INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCE STUDIES
Vol: 14 **No:** 1 **Year:** 2022 **ISSN**: 1309-8055 (Online) (**pp.** 116-137) **Doi:** 10.34109/ijefs. 202220004
Received: 19.10.2021 | **Accepted:** 09.01.2022 | **Published Online:** 10.03.2022

-RESEARCH ARTICLE-

SPATIAL CLUSTERING OF MANUFACTURING FIRMS IN VIETNAM

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Citation (APA): Chi, H. N., Chuong, H. N., Pham-My, D., Nguyen-Anh, T., Tra-Van, T. (2022). Spatial Clustering of Manufacturing Firms in Vietnam. *International Journal of Economics and Finance Studies, 14* (1), 116-137. doi: 10.34109/ijefs. 202220004

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Vol: 14 **No:** 1 **Year:** 2022 **ISSN**: 1309-8055 (Online) (**pp.** 116-137) **Doi:** 10.34109/ijefs. 202220004

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─Abstract─

Recently, effective cluster growth has become a critical component of industrial development, requiring the attention of emerging academics. Thus, the study aims to identify industrial clusters that have occurred due to the expansion of manufacturing industries at the industrial district level in Vietnam. The work is theoretical and guided by experimental indicators and spatial regression models. The current page has compiled secondary data spanning the years 2011 through 2020. The research findings indicate that the industrial development process is highly spatially connected at the local level, clearly producing industrial clusters or poles in Vietnam's manufacturing industry development. Additionally, the degree of spillover in industrial development is high, as evidenced by the indicators and testing the magnitude of the linkage, demonstrating the expansion and spillover in industrial development in Vietnam. The authors propose several recommendations based on the analysis's findings to boost both the links and the industrial development process in Vietnam.

Keywords: Industrial cluster, industrial district, industrial development, spatial regression.

JEL Classification: O20, O25, O53, O47, L16

1. INTRODUCTION

Among regional and industrial linkages, industrial cluster linkages are a typical type of connection that is well-suited to small and medium-sized businesses (Hidayatno et al., 2019). The establishment and development of existing industrial clusters will result in positive spillover effects or positive externalities, assisting enterprises, tiny and medium-sized enterprises, in increasing their competitiveness and economic efficiency (Shakib, 2020), thereby promoting local financial restructuring and contributing to the attraction of human resources and capacity for innovation (Pietrobelli, 2019). Industrial cluster development has a favourable spillover effect on the clustered firms and nearby enterprises (Prokhorova et al., 2018).

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The evolution of industrial clusters suggests that industrial clusters in East Asia, particularly in Japan and Taiwan, have played a significant role in the history of industrial development (Ullah et al., 2021). Industrial clusters are critical in transforming China into the world's industrial manufacturing powerhouse, accounting for 83 percent of total industrial production (Zhao et al., 2019). The knowledge-based industrial cluster catalyzes innovation in Singapore (Osman et al., 2021). Cluster formation and nurturing became critical components of regional and urban development initiatives, especially in developed or developing countries (Hidayatno et al., 2019).

Between 2011 and 2020, Vietnam's industrial development surged significantly. In 2011, Vietnam had almost 54 thousand industrial enterprises. By 2015, this figure had risen to more than 68.5 thousand firms, and by 2020, it had reached approximately 111 thousand. Thus, between 2011 and 2015, the number of firms working in this industry increased about 1.3 times. At the same time, the number of enterprises increased 1.6 times between 2015 and 2020. In general, the number of enterprises in each district-level area has expanded dramatically due to industrial development; compared to 2011, the density of manufacturing enterprises in district-level units has increased by twofold (from nearly 80 enterprises to about 160 enterprises).

The majority of firms in Vietnam are small and medium-sized, and the creation of industrial clusters is critical to the country's industrialization strategy (Otsuka et al., 2018). According to Vietnam's Ministry of Industry and Trade, the entire country will have 968 industrial clusters by 2021, concentrated primarily in key economic regions, with the Southern Key Economic Region, Northern Key Economic Region, and Central Key Economic Region having the most industrial clusters, while the Southwestern Key Economic Region has few industrial clusters (Otsuka et al., 2018).

The rapid growth of industrial clusters in Vietnam, associated with the reform, opening, and industrialization processes, has made significant contributions to the country's economic development over the last three decades (1991 - 2020) (Van Bavel et al., 2022), assisting Vietnam in improving its technology level, increasing product competitiveness, expanding the scale of commodity exports, and transforming the economic structure toward industrialization and modernization (Lung et al., 2019).However, there are still numerous limits and deficiencies in rapidly building industrial clusters, particularly in boosting the role of connection and spreading broadly among localities throughout Vietnam's territory (Ha et al., 2020).

Industry growth in general, and manufacturing development in particular, is shaped as a critical development goal in Vietnam's economic development goals up to 2025 and orientation to 2035. According to 2014 Decision No. 879/QD-TTg, the industry and area's growth structure is highlighted to establish contemporary industrial centres that

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participate in global value chains. This demonstrates that the spatial structure and connectivity of the industrial development process are viewed as critical pillars in the policy and direction of Vietnam's industrial growth (Chuong et al., 2018). According to Sopoligová and Pavelková (2017), industrial cluster policies vary according to the stage of development; thus, each nation must understand the characteristics of its industrial structure to choose appropriate support policies: bottom-up or top-down, as well as the role of localities in cluster policies (Briard et al., 2020).

The report provides policymakers with ideas for developing policies that promote industrial development through industrial clustering. Additionally, the current work is beneficial for new academics interested in examining this topic in the future. Further, this study contributes to the body of knowledge regarding industrial clustering and development (Duke et al., 2020). This study aims to determine the spatial distribution of industrial clusters in Vietnamese localities and economic regions. Based on Vietnam Enterprise Data 2011-2020, the spatial dispersion of industrial clusters is evaluated. Industrial clusters are identified and defined using statistical indicators and maps. Spatial modelling effectively reveals industrial cluster patterns (Albraheem et al., 2021). Additionally, the article examines the degree of spillover and the factors impacting the degree of spillover of industrial clusters to the economic development of localities and regions in Vietnam compared to the country's policy implementation orientations (Gudalov et al., 2020). As a result, the study makes recommendations for the spatial industrial growth of Vietnam.

2. LITERATURE REVIEW

2.1 Agglomeration And Clustering In Development

According to neoclassical economists such as Wang, Liang, Sun, and Wang (2019), economies will aggregate based on their income per capita in the long term. This indicates that lower-income economies will expand more rapidly than higher-income economies, implying that economies will eventually achieve a state of agglomeration (the action or process of gathering in a mass or cluster). Wang et al. (2019) also indicated that cluster formation is a critical component of industrial development that should be examined regularly. Thus, the current research explores industrial development's clustering development role to address this gap (Habanabakize, 2020). However, in terms of research on spillovers and links in spatial economic growth, this topic only becomes significant following Krugman and other economists' formulation of the 'new economic geography' hypothesis. According to Gaspar's study (2021), the 'new economic geography theory provides good theoretical foundations for explaining agglomeration phenomena in the economy regarding regional linkage, economic activity

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concentration in distinct geographical regions, and the activities that regulate this concentration (Kikulwe et al., 2020).

Additionally, Baumol (1986) was one of the first studies to incorporate data from global economies. The researchers discovered an economic agglomeration based on geographical regions, which has become a study issue garnering the attention of leading economists worldwide. According to Badia-Miró (2020), there is an agglomeration of income in observed samples of different economies in different locations when using regression models with cross-sectional data. This study concluded that industrial development through clustering is a critical topic that requires the attention of future academics, and to address this gap, the current article explores the impact of clustering development on industrial development. Sala-i-Martin (1996) summarised previous research, demonstrating that the agglomeration of economic development by geographical region via the income variable is supported by accurate data in countries such as the United States of America (48 states), Japan (47 localities), Europe (90 regions), and Canada (10 regions).Paas et al. (2007) conducted a comprehensive study analyzing empirical data from 861 regions across Europe from 1995 to 2003. The researchers identified correlations in development across locales using econometric models, demonstrating that places near central Europe expand quicker than other regions (Matthews et al., 2020).

2.2 Clusters in industrial development

Economic clusters in general, and industrial clusters in particular, have emerged as a hot issue of economic research Chain et al. (2019). advocated for research on industrial clusters, particularly in economic geography-related industries. The concept of an industrial cluster is pervasive in academic study, but it is also ingrained in regional and local development policy. Clusters affect the economy's rapid progress, and industrial clusters become an essential growth engine for both countries and regions (Valencia, 2020). The first, or most fundamental level, is a space-based industry cluster or region (distance between two industries). A regional cluster is defined as 'an industry cluster whose member firms are located close to one another' (Kiese, 2019). In contrast, an industry cluster is a collection of relevant industries linked by relationships between buyers and suppliers, either through shared technology, joint purchasers, distribution channels, or joint labour groups (Ketels et al., 2021).

The concentration of running firms is an appropriate starting point for developing clusters of industrial spaces. A developing cluster of major firms is critical for integrating small and medium-sized enterprises into the flexible system and innovation model (Schepinin et al., 2018). (Arbolino et al., 2019). According to Kapoguzov et al. (2019), clusters connect significant firms in a geographic area to the heart of a particular sector, where local ties are critical. Additionally, the above study advised that future research

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should focus on the clustering development function in industrial development. Further, traditional connections can aid in the development of clustered firms (Medvedev et al., 2021). Business development occurs due to knowledge spillover effects, technical innovation, and increased competitiveness. Simultaneously, the degree of connectivity and development of industry clusters has significantly boosted the expansion of geographical regions (Wallenius et al., 2020).

However, several other perspectives and empirical research show that spatial clustering is not always correlated with the connectivity of production networks (S. Yoon et al., 2018). Each industry or industrial group can ultimately reveal the degree of capital concentration, competitiveness, and enterprise by space at the local, regional, national, and worldwide levels. Prokopenko et al. (2020) assessed the innovation indices of the Czech Republic's innovative industrial clusters between 2010 and 2012. The authors described spatial features that allow the discovery of innovating industrial clusters at the district level and assessed the cluster patterns in the Czech Republic (K. P. Yoon et al., 2020).

2.3 The Measurement of Industrial Linkage Clusters

The spatial concentration of district industrial clusters will be determined using a data-driven methodology and the relative concentration level of firms and labourers. A centralized spatial distribution is one of the prerequisites for determining the degree of concentration and establishment of industrial clusters. There are numerous measurement tools; Prokhorova et al. (2018) determined concentration relative to total employment in German businesses by applying the Glenn Ellison et al. (1997) measure. Hoover's Location Quotient indicator quantifies the degree to which an area is specialized in a particular industry or the Gini coefficient. Industry distribution among space subregions is quantified using a coefficient (Panzera et al., 2020).

Industrial clusters must be viewed spatially. Economic activity concentrations and clusters must be weighed against the total number of regions. The Location Quotient is a frequently used metric (Liu et al., 2019). The Location Quotient's shortcoming measures a region's relative industry speciality, not industrial concentration, and hence is insufficient to detect clusters. Industrial density as an indicator of labourers and firms must be compared to the entire economy under geographic control (O'Hagan et al., 2018). In many circumstances, industrial values are dominated by one or two firms in a region. So the indicators of the location quotient depart from the cluster definition when enterprises (employees) are concentrated in a broad geographical expanse (Lee et al., 2019).

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3. METHODOLOGY

3.1 Agglomeration

The absolute industrial concentration index is measured by the local labor size/ output value concerning the whole region (Wang et al., 2019). In this study, we use the district level of analysis in the research space in the Southern Key Economic Region as follows:

Aij =Eij/Ei; Eij: Labor size (enterprise) of industry i in district j; Ei: Labor size (enterprise) of industry i in Vietnam

3.2 Spatial Cluster Identification

To define a spatial cluster, two conditions must be defined: 1- the degree of industrial concentration that serves as the foundation for cluster formation; 2- the degree of spatial connectivity. As a result, the spatial linkage and industrial agglomeration indicators effectively describe industry clusters by space. To do so, we employ the following two groupings of indicators:

3.3 Getis-Ord Gi and Spatial Autocorrelation Test

Getis and OrdGetis developed the Getis-Ord Gi index, and Ord developed the Getis-Ord Gi index in 1992 that determines spatial variable proximity to indicate the hot spot. This index has been used by many past studies such as Manap et al. (2019), Rossi et al. (2019) and Kumar et al. (2021). Spatial regions with statistical significance are confirmed industrial district clusters.

The Getis- Ord local statistic is given as:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{i,j}x_j - \bar{X}\sum_{j=1}^{n} w_{i,j}}{S\sqrt{\frac{[n\sum_{j=1}^{n} w_{i,j}^2 - \left(\sum_{j=1}^{n} w_{i,j}\right)^2]}{n-1}}} \quad (1)$$

Where x_j is the attribute value for the feature j, $w_{i,j}$ is the spatial weight between feature i and j, n is equal to the total number of features and:

$$\bar{X}=\frac{\sum_{j=1}^{n} x_j}{n} \quad (2); \quad S=\sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2} \quad (3)$$

The G_i^* the statistic is a z-score, so no further calculations are required

Besides, we use the Moran test developed by Moran in 1950 to measure the degree of connectivity among the localities of the variables by the spatial weighting matrix. Most

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of the past studies have used Moran Index such as Tillé et al. (2018) and de Paula Alves et al. (2021). Moran's I index expresses the degree of spatial linkage in the whole data under the influence of different variables. The Global Moran's I index confirms the degree of linkage among localities for representative values of local industrial clusters.

The use of both the Getis-Ord Gi and Moran's I indexes allows the study to compare, identify and test industrial clusters by industrial centres in Vietnam. These indicators help define and group industrial clusters and development centers by space. Thereby, we point out the hot-spot position in industrial development in Vietnam in the period 2011-2020 and determine the development space of industrial district clusters in Vietnam.

3.4 Spatial Econometric Models

In terms of econometric procedures and regression using standard econometric models, the initial region factor is determined using variables reflecting relative geographic locations or dummy variables representing distinct regions. Geographic location was employed as a control variable in economic growth models, confirming the influence of geographic location on economic development after correcting for other model factors. Meanwhile, Baumol (1986) estimated agglomeration in the economic development of European regions and employed a spatial weighting matrix to demonstrate the emergence of spillover-prone, spatially connected regions in Europe using empirical data (138 regions from 1980 to 1995).

We examined agglomeration in Vietnam's industrial development using indicators derived from the degree of agglomeration as measured by the industrial district agglomeration index. The indicators used to determine the locality's beginning conditions are the industrial output value and the degree of industrial agglomeration on both labour and business dimensions. This model, which is based on the spatial linking technique, examines the influence of initial conditions on industrial concentration or spillover between locales and tests the hypothesis regarding the establishment and evolution of geographically industrial clusters in Vietnam.

The authors selected an adequate estimating model based on linkage tests in industrial development. The linkage test table demonstrates that the confirmation model is generally linked (both in error and latency). According to Anselin et al. (2012), if the spatial error model (SEM) is more significant than the spatial lag model (SAR) and the spatial lag model's robustness test is not statistically significant, the spatial error model (SEM) should be chosen. According to LeSage et al. (2009), economic development has always faced the potential problem of a shortage of explanatory variables when using the SEM model to estimate the linkage in growth models. This results in a bias in assessing the connection degree and the influence of the explanatory variables in the

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model, and LeSage et al. (2009) demonstrate that the Spatial Durbin Model is suitable for overcoming this.

Table 1: Spatial Model Tests

Lagrange multiplier diagnostics for spatial dependence (df = 1)	Industrial agglomeration (labor)	Industrial agglomeration (Enterprise)
Lmerr	52 (0.00)	48 (0.00)
Lmlag	126 (0.00)	80 (0.00)
RLMerr	7 (0.01)	15 (0.00)
RLMlag	81 (0.00)	47 (0.00)
SARMA	133 (0.00)	95 (0.00)

3.5 Empirical Results and Discussion

Along with the expansion of businesses, laborers in manufacturing industrial zones have risen significantly from almost 4 million to over 7.2 million. Thus, between 2011 and 2020, the manufacturing sector's workforce grew by more than 1.8 times. The average number of labourers engaged in industrial and production activities increased from 5.7 thousand in 2011 to 10.4 thousand in 2020 per district-level space unit. Industrial output value increases proportionately as production activities expand in quantity and labour. In 2020, the overall value of industrial production (at current prices) triples (the average value for each locality at the district level also increases at the same rate).

Table 2: Summary of Industrial Development

Year	Mean			Sum		
	Number of enterprises	Number of laborers	Production value	Number of enterprises	Number of laborers	Production value
2011	79.97	5746	4046952	53900	3872565	2727645512
2015	98.82	7217	5601187	68581	5008721	3887223810
2020	159.60	10393	11815460	110920	7223382	8211744741

Note: Production value unit is million VND.

3.6 Identifying the Spatial Cluster in Vietnam

According to the Getis-Ord Gi statistics indicator, Vietnam created three industrial centres in 2011. Industrial clusters are found statistically using enterprise concentration and labour indices, indicating that the most significant concentration occurs in the Southern main economic zones, with Ho Chi Minh City as the core. Additionally, the industrial cluster occupies a large area; the northern part is centred on Hanoi, while the central region's early formation is on Da Nang. The industrial spillover area in the

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Northern critical zone is comparable to that in the crucial Southern region, while the Central critical region remains minor.

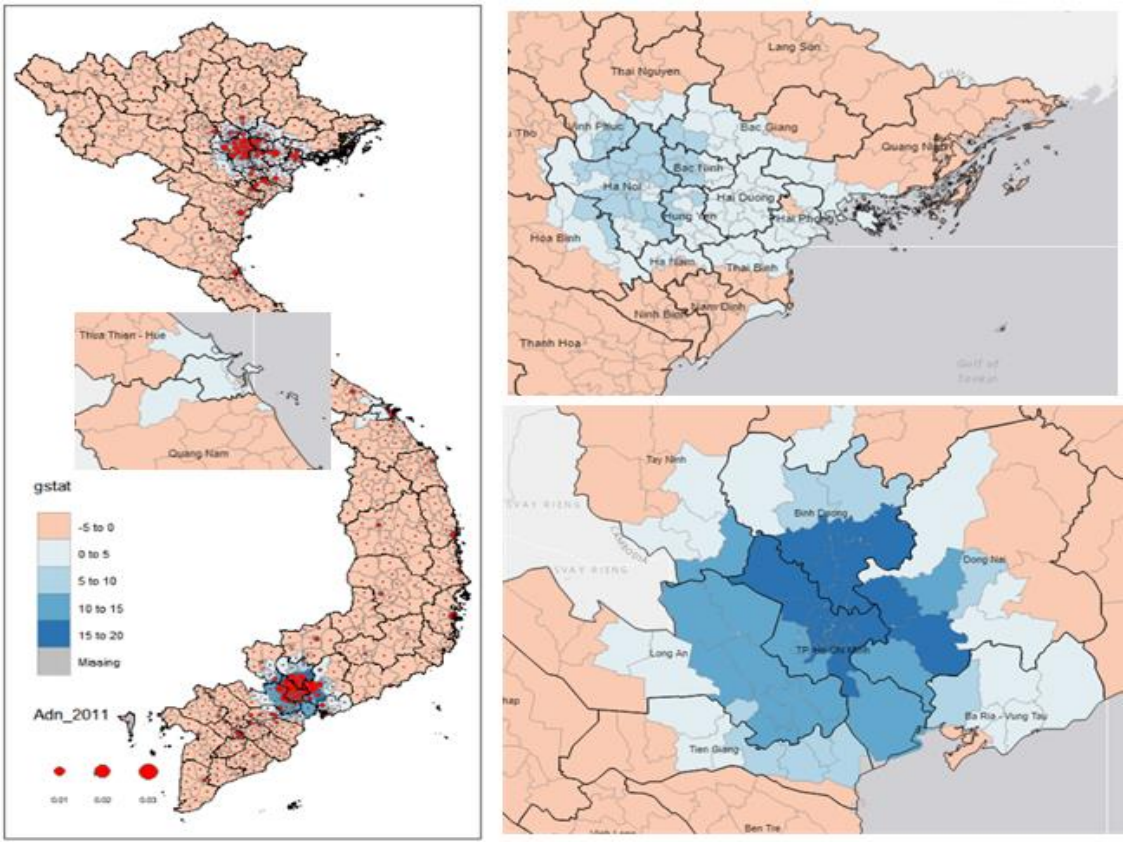

Figure 1: Spatial clusters in 2011

Compared to 2011, the spatial distribution of industrial clusters in Vietnam's industrial centres has remained relatively stable. The northern region's industrial cluster space has expanded significantly compared to 2011, with a more significant spatial spillover than the two industrial clusters in the south and central. This metric demonstrates that the north's industrial development space is significantly more ubiquitous than industrial clusters in other regions. One explanation for industrial cluster spillover is that industrial parks and export processing zones facilitate the construction of industrial linkage clusters.

The Southeast area leads the country with 369 industrial parks and export processing zones, accounting for 31% of the country's total industrial parks and export processing zones; the Red River Delta region accounts for 24% of all industrial parks and export

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processing zones the country. However, industrial parks and export processing zones thrive in four provinces and towns in the Southeast region: Ho Chi Minh City, Dong Nai, Binh Duong, and Ba Ria-Vung Tau. In the remaining areas, industrial zones and clusters remain underutilized, owing to asynchronous infrastructure investment, a lack of connectivity, and a lack of human resources that match investor attractiveness requirements.

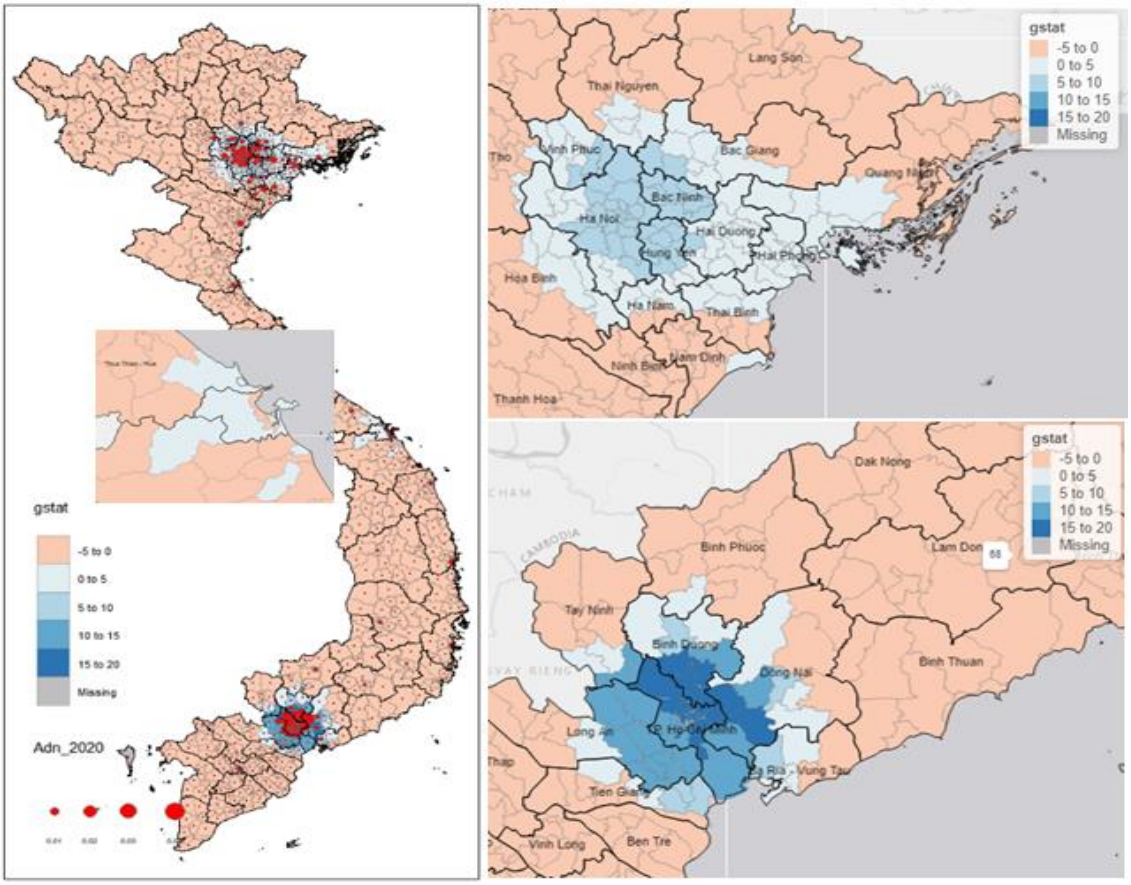

Figure 2: Spatial clusters in 2020

3.7 Spatial Clustering in The Manufacturing Industry in Vietnam

Along with identifying Vietnam's important industrial centres, we estimated the absolute concentration level in terms of company and labour force agglomeration. The agglomeration indicators in Vietnam's geographically industrial development reveal considerable agglomeration, mainly in the two industrial clusters in the south and north.

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The level of industrial concentration in the Southern regions is significantly higher than in other parts of the country. This southern economic zone is Vietnam's industrial development's birthplace and focal point. Industrial exposure levels do not have changed significantly between 2011 and 2020. While the industrial area continues to develop significantly, industrial concentration is concentrated primarily in Vietnam's industrial cities. The geographic linking test demonstrates that the industrial agglomeration level has a high degree of statistical cohesion, demonstrating the importance of spatial cohesion in industrial agglomeration.

3.8 Econometric Models and Discussion

The authors examined the establishment of industrial clusters in Vietnam, demonstrating a high degree of spillover both under initial cluster conditions and when the current industrial output variable is controlled (industrial value in 2020). Between 2011 and 2020, the econometric model's output indicates that the starting conditions in each locality significantly affect the level of industrial development over time. As a result, the degree of agglomeration required to produce spatially distinct industrial clusters is related to the initial industrial cluster formation. Industrial concentration in 2011 may affect the increase in labour concentration to around 0.77 percent of industrial labour concentration by 2020. Meanwhile, when the degree of enterprise agglomeration in 2011 is less than 0.05 percent of the degree of enterprise agglomeration in 2020, the degree of enterprise agglomeration tends to be prevalent. The reasons are that the effect of industrial clusters on initial labour concentration increases labour productivity, urban agglomeration produces more efficient outcomes between capital and labour than segregation or concentration, and this result is consistent with previous research such as (Park et al., 2019).

However, the degree of enterprise concentration would eventually expand to neighbouring localities rather than existing regions, as the consolidation of numerous firms into a single area results in higher pay and land leasing in the area surrounding the industrial cluster. Such high pay and land rents function as a dispersive force, discouraging further agglomeration of enterprises in the exact location. In the long run, real wages affect the ability of local economic regions to attract competent personnel (Wang et al., 2019). The evidence indicates that labour salary and rent costs in the core areas of critical economic regions in Vietnam tend to increase rapidly over time, with Hanoi and Bac Ninh in the Northern Key Economic Region and Ho Chi Minh City, Dong Nai, Ba Ria-Vung Tau, and Binh Duong in the Southern Key Economic Region leading the country in terms of labourer wages paid.

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Table 3: Moran I Tests

Index	2011				2020			
	SD	Mean	Max	Moran I	SD	Mean	Max	Moran I
Enterprise	0.0034	0.0014	0.0367	0.702 (0.00)	0.0036	0.0014	0.0391	0.4942 (0.00)
Labor	0.0042	0.0014	0.0529	0.714 (0.00)	0.0036	0.0014	0.0411	0.461 (0.00)

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Table 4: Spatial Regression Models

Durbin Model	Labor agglomeration		Enterprise agglomeration	
	OLS	SDM	OLS	SDM
(Intercept)	-0.0004***	-0.00048**	0.00024**	0.00019
Ald_2011	0.8659***	0.7677***	0.0132	-0.0534***
Adn_2011	-0.1632***	-0.12***	1.026***	0.99359***
log(GTCN_2020)	0.00007***	0.000044***	-0.00003***	-0.000031***
lag.Ald_2011		-0.001		0.171***
lag.Adn_2011		-0.114**		-0.4018 ***
lag.log(GTCN_2011)		0.000017		0.000007
Test	Moran I: 7.3 (0.00) Rho: 0.2874, LR: 30.24 (0.00) Wald statistic: 31.96 (0.00) AIC: -7535, (AIC for lm: -7506) LM test for residual autocorrelation: .571 (0.05879)		Moran I: 7 (0.00) Rho: 0.3567, LR: 41.18 (0.00) Wald statistic: 55.05 (0.00) AIC: -8073, (AIC for lm: -8034) LM test for residual autocorrelation: 2.06 (0.151)	

Note: *, **, *** have statistical significance at 10%, 5%, 1%, respectively. The index in brackets () is the p value.

Along with the trend toward labour concentration and spillover effects in enterprise development, the level of enterprise concentration in 2011 may significantly impact the attraction of increased labour concentration. However, the degree of spillover from existing enterprise concentrations may expand to neighbouring locations rather than increasing labour concentrations in the present area. The estimated results from the SDM model demonstrate the effect of the lagged variable on industrial development in the region's locales. In other words, when the level of industrial development in a locality is in the leading region, the degree of industrial linkage and the formation of industrial district clusters based on the positive Rho index indicates that the linkage is in the direction of spillover, as when the level of industrial development in the locality is in the leading region, the development spreads to neighbouring localities. This connection is made in three ways: directly, indirectly, and aggregately. This enables a more precise analysis of the degree of interconnection between areas during economic development. Specifically, an industrial cluster centre will initially operate as a hot-spot, attracting businesses and labourers and forming spatial industrial clusters, expanding the cluster into nearby regions.

The initially generated hot-spot has a concentration level of enterprises greater than 1%, which improves the concentration level directly by 0.8 percent during the research time and indirectly by encouraging roughly 0.26 percent of local firm concentration level. Simultaneously, spillover and the expansion of the local industrial cluster have a significant effect. The spillover effect of the initial hot-spot cluster might result in substantial spillover to nearby towns, so expanding the industrial space cluster regionally. The spillover effects in both early and late stages are roughly 0.3 percent, with the index of indirect influence indicating a high degree of rivalry among locations in luring firms, particularly during the study period. This results in distinct cluster space expansion paths in different spatial dimensions. This finding is consistent with the findings of Kapoguzov et al. (2019). Industrial agglomeration can significantly promote a new type of local urbanization; the spatial spillover effect is more pronounced between cities with comparable economic development levels. The long-term impact of industrial agglomeration on new urbanization is more significant than the short-term effect. The experience in Vietnam demonstrates that the expansion of nuclear cores has resulted in the development of nearby areas. In the Southern Key Economic Region, the initial core of Ho Chi Minh City led to the dynamic quadrilateral enterprises being concentrated in four provinces over time: Binh Duong, Dong Nai, and Ba Ria-Vung Tau. (Panzera et al., 2020), these four provinces will account for 40% of all enterprises in the country, with Ho Chi Minh City accounting for 31.4 percent of all enterprises.

The high and positive r-index, in conjunction with the direct and indirect effects of local industrial cluster development conditions, demonstrates the existence of linkages between localities in the formation of industrial clusters via the identification of industrial spatial clusters. This finding is consistent with Sheina et al. (2021).The linking effect between locations based on the positive concentration index in the labour agglomeration model suggests that each industrial development in a region benefits neighbouring towns by drawing labour and spreading labor-intensive industries. Not only does cluster development increasingly focus on hot-spots, but it also fosters cluster expansion through spillover in industrial development, particularly by luring labourers and businesses in the centre point's bordering districts. As a result, the cluster development trends in various spatial directions are shaped by the amounts of spillover, agglomeration, and rivalry among nearby areas. The origin of this spillover effect can be described by Marshall (2009) agglomeration theory, which includes the cost of transferring people, products, and ideas and the cost of sharing inputs and labour markets, or simply by natural advantages and information sharing.

Meanwhile, the leading industrial hubs continue to encourage agglomeration in another way, owing to the influence of the enterprise agglomeration indicator, as Zhao et al. (2019)). The indirect result of the negative enterprise agglomeration indicator on the agglomeration process in nearby places reflects the rivalry in Vietnam's industrial space

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growth. This manifests itself as a ubiquitous foundation for economic and industrial development, where the spillover effect on industries, mainly traditional sectors in developed economies, is more significant. While economies develop and emerge, this influence is complicated by the degree of agglomeration and spillover associated with industrial development. This also explains the degree of agglomeration and spillover that is constantly visible in the influence of industrial development in Vietnam, which results in a combination of spillover and agglomeration effects rather than a one-way effect. This partially explains why, despite the expansion of the industrial area in the recent decade in Vietnam (2011-2020), the degree of agglomeration in traditional industrial centres remains at an all-time high. Additionally, the spatial cluster analysis in Section 4.3 demonstrates that the spillover effect is more significant in Vietnam's Northern critical economic region. In contrast, despite the expansion of industrial space in the critical Southern region, the influence of industrial agglomeration persists and converges in the traditional industrial centres.

Table 5: Spatial Linkage Effects

		Ald_2011	Adn_2011	log(GTCN_2011)
Labor agglomeration	Direct	0.7812	-0.1293	0.00005
	Indirect	0.2916	-0.1974	0.00004
	Total	1.0728	-0.3267	0.00009
Enterprise agglomeration	Direct	-0.0413	0.9898	-0.00003
	Indirect	0.2217	-0.0692	-0.00001
	Total	0.1804	0.9206	-0.00004

4. CONCLUSION AND IMPLICATIONS

Thus, the current study indicated that effective cluster development is an essential condition for the country's industrial and economic development. The authors will provide ways to build industrial clusters and encourage connections for the industrial development of territories in Vietnam based on the research model and analysis above. The following are the study's recommendations or implications.

First, the development of local industrial clusters has a spillover impact on neighbouring communities, so it is vital to encourage investment and development of additional industrial clusters in communities based on their strengths and comparative advantages. To ensure spillover effects among industrial clusters and municipalities across the country, it is vital to prioritize investment in key economic regions. Additionally, the extension and development of industrial clusters in other locations are critical for increasing the dispersion of industry throughout the economy.

Vol: 14 **No:** 1 **Year:** 2022 **ISSN**: 1309-8055 (Online) (**pp.** 116-137) **Doi:** 10.34109/ijefs. 202220004

Second, the research demonstrates that the initial location and foundation for the industrial cluster affect the amount to which spillover occurs in other areas in the vicinity. As a result, planning for industry development in conjunction with national and regional integration is critical. As a result, the approval and execution of scientific and reasonable planning will foster investment and growth of industrial clusters in strategically advantageous places, thereby enhancing the role of spillover and spreading to other localities. The Vietnamese government is now executing regional and local socio-economic development plans for 2021-2030, with an eye toward 2045. This will provide authorities with an opportunity to build appropriate strategies to guide the future growth of local industrial clusters.

Thirdly, the Covid-19 epidemic in Vietnam in the two years 2020 and 2021, notably the fourth pandemic outbreak that occurred seriously in the Southern Key Economic Region from June to September 2021, has severed the link between industry and development, infecting labourers in areas with a high concentration of industrial clusters such as Ho Chi Minh City, Binh Duong province, and Dong Nai, among others. Numerous workers 'leave' for their hometowns, resulting in a workforce shortage in industrial businesses. This practice, combined with the research findings, demonstrates that Vietnam should place a greater emphasis on investing in and developing industrial clusters in rural areas, thereby limiting excessive concentration in large cities; additionally, local governments and businesses should prioritize the construction of housing for workers, as well as the equipping of medical stations and emergency centres in industrial clusters.

Fourthly, to foster the growth of industrial clusters, authorities must provide favourable conditions for increased investment through methods, regulations, and the physical environment. To our mind, the most pressing issue in Vietnam now is to build high-quality human capital and swiftly expand technical infrastructure. For human resources, universities must align their programmes with market demands while increasing students' foreign language proficiency; vocational training schools must be developed and improved. The role of institutions cooperating with foreign foundations and large enterprises must be promoted. For the technical infrastructure system, it is vital to prioritize investment in the development of the transportation system, internal highways connecting communities and industrial clusters, and connectivity between metropolitan areas and rural areas. Additionally, it is required to gradually update the technical infrastructure system in major cities such as Vietnam Hanoi and Ho Chi Minh City, improve public transportation, and alleviate traffic congestion.

Fifthly, the research model indicates that an expansionary strategy is essential to encourage domestic and foreign investors to create industrial clusters, particularly those with financial potential and advanced technology from developed countries such as the United States, Japan, and Western Europe. The input-output linkages, regional and

interregional linkages, and domestic and international linkages need to be reinforced, as this is an essential requirement for increasing the industry's appeal to investors. Additionally, for industrial clusters located on the outskirts (not in major cities), local governments must provide various services, medical, and educational facilities to suit the needs of businesses and labourers.

5. ACKNOWLEDGEMENT

The authors are thankful to the Vietnam National University Ho Chi Minh City. This work was supported by the Vietnam National University Ho Chi Minh City (VNU-HCM) under Grant B2019-34-01.

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