel, Mallol-Gasch, and Boix-Palomero (2019) or Salom and Albertos (2014) among others. The results are in line with those obtained by Miret-Pastor et al. (2011), they find four industrial districts, two of them of traditional industries and the other two of medium and high technology. The traditional ones correspond to our areas 2 (in Castellón) and 3 (in Alicante). Moreover, they find a chemical industry cluster in Castellón also and manufacture of machinery sector in Valencia. At last, we can find that in area 2 there was a traditional industry, ceramics, supported by one chemical cluster and, now, we find also an agglomeration of the manufacture of machinery industry. Similar is the situation in the area of Alicante, a traditional textile industry is obtaining support by a higher technological industry.

On the grounds of our results it seems that the hi-tech industries agglomerations are independent of the ubication of technological institutes. Nevertheless, we obtained a strong relationship between traditional industry and high-tech industry. Moreover, as those high-tech firms don't present a special connection with international trade, it seems that we are talking about Jacobs or interindustrial externalities.

Concluding, Hi-tech industry agglomerations can allow a chance to the Valencia's economy to perform its productivity. Locating them and identifying their characteristics can be a helpful instrument to local industrial policies. In the current work we find four hi-tech industry agglomerations and we analyse their characteristics. Moreover, we open the door to further researches: First, it would be interesting to check if those firms located in an agglomeration area perform better than others. Second, we didn't find empirical evidence of the relationship between high-tech industries agglomeration and location of a technological institute. In this sense, a more extensive analysis of the spillovers of National Systems of Innovation structure can be an instrument for industrial policy-makers.

6 | CONCLUSIONS

On explaining the data available, we can see that 2% of the companies in the Valencia Community region can be considered technological according to the Spanish National Statistics Institute's classification (INE, n.d.). Most of these (approximately 77%) are small companies.

With the data and method used, four agglomerations or significant zones have been detected for 2019. Two of them are located in the province of Valencia, one in Alicante and one in Castellón. The first zone found, which is also the biggest, is located in the area of Paterna. In fact, Paterna has two scientific and technological parks, five technological institutes and six research centers. The other zone in the province of Valencia is in the coastal area of Sagunto. In the province of Castellón we can see that the zone coincides with the area where ceramics companies have traditionally settled. The zone in Alicante is in the area of Ibi and Castalla. It also has a deep industrial tradition. The predominant activities in these zones are the production of machinery and IT services. As for the level of internationalization, 20.64% of the technological companies are engaged in some form of foreign activity. The Valencia Interior Zone is the most active in this regard, with 28.91% of its companies involved in some form of foreign trade. These are not very high figures for foreign trade, indicating that these companies mostly supply and are supplied by the Spanish market. The presence of technological institutes in the Valencia Community region may be thought to foster the existence of technological concentrations. However, the evidence indicates this is not the case, because 70% of the companies located in a zone (1,181 out of a total of 1,515 companies) are not located in the same area as a technological park or institute. Lastly, analysing the map of zones for the year 2000, the robustness of the two current zones of Paterna and Castellón becomes clear. They were already present almost 20 years ago, together with

the dynamic nature of the province of Alicante in generating a new zone. It has also become clear that high-tech companies are less dependent on foreign trade today than they were 20 years ago.

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APPENDIX A

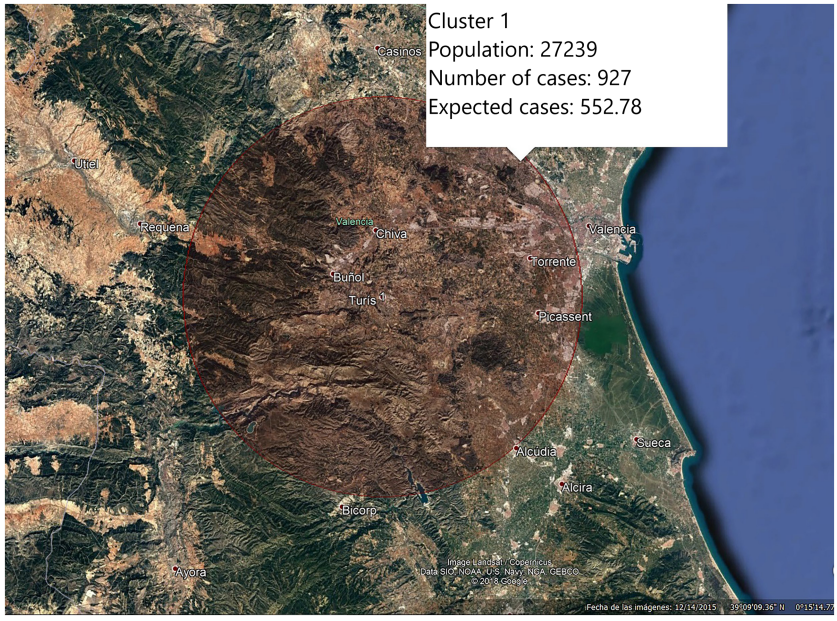

FIGURE A1 Valencia interior zone

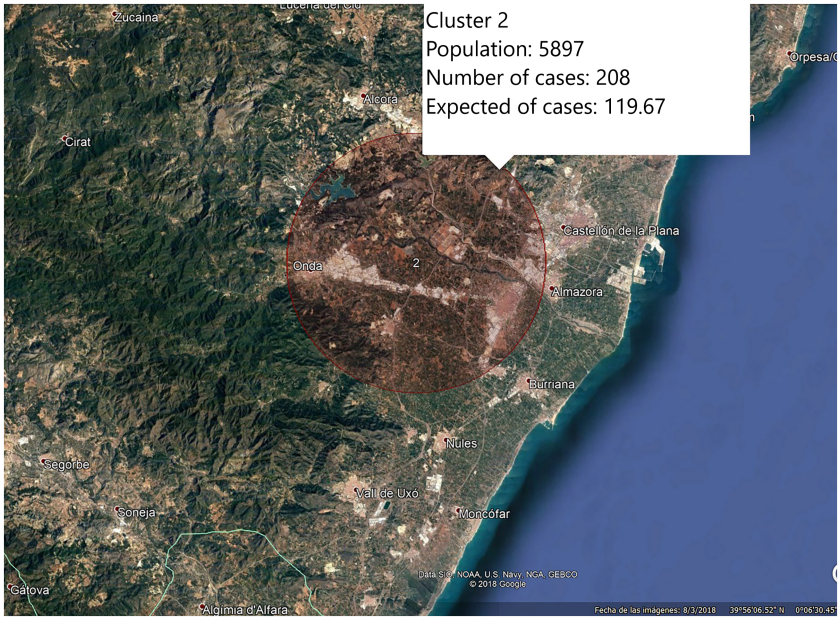

FIGURE A2 Southern Castellón zone

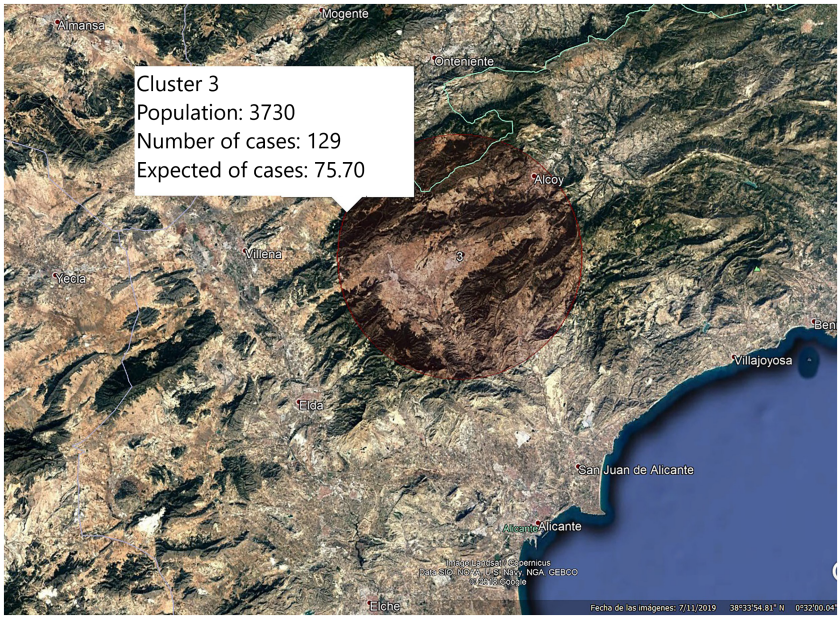

FIGURE A3 Ibi zone

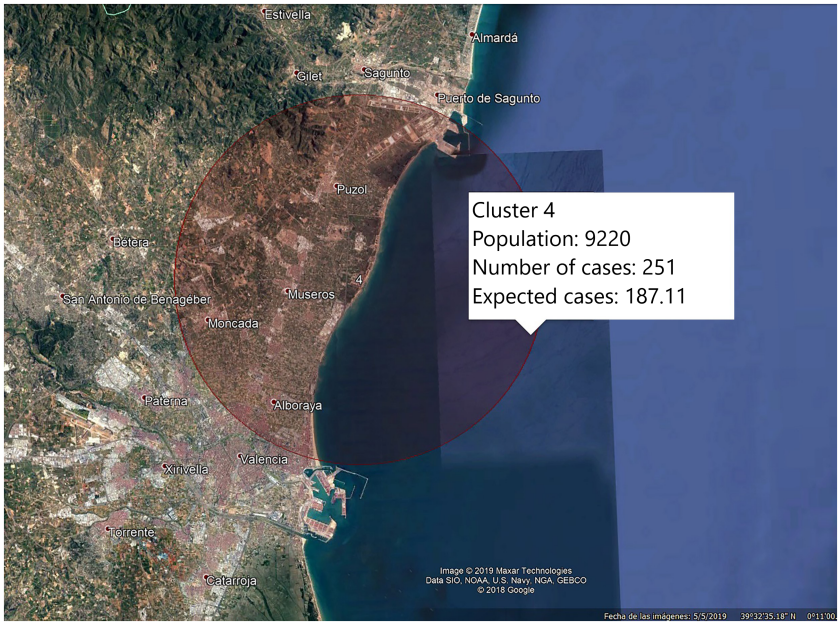

FIGURE A4 Northern Valencia zone

APPENDIX B

TABLE A1 Technological centres and institutes in the Valencia Community region

No.	Technical institute	Address
1	INESCOP: *Instituto Tecnológico del Calzado* (Footwear IT)	Polígono Industrial Campo Alto Ctra. Elda-Monóvar 03600 ELDA (Alicante)
2	Inescop Elche (Technical Unit)	Polígono Industrial CARRÚS II Ronda Vall d'Uixó, 12503291 ELCHE (Alicante)
3	Inescop	Polígono Industrial EL RUBIAL C/7, parcela 9203400 VILLENA (Alicante)
4	C.E.E.I. VALENCIA	Parque Tecnológico Avda. Benjamín Franklin, 1246980 PATERNA (Valencia)
5	C.E.E.I. ELCHE	Polígono Industrial del Carrús Ronda Vall d'Uixó, 12503206 ELCHE (Alicante)
6	ITI: Instituto Tecnológico de Informática	Universidad Politécnica de Valencia Camino de Vera, s/n (Edif. INSTITUTOS II) 46022 Valencia
7	ITE: *Instituto Tecnológico de la Energía* (Energy Technological Institute)	Parque Tecnológico Avda. Juan de la Cierva, 2446980 PATERNA (Valencia)
8	IBV: *Instituto de Biomecánica de Valencia* (Biomechanics Institute of Valencia)	Universidad Politécnica de Valencia Camino de Vera, Edificio 9C 46022 VALENCIA (Valencia)
9	C.E.E.I. CASTELLÓN	Edificio IVACE-CASTELLON Ginjols 112003 (Castellón de la Plana)
10	`ITENE: *Instituto Tecnológico del Embalaje, Transporte y Logística* (Packaging, Transport and Logistics Research Center)	Parque Tecnológico Carrer Albert Einstein, 146980 PATERNA (Valencia)
11	AINIA: *Instituto Tecnológico Agroalimentario*, (Agrifood Technological Institute)	Parque Tecnológico Avda. Benjamín Franklin, 5–7–9-1146980 PATERNA (Valencia)
12	AITEX: Instituto Tecnológico Textil	Pl. Emilio Sala, 103801 ALCOY (Alicante)
13	AIJU: *Instituto Tecnológico del Juguete* (Toys IT)	Avda. de Industria, 2303440 IBI (Alicante)
14	AIDIMME: *Instituto Tecnológico metalmecánico, mueble, madera, embalaje y afines* (Technological Institute of metalworking, furniture, wood, packaging and related)	Parque Tecnológico Av. Benjamín Franklin, 1346980 PATERNA (Valencia)
15	AIMPLAS: *Instituto Tecnológico del Plástico* (Plastics IT)	Parque Tecnológico Avda. Gustavo Eiffel, 2–846980 PATERNA (Valencia)
16	AICE-ITC: Instituto Tecnológico de Cerámica	Universidad Jaume I Campus Universitario de Castellón Av. Vicente Sos Baynat, s/n 12006 Castellón (Castellón)

APPENDIX C

DEFINITIONS

c = Identification no. for the concentration (zone).

TEC_c = No. of technological companies in concentration c.

$Total_c$ = Total no. of companies in concentration c.

TEC_t = No. of technological companies in the entire Valencia Community region.

$Total_t$ = Total no. of companies in the entire Valencia Community region.

$$\text{cases in concentration c} = \frac{TEC_c}{Total_{c.}},$$

$$E = Total_c * \left(\frac{TEC_t}{Total_t}\right),$$

$$\text{Relative success} = \frac{\left(\frac{TEC_c}{Total_c}\right)}{\left(\frac{TEC_t - TEC_c}{Total_t - Total_c}\right)}.$$