MEASURING THE PERFORMANCE OF EXPORT ECONOMIC BRANCHES LOCATED INSIDE CLUSTERS: EVIDENCE FROM GREECE

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Abstract

The paper investigates the impact of clusters on the performance of export economic branches in Greek NUTS-2 regions for 2008 and 2018. The study employs a Cluster Index, statistical techniques and Exploratory Spatial Data Analysis, unveiling the intricate relationship between clusters and the competitiveness of export-driven economic branches. The findings illuminate the pivotal role clusters play in shaping export outcomes, indicating that regions in both mainland and insular space host multiple clusters that significantly influence export performance of economic branches. The outcomes of the research offer valuable insights for policy formulation, emphasising the need for custom-tailored strategies that harness sectoral-spatial patterns. In a broader context, the study's insights provide valuable implications for enhancing overall economies by leveraging agglomeration effects and promoting growth in export-driven branches. This study contributes to a deeper understanding of the complex dynamics between clusters and export performance, offering a roadmap for policymakers and stakeholders to foster economic advancement.

Keywords: clusters, export economic branches, Greek NUTS-2 regions, Cluster Index, economic base theory

JEL classification: C18, R12, R58

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1. Introduction

The advantages of territorial firm agglomerations and the notion of industrial districts are rooted in the pioneering ideas of Alfred Marshall, who put forward at the beginning of the twentieth century (Giner-Pérez and Santa María, 2020). Industrial agglomeration is usually defined as the geographical concentration of companies and institutions with common or complementary properties in a specific field (Chen et al. 2021; Porter, 1998). The greatest advantage of an enterprise being close to other companies, in the same or related economic activities, is that it is easier to network between the companies. This in turn can benefit all companies that are part of the collaboration system. In this way, entrepreneurship in an area is strengthened and in the end it benefits the region as a whole. In recent years, a number of publications have raised greater interest in the performance of economic branches located inside or outside the clusters (Wennberg and Lindqvist, 2008; Beaudry and Swann, 2009; Segarra-Oña et al. 2012; De Vaan et al. 2013; Branco and Lopes, 2018; Hervas-Oliver et al. 2018; Sellitto and Luchese, 2018; Mendoza-Velázquez and Benita, 2019; Stojčić et al. 2019; Grashof, 2021; Ketels and Protsiv, 2021; Pavelkova et al. 2021). Wennberg and Lindqvist (2008) demonstrated that new Swedish firms from the technology and healthcare industry located within a cluster had positive effects on their survival, creating more jobs, higher tax payments, and higher wages to employees. Beaudry and Swann (2009) found that cluster effects were strongest in manufacturing, manufacturing- related, and infrastructure, but weaker in services. Segarra-Oña et al. (2012) displayed that hotels located inside tourism clusters perform better economically than those located outside the clusters in the Spanish tourism sector. De Vaan et al. (2013) studied the survival patterns of firms and subsidiaries in

the global video game industry and figured out that a positive net effect of clustering appeared after a cluster reached a critical size. Branco and Lopes (2018) demonstrated that the cluster experienced a remarkable growth especially during the development phase. Hervas-Oliver et al. (2018) noted that co-location in an agglomeration had a positive influence on a firm's innovative performance, although even agglomeration gains existed; however, not all firms benefited equally in Spanish economy. Sellitto and Luchese (2018) explored cooperation practices within a Brazilian furniture cluster, identifying four types of cooperative practices. Workforce development showed strong collaboration, but other practices had lower cooperation levels due to rivalry and distrust. Mendoza-Velázquez and Benita (2019) investigated Mexico's automotive sector, analyzing efficiency, productivity, and technological change across subclusters and regions, including the impact of the Great Crisis and identification of input congestion, with their findings highlighting congestion in certain regions and varying crisis resilience. Stojčić et al. (2019) distinguished that clusters had a positive impact on firm productivity, sales revenues, size, and export performance in the traditional wood-processing and furniture industries in Croatia and Slovenia between 2013 and 2016. Grashof (2021) examined a dataset with a significant number of companies in Germany and indicated that firms benefited unequally within the cluster, depending on the characteristics of the specific firm, the cluster and the conditions of the market. Ketels and Protsiv (2021) noticed a relationship between clusters and economic outcomes as industry-level wages associated with industry- and surrounding-cluster agglomeration levels to a similar degree through a data from 28 European countries. Pavelkova et al. (2021) failed to confirm any significant influence of firm localisation in the natural cluster or membership in the cluster organisation on financial performance for firms in the plastics and textiles sectors in the Czech Republic in the period of 2009–2016.

Moreover, the recent literature review presents the link between exports and the agglomeration of economic branches (Lovely et al. 2005; Koenig, 2009; Yilmazkuday, 2011; He et al. 2012; He et al. 2015; Liu and Wang, 2022). Lovely et al. (2005) examined the spatial concentration of headquarter activity of exporters to that of non-exporters and found that industries that export to countries with a financial risk had more highly agglomerated exporter headquarter activity. Koenig (2009) investigated the impact of proximity to other exporters on the export behavior of individual French manufacturers between 1986 and 1992; the researcher presented a distinct evidence of export-agglomeration economies, where local exporters were positively influenced by the probability of starting to export to a given country. Yilmazkuday (2011) examined the connection between economic agglomeration and trade patterns within the U.S. at the industry level; he demonstrated that agglomeration as a specialisation of industries played an important role in determining the patterns of trade, both intranationally and internationally. He et al. (2012) and He et al. (2015) revealed that exporters were significantly more geographically agglomerated than non-exporters using the annual survey of industrial firms in China. Liu and Wang (2022) presented that manufacturing firms should be encouraged to interact with local economies rather than merely engaging in exporting with straightforward assembling activities.

The study advances existing research by investigating the impact of clusters on the export performance of economic branches in Greek NUTS-2 regions. Unlike prior work that broadly explores agglomeration effects, this study explores the nuances of export-driven branches in the Greek context. The novelty lies in its comprehensive evaluation of export efficiency, allowing for inter-branch and regional comparisons. Additionally, the research introduces a unique approach to uncovering localised clusters' spatial relationships, revealing how agglomeration influences specific regions. By focusing on the export sector within Greek regions, this study provides a targeted analysis of clusters' effects on economic performance. Its original methodologies and concentrated focus contribute to the understanding of clusters' role in enhancing the competitiveness and growth of export-oriented branches within Greece, carrying implications for economic development and competitive strategies. The paper is arranged as follows: Section 2 explores the methodology and offers an overview of the analysis data. In section 3, the paper presents the research findings, and finally, section 4 provides the concluding remarks of the paper.

2. Research methodology

It is shown that firms in clusters experience stronger growth and higher innovation rates than those outside clusters (Audretsch and Feldman,1996 a, b; Baptista and Swann, 1998; Baptista, 2000; Broekel et al. 2015); at the same time fostering clusters is considered one important approach to improving regional competitiveness (Chen et al., 2020).

Based on the Sternberg and Litzenberger (2004) approach, the paper implements a Cluster Index that identifies clusters of economic branches in Greek economy:

$$CI_{ir} = ID_{ir} * IS_{ir} * \frac{1}{SB_{ir}} = \frac{\frac{e_{ir}}{\sum_{i=1}^{n} e_{ir}}}{\frac{i_r}{\sum_{r=1}^{n} i_r}} * \frac{\frac{b_{ir}}{\sum_{i=1}^{n} b_{ir}}}{\frac{a_r}{\sum_{r=1}^{n} a_r}} \quad (1)$$

Here, eir is the number of employees in NUTS-2 regions, bir is the number of local units per economic branch, ir is the number of inhabitants and ar is the size of the NUTS-2 region.

All three components of the CI (ID, IS, and PS) are defined between zero and infinity, implying that the whole index also has the potential range from zero to infinity; furthermore the main advantage of the CI is that a value for each analysed area/sector can be derived; also, comparison between areas/sectors is easier than with other measures such as the Gini coefficient, which does not consider the size of the statistical units (Giner-Pérez and Santa María 2020).

The economic base theory separates an economy by its sectoral approach. According to the theory, there are export economic branches that depend on the demand for their goods outside the region; also, there are local economic branches whose survival depends on the local economic circumstances of the specific region (Schaffer, 2020). Here, the paper uses the above theoretical approach through a quantitative method which estimates the export efficiency of each economic branch. That is estimated by the formula below (Isserman, 1977); so the size of each export activity for each Greek region is:

$$X_{ir} = \frac{E_{ir}}{E_{in}} - \frac{E_r}{E_n} * E_{in} \quad (2)$$

The one-way analysis of variance (one-way ANOVA) (Gelman, 2005) was applied to seek if the export economic branches perform better inside clusters than those located outside clusters, while Pearson's correlation index (Rodgers and Nicewander, 1988) measures the correlation between number of clusters and the total export employment data:

$$r = \frac{\sum(X_i - \bar{X})(Y_i - \bar{Y})}{[\sum(X_i - \bar{X})^2 \sum(Y_i - \bar{Y})^2]^{1/2}} \quad (3)$$

Into analysis, X represents the number of clusters, and Y represents the total export employment data.

While, each size of export economic branch for each Greek region is pictured through the spatial autocorrelation Moran's I. The common form of spatial autocorrelation Moran's I is (Hassan et al, 2020):

$$I = \frac{n}{W} \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n}(x_i - \bar{x})^2} \quad (4)$$

Where, wij is the weight between observation i and j (geographic coordinates), and Wis the sum of all wij; x is the value of the variable (export economic branch) at location i and j. The normalised values of Moran's index range between -1.0 and 1.0, where values approaching 1 indicate positive autocorrelation and values closer to -1.0 mean negative autocorrelation.

Finally, the local indicators of spatial association (LISA) developed by Anselin (1995) to identify local clusters of positive or negative spatial autocorrelation. It is computed as (Cheng et al. 2013):

$$I_i = z_i \sum_j w_{ij} z_j \quad (5)$$

Where, zi is the standardised form of xi; and the wij is the same elements of the weight matrix as defined in the global Moran index. The sum of all the local Moran's indices is equal to the global Moran's index. The local indicators of spatial association (LISA) allow visualising four categories of local spatial association: high-high (HH) indicates a region with an above-average value is surrounded by neighbours whose values are above-average; high-low (HL) means an above average region is adjacent to below-average neighbours; and vice versa for low-low (LL) and low-high (LH) categories.

Below, Table 1 exhibits the 9 economic branches (Eurostat, 2024a) and Figure 1 illustrates the 13 Greek NUTS-2 regions are used in the analysis; Table 2 presents the population and the size of each region for the examined years (Eurostat, 2024b; 2024c).

Table 1: Economic Branches

A. Energy
B. Manufacturing
C. Construction
D. Wholesale and retail trade
E. Transportation and storage
F. Accommodation and food service activities
G. Information and communication
H. Real estate activities
I. Professional, scientific and technical activities-Administrative and support service activities

Source: Eurostat, 2024a

Figure 1: Greek NUTS-2 Regions

In the table below, the population data as the size of each Greek NUTS-2 region is displayed. This data can be used in the analysis of the paper.

Table 2: Greece Population and Area

	2018		2008		2018 and 2008	
Regions-Nuts 2	**Population**	**%**	**Population**	**%**	**Area, Km2**	**%**
Anatoliki Makedonia. Thraki	601175	5.60	605411	5.47	14179	10.74
Kentriki Makedonia	1875996	17.47	1905904	17.23	19166	14.51
Dytiki Makedonia	269222	2.51	286696	2.59	9471	7.17
Ipeiros	334337	3.11	344410	3.11	9164	6.94
Thessalia	722065	6.72	743919	6.73	14051	10.64
Ionia Nisia	204562	1.90	207508	1.88	2306	1.75
Dytiki Ellada	659470	6.14	693549	6.27	11327	8.58

Regions-Nuts 2	2018		2008		2018 and 2008	
	Population	%	Population	%	Area, Km2	%
Sterea Ellada	555623	5.17	555577	5.02	15561	11.78
Peloponnisos	576749	5.37	585892	5.30	15511	11.75
Attiki	3756453	34.97	3990727	36.08	3814	2.89
Voreio Aigaio	211137	1.97	198675	1.80	3854	2.92
Notio Aigaio	340870	3.17	329525	2.98	5305	4.02
Kriti	633506	5.90	613144	5.54	8340	6.32

Source: Eurostat, 2024b; 2024c and Authors' estimations

According to the most recent population data, Attiki concentrates 3756453 (34.97%) and Kentriki Makedonia contains 1875996 (17.47%) of the national population. Both regions share 5632449 (52.44%) of the Greek population. Furthermore, the two largest urban concentrations of the country are located in these two regions: Athens (the capital city of the country) is located in the region of Attiki and Thessaloniki (the second largest city of the country) is located in the region of Kentriki Makedonia.

Also, Kentriki Makedonia is the largest region in terms of area with 19166 Km^2 (14.51% of the country's surface) and is followed by the mainland regions of Sterea Ellada, 15561 Km^2 (11.78%) and Peloponnisos, 15511 Km^2 (11.75%). On the other hand, the region of Attiki is one of the smallest regions, 3814 Km^2 (2.89%).

Table 3: Local units and employment, 2018 and 2008

Regions- Nuts 2	2018				2008			
	Local Units		Employment		Local Units		Employment	
	No	%	No	%	No	%	No	%
Anatoliki Makedonia-Thraki	34122	4.45	96234	3.73	40442	4.59	105702	3.90
Kentriki Makedonia	124617	16.25	389446	15.10	146434	16.62	429499	15.83
Dytiki Makedonia	17035	2.22	40052	1.55	22279	2.53	54434	2.01
Ipeiros	22667	2.96	59460	2.31	26964	3.06	57743	2.13
Thessalia	45369	5.92	116458	4.51	51091	5.80	130479	4.81
Ionia Nisia	25885	3.38	74182	2.88	25625	2.91	53697	1.98
Dytiki Ellada	40244	5.25	95972	3.72	45738	5.19	108760	4.01
Sterea Ellada	33034	4.31	83840	3.25	40671	4.62	106123	3.91
Peloponnisos	38974	5.08	95971	3.72	45062	5.12	101036	3.72
Attiki	279768	36.48	1182885	45.86	330182	37.48	1303564	48.04
Voreio Aigaio	14762	1.93	34031	1.32	16115	1.83	36426	1.34
Notio Aigaio	39211	5.11	138635	5.37	38740	4.40	85032	3.13
Kriti	51145	6.67	172342	6.68	51610	5.86	140991	5.20
Total	766833	100.00	2579508	100.00	880953	100.00	2713486	100.00

Source: Eurostat, 2024a and Authors' estimations

Table 3 notes the number and percentage share of local units and employment for each Greek region. The regions of Attiki and Thessaloniki have the highest number and share in the specific data for 2018 – 2008 and are followed by the insular region of Kriti. In contrast, another insular region, Voreio Aigaio has the lowest number and share of local units and employment.

3. Research results and Discussions

Beginning the analysis, the table below shows the clusters are created by each economic branch and region, while the figure exhibits the number of clusters created for each region:

Table 4:Cluster Index, 2018 and 2008

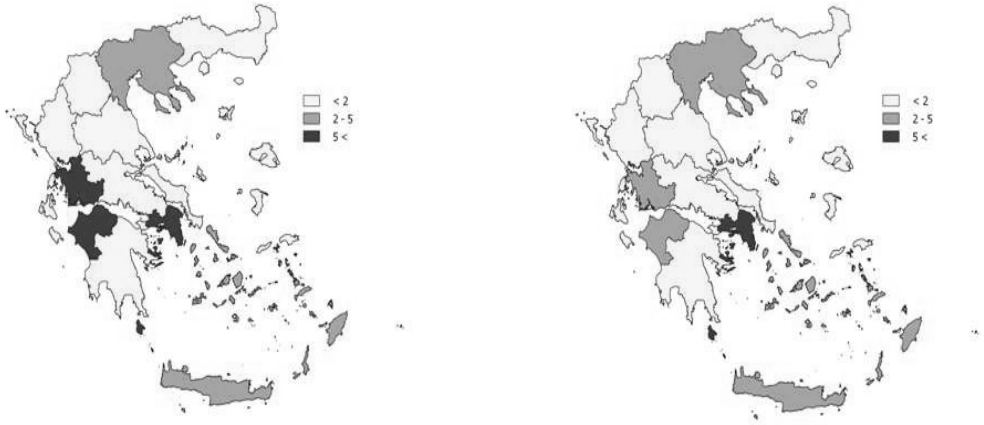
	A		B		C		D	
Regions-Nuts 2	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**
Anatoliki Makedonia-Thraki	0.60	1.81	0.42	0.39	0.25	0.42	0.31	0.32
Kentriki Makedonia	0.76	0.49	1.58	1.80	0.68	0.69	1.15	1.25
Dytiki Makedonia	0.42	10.37	0.41	0.60	0.49	0.40	0.19	0.20
Ipeiros	0.63	0.63	0.36	0.19	0.49	0.36	0.26	0.17
Thessalia	0.44	1.90	0.54	0.83	0.41	0.67	0.39	0.64
Ionia Nisia	0.07	0.16	0.08	0.08	0.50	0.29	0.23	0.18
Dytiki Ellada	1.67	0.85	1.60	1.80	2.40	2.64	2.28	2.15
Sterea Ellada	0.30	2.09	0.55	0.68	0.47	0.54	0.32	0.34
Peloponnisos	0.41	0.25	0.35	0.34	0.46	0.46	0.31	0.31
Attiki	16.66	0.10	14.53	13.39	13.38	14.01	16.84	17.03
Voreio Aigaio	0.21	0.52	0.26	0.28	0.87	0.78	0.46	0.45
Notio Aigaio	0.52	3.48	0.35	0.34	2.22	1.28	1.22	0.87
Kriti	0.88	0.47	0.74	0.62	1.72	1.21	0.95	0.85

	E		F		G		H		I	
Regions-Nuts 2	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**
Anatoliki Makedonia-Thraki	0.18	0.21	0.34	0.38	0.09	0.09	0.09	0.29	0.15	0.14
Kentriki Makedonia	0.64	0.90	0.80	0.99	0.40	0.37	0.62	1.36	0.90	0.67
Dytiki Makedonia	0.13	0.14	0.15	0.33	0.04	0.04	0.02	0.05	0.11	0.07
Ipeiros	0.29	0.16	0.53	0.32	0.08	0.04	0.08	0.04	0.19	0.12
Thessalia	0.28	0.41	0.45	1.00	0.07	0.11	0.10	0.13	0.28	0.27
Ionia Nisia	0.24	0.13	2.36	1.73	0.03	0.02	0.41	0.38	0.20	0.14
Dytiki Ellada	2.36	1.96	1.69	2.73	1.01	0.81	0.37	0.33	1.33	0.81
Sterea Ellada	0.38	0.46	0.34	0.47	0.05	0.07	0.08	0.12	0.17	0.22
Peloponnisos	0.29	0.33	0.46	0.50	0.04	0.09	0.10	0.31	0.15	0.12
Attiki	22.65	22.44	5.56	5.38	45.85	45.47	35.61	21.23	26.93	32.68
Voreio Aigaio	0.32	0.50	1.08	1.07	0.11	0.16	0.18	0.55	0.15	0.22
Notio Aigaio	1.05	0.65	11.55	7.43	0.17	0.12	1.64	1.89	0.82	0.49
Kriti	0.83	0.62	2.73	2.16	0.45	0.27	0.80	1.66	0.82	0.46

Source: Authors' estimation.

A: Energy, B: Manufacturing, C: Construction, D: Wholesale and retail Trade, E: Transportation and storage, F: Accommodation and food service activities, G: Information and Communication, H: Real estate activities, I: Professional, scientific and technical activities-Administrative and support service activities.

Figure 2: Number of clusters for each Greek Nuts-2 Region, 2018 and 2008



According to the table and figure above, more than two (2) clusters are located in the regions of Attiki, Dytiki Ellada, Notio Aigaio, Kentriki Makedonia and Kriti. Specifically, the metropolitan region of Attiki has the highest Cluster Index for each economic branch; also has the largest number of clusters located, compared to the rest regions. It is followed by the region of Dytiki Ellada, where almost all of the economic branches form clusters, with the exception of the branch of real estate activities for 2018.The specific region increases its number of cluster compared to 2008. Additionally, in the insular region of Notio Aigaio, economic branches of construction, wholesale and retail trade, transportation and storage, accommodation and food service activities and real estate activities form clusters. More than two (2) clusters can be found in the regions of Kentriki Makedonia (manufacturing, wholesale and retail trade) and Kriti (construction, accommodation and food service activities). Other regions with one (1) cluster are the rest two insular regions, Voreio Aigaio and Ionia Nisia (both regions in the accommodation and food service activities) for the most recent year.

Later, Table 5 pictures the export economic branches for each region, according to employment data. Figure 3 illustrates the size of total export employment in regions where more than two clusters are located.

Table 5: Export Economic branches, 2018 and 2008

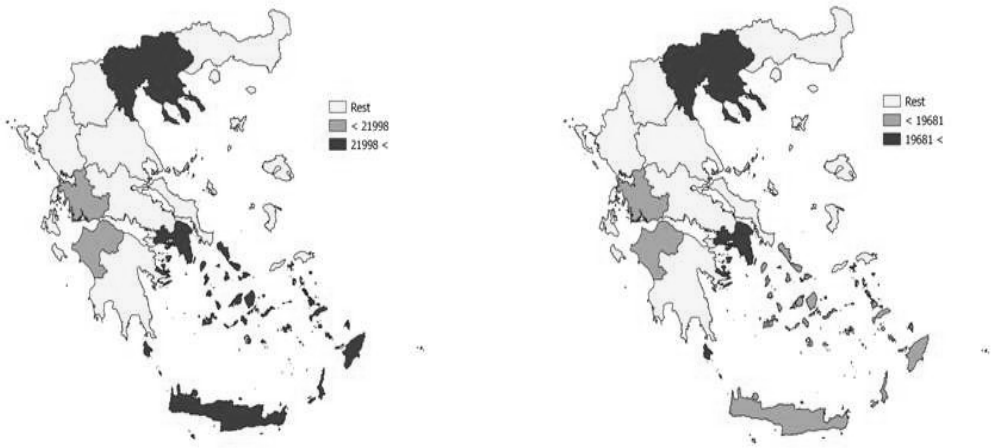
	A		B		C		D		E	
Regions-Nuts 2	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**
Anatoliki Makedonia, Thraki	1309	707	4329	5192	0	4006	785	0	0	0
Kentriki Makedonia	0	0	21313	24413	0	0	6769	12599	0	0
Dytiki Makedonia	367	8028	2217	1560	2752	977	0	0	0	0
Ipeiros	476	0	1056	447	809	2560	0	588	0	0
Thessalia	0	55	4728	5632	773	719	0	223	0	0
Ionia Nisia	0	0	0	0	115	0	0	0	0	0
Dytiki Ellada	0	0	0	224	1216	1976	4334	2580	665	0
Sterea Ellada	0	430	6789	13100	1120	0	0	0	7	0
Peloponnisos	35	0	187	1287	1202	928	936	50	0	483
Attiki	5387	0	0	0	0	0	15901	0	18323	8867
Voreio Aigaio	0	0	0	0	837	988	347	330	0	554
Notio Aigaio	0	738	0	0	0	0	0	0	0	0
Kriti	0	0	0	0	1637	1593	0	209	0	34

	F		G		H		I		TOTAL	
Regions-Nuts 2	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**	**2018**	**2008**
Anatoliki Makedonia, Thraki	1493	1026	0	0	0	74	0	0	7915	11005
Kentriki Makedonia	0	0	0	0	0	76	0	0	28083	37088
Dytiki Makedonia	0	487	0	0	0	0	0	0	5336	11052
Ipeiros	3005	350	0	0	0	0	0	0	5347	3945
Thessalia	1645	5789	0	0	0	0	0	0	7146	12418
Ionia Nisia	21376	10443	0	0	0	82	0	0	21491	10525
Dytiki Ellada	0	3462	0	0	0	0	0	0	6215	8243
Sterea Ellada	0	854	0	0	0	0	0	0	7916	14384
Peloponnisos	5304	4515	0	0	0	44	0	0	7665	7307
Attiki	0	0	26422	31237	3013	176	40788	64073	109835	104353
Voreio Aigaio	4246	2545	0	0	0	31	0	0	5430	4447
Notio Aigaio	46600	16334	0	0	0	155	0	0	46600	17227
Kriti	25355	11819	0	0	0	202	0	0	26991	13857

Source: Authors' estimation.

A: Energy, B: Manufacturing, C: Construction, D: Wholesale and retail Trade, E: Transportation and storage, F: Accommodation and food service activities, G: Information and Communication, H: Real estate activities, I: Professional, scientific and technical activities-Administrative and support service activities.

Figure 3: Regions more than two clusters of export economic branches have been identified, 2018 and 2008



Based on the table and figure above, four (4) regions have higher total export employment than the average (21998) for 2018. Those regions are the two metropolitan regions Attiki and Kentriki Makedonia from the mainland space and Notio Aigaio and Kriti from the insular space. Only Dytiki Ellada has fewer total export employment than the average for regions with more than two clusters for the recent year. In 2008, Attiki and Kentriki Makedonia were the only regions with more total export employment than the average (19681).

For the recent year, the largest number of export branches in regions with a significant number of clusters places in Attiki. More specifically, the export branches of energy, wholesale and retail trade, transportation and storage, information and communication, real estate activities, professional, scientific and technical activities-administrative and support

service activities contribute to the export-orientation of the region. The export branches of manufacturing, wholesale and retail trade are located in Kentriki Makedonia. Construction, accommodation and food service activities are located in Kriti and accommodation and food service activities are located in Notio Aigaio.

Later, the table below indicates the results of Pearson correlation between the total number of clusters and the sum of export economic branches exist in each region for the examined years.

Table 6: Pearson correlation index, 2018 and 2008

Employment		
2018	**Export Economic Branches**	**Number of Clusters**
Export Economic Branches	1.000	-
Number of Clusters	0.714	1.000
2008	**Export Economic Branches**	**Number of Clusters**
Export Economic Branches	1.000	-
Number of Clusters	0.745	1.000

Source: Authors' estimations

As a result, there is a quite strong correlation between the sum of export branches and the total number of clusters for 2018 and 2008. A link between clusters and export economic branches has been identified.

Next the paper focuses on the performance of export economic branches located inside or outside the related clusters. Therefore, the paper applies a one-way analysis of variance (one-way ANOVA).

Table 7: One-way Anova, 2018 and 2008

Export economic branches		Means	F	P-value
2018	Clusters	43545	6.372	0.028**
	Rest	8531		
2008	Clusters	36153	3.798	0.077*
	Rest	9385		

* p<0.10;** p< 0.05; *** p < 0.01

Source: Authors' estimations

Therefore, the means for export branches located inside the clusters are significantly higher than for export branches located outside the clusters. Furthermore, it can be noted that p-value becomes more significant for 2018 than it was in 2008. This indicates that the difference in performance between the two groups (inside and outside clusters) is even more pronounced in 2018 than in 2008, indicating that the clustering effect on export branch performance has strengthened over time.

Furthermore, Table 8 demonstrates the employment change of the export economic branch for each region; Figure 4 presents the employment change of the export economic branch for each region where more than two clusters have been identified.

Table 8: Employment change of export economic branches, 2008-2018

Regions-Nuts 2	A	B	C	D	E	F	G	H	I	TOTAL
Notio Aigaio	-100.00	0.00	0.00	0.00	0.00	185.30	0.00	-100.00	0.00	170.51
Ionia Nisia	0.00	0.00	0.00	0.00	0.00	104.70	0.00	-100.00	0.00	104.20
Kriti	0.00	0.00	2.76	-100.00	-100.00	114.52	0.00	-100.00	0.00	94.79
Ipeiros	0.00	136.00	-68.38	-100.00	0.00	759.75	0.00	0.00	0.00	35.54
Voreio Aigaio	0.00	0.00	-15.24	5.11	-100.00	66.87	0.00	-100.00	0.00	22.09
Attiki	0.00	0.00	0.00	0.00	106.66	0.00	-15.41	1609.03	-36.34	5.25
Peloponnisos	0.00	-85.45	29.53	1784.86	-100.00	17.48	0.00	-100.00	0.00	4.90
Kentriki Makedonia	0.00	-12.70	0.00	-46.27	0.00	0.00	0.00	-100.00	0.00	-24.28

Regions-Nuts 2	A	B	C	D	E	F	G	H	I	TOTAL
Dytiki Ellada	0.00	-100.00	-38.48	67.95	0.00	-100.00	0.00	0.00	0.00	-24.60
Anatoliki Makedonia. Thraki	85.31	-16.63	-100.00	0.00	0.00	45.47	0.00	-100.00	0.00	-28.07
Thessalia	-100.00	-16.06	7.49	-100.00	0.00	-71.59	0.00	0.00	0.00	-42.46
Sterea Ellada	-100.00	-48.18	0.00	0.00	0.00	-100.00	0.00	0.00	0.00	-44.97
Dytiki Makedonia	-95.43	42.07	181.85	0.00	0.00	-100.00	0.00	0.00	0.00	-51.72

Source: Authors' estimation.

A: Energy, B: Manufacturing, C: Construction, D: Wholesale and retail Trade, E: Transportation and storage, F: Accommodation and food service activities, G: Information and Communication, H: Real estate activities, I: Professional, scientific and technical activities-Administrative and support service activities.

Figure 4: Employment change of export economic branches in regions more than two clusters have been identified, 2008-2018

According to the table and figure above, Notio Aigaio, Kriti and Attiki are among the regions with export employment growth for the examined period. Especially, Notio Aigaio shows the highest export employment growth, which is mainly due to the employment growth of the export economic branch of accommodation and food service activities. This implied that growth could be attributed to an increase in demand for tourism from the region. It is important to note that this statement only refers to the export economic branch of accommodation and food service activities, meaning that there are no other economic branches within the region experiencing levels of growth in export employment. Finally, the export branches of construction, accommodation and food service activities contribute to the export employment growth in Kriti and transportation and storage, as well as real estate activities contribute to the export employment growth in Attiki. On the other side, it appears that Kentriki Makedonia and Dytiki Ellada have experienced a decline in export employment between 2008 and 2018.

Table 9: Global Moran index, 2018

Economic Branches	I	E[I]	mean	sd	z-value	P-value
Energy	-0.103	-0.083	-0.080	0.086	-0.264	0.374
Manufacturing	0.110	-0.083	-0.086	0.126	1.558	0.076*
Construction	-0.218	-0.083	-0.079	0.193	-0.719	0.219

Economic Branches	I	E[I]	mean	sd	z-value	P-value
Wholesale and retail trade; repair of motor vehicles and motorcycles	-0.065	-0.083	-0.082	0.132	0.129	0.358
Transportation and storage	-0.048	-0.083	-0.080	0.038	0.841	0.245
Accommodation and food service activities	0.402	-0.083	-0.089	0.171	2.867	0.018**
Information and communication	-0.059	-0.083	-0.080	0.036	0.599	0.241
Real estate activities	-0.059	-0.083	-0.080	0.036	0.599	0.241
Prof-admin	-0.059	-0.083	-0.080	0.036	0.599	0.324

* $p<0.10$;** $p< 0.05$; *** $p < 0.01$
Source: Authors' estimations

Figure 5: Local Moran index, 2018

Table 9 and Figure 5 implement measurements of spatial autocorrelation for export branches in regions. The global indicator presents a positive spatial dependence in manufacturing and accommodation and food service activities. However, the more significant spatial clustering shows the export economic branch of accommodation and food service activities in Notio Aigaio, as is illustrated by the local indicator for 2018. So, a large number of economic activities that are involved in exporting goods and services related to accommodation and food services are located in Notio Aigaio.

4. Conclusions

The paper explores the impact of clusters on the export performance of economic branches in Greek NUTS-2 regions. Analysis focuses on the nuances of export-driven branches within the Greek context, offering a comprehensive evaluation of export efficiency, inter-branch and regional comparisons, and uncovering spatial relationships in localised clusters. The paper's methodologies and goal bring valuable contributions to understanding the role of clusters in enhancing the competitiveness and growth of export-oriented branches in Greece. Unique to this research is the utilisation of the Cluster Index in conjunction with techniques drawn from economic base theory, encompassing both statistical and spatial methodologies. These methodological choices provide a novel approach to uncovering the intricate relationship between clusters and export performance, contributing to the methodological toolkit of agglomeration research. The robust findings highlight the positive impact of agglomeration

on economic growth and efficiency, reinforcing the importance of fostering clusters as a means to enhance the competitiveness of export-oriented economic branches.

Furthermore, the in-depth exploration of the Greek context not only fills a gap in the literature but also offers a fresh perspective that bridges the gap between theory and practice. This paper brings forth a plethora of novel contributions when juxtaposed with the works of the mentioned authors. It transcends Alfred Marshall's foundational notions by embarking on a contemporary and empirical analysis of clusters' impact on export performance within Greek NUTS-2 regions. Extending Giner-Pérez and Santa María's (2020) exploration of territorial firm agglomerations, this study narrows its gaze to the Greek context, enhancing the comprehension of how agglomeration shapes export outcomes in this unique geographical and economic milieu. In contrast to Lovely et al.'s (2005) focus on exporters' headquarters, this research shifts its focus to Greek NUTS-2 regions, unveiling how clusters influence export efficiency and competitiveness across diverse economic branches. Diverging from He et al.'s (2012; 2015) study on Chinese industrial firms, this paper ventures into Greek NUTS-2 regions and their export-oriented sectors, enriching the understanding of the relationship between clusters and export performance in a distinctive geographic and economic setting. While Segarra-Oña et al. (2012) scrutinised tourism clusters, this research extends its scope to encompass a broader array of export-oriented branches within diverse Greek regions, unraveling how clusters impact various sectors' export efficiency and competitiveness. By extrapolating the insights of Wennberg and Lindqvist (2008), Beaudry and Swann (2009), Yilmazkuday (2011) to Greek NUTS-2 regions, this analysis ushers in a fresh perspective on clusters' influence on export performance, expounding their effects across diverse economic branches in a distinct cultural and economic context.

From a policy perspective, paper's findings underscore the significance of tailoring strategies to foster sectoral-spatial patterns based on Greek insular and mainland regions, as well as export branches. The identification of clusters within specific economic branches and regions provides a roadmap for policymakers to target their efforts effectively. For instance, the prominence of export-oriented clusters in larger populated mainland regions such as Attiki and Kentriki Makedonia calls for targeted initiatives to further strengthen these regions' competitiveness in manufacturing, transportation and wholesale and retail trade. These clusters can serve as hubs for advanced manufacturing and logistics, attracting investments and enhancing the export potential of related economic branches. Moreover, the distinct growth in export efficiency within insular regions such as Ionia Nisia, Notio Aigaio and Kriti highlights the potential of nurturing the accommodation and food service activities sector in these areas, aligning with their geographical advantage for tourism; fostering collaborative efforts among hospitality businesses, cultural institutions, and local governments can amplify the impact of clustering, enhancing the overall tourism experience and driving export revenues.

By aligning policy interventions with the unique sectoral-spatial dynamics identified in the study, policymakers can catalyse growth and competitiveness in regions where clusters exhibit varying levels of export potential. This tailored approach acknowledges the diverse strengths and opportunities that each insular/mainland region and economic branch bring to the table, fostering a holistic and strategic path toward enhancing export economic performance.

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