

## PROVINCIAL CLUSTERING IN THE SOUTH OF THAILAND: CONCEPTUAL AND EMPIRICAL

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### **Abstract**

This paper aims to determine the cluster of 14 provinces in the Southern part of Thailand. We formulated 24 indicators for provincial clustering based on three major concepts: spatial, functional, and micro-foundational. Factor analysis shows that 10 of these indicators significantly determine provincial clustering. Cluster analysis obviously categorises 14 provinces into five cases of three to seven provincial clusters. In each case, the formation of groups is determined using the proximity criteria. Discrimination analysis helps to classify the most appropriate form, and in each case shows that suggested clusters three and four are appropriate for provincial clustering.

**Keywords:** Geographical cluster, Provincial clustering, Agglomeration effect

**JEL classification:** N95, R12, R58

### **1. Introduction**

The main purposes of economic development are to enhance economic growth, create stability, and ensure a more equal income distribution. In terms of geographical area, the difference in structure of economy and society is a major factor for determining development policy. The approach for development is usually considered in response to the capacity and potential that each area can achieve according to its economic goals.

Over the past three decades Thailand has focused on spatial development. The early stages of spatial development planning for urban and regional areas started under The Third National Economic and Social Development Plan (1972–1976). During the Fourth to Sixth Plans (1977–1991), the emphasis of development policy focused more on primary and secondary cities in various regions, including the development of new economic areas. Following the introduction of the Seventh Plan (1992–1996) the focus was on regional networks through the building of the physical infrastructure and social services to support the development of the urban system and expand economic growth as a regional centre that would further lead to local development as part of urban hierarchy.

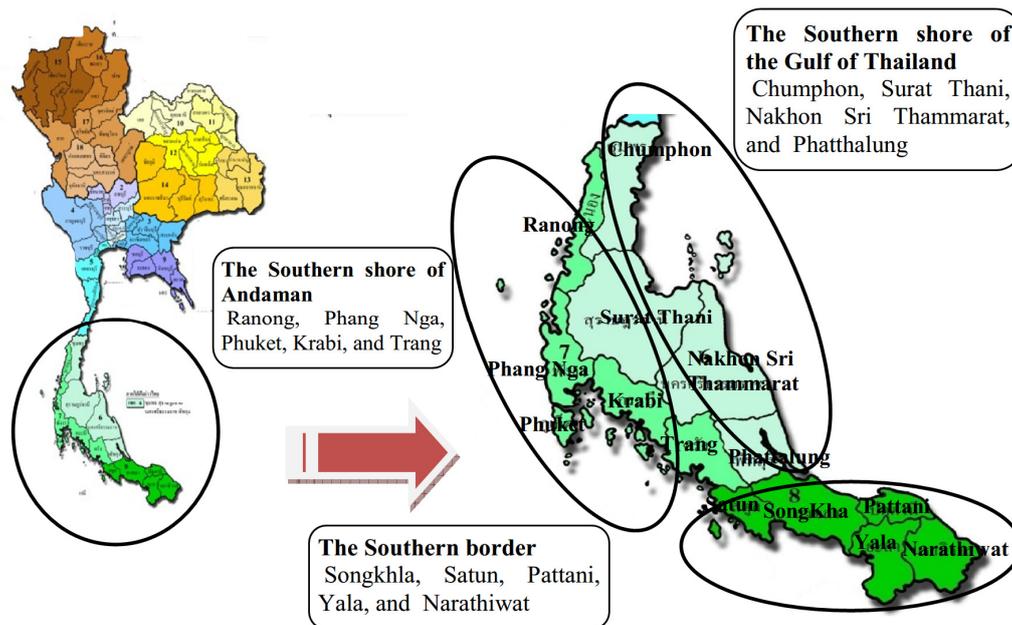
During the Eighth Plan (1997–2001), in a period of economic crisis, the concept of sustainable development was adopted for economic development policies based on the allocation of government resources to encourage the participation of all sectors and organisations for joint effect. The Ninth and Tenth Plans (2002–2011) offered holistic approaches aimed at supporting decentralisation to encourage a fair distribution of economic power and resources. Accordingly, the policy for public administration uses the concept of provincial clustering as the approach for development implementation.

Following the Regulation of the Prime Minister's office with the Integrated Provincial Administration (B.E. 2003), Article 4 established the definition of provincial clustering as provinces and territories to support the relationship between economic and social development of the country in all aspects of production, trade, and investment for specific problems requiring cooperation between the provinces concerned. On 15 January 2008, the

Cabinet approved 18 provincial clusters (Figure 1) and implemented them under the legislation with government support.

Figure 1, shows the 14 Southern provinces grouped into three existing groups. Firstly, the Southern shore of the Gulf of Thailand including Chumphon, Surat Thani, Nakhon Sri Thammarat, and Phatthalung. Secondly, the Southern shore of Andaman containing Ranong, Phang Nga, Phuket, Krabi, and Trang. Lastly, the Southern border consisting of Songkhla, Satun, Pattani, Yala, and Narathiwat. The first and second groups are located along the coast of the Andaman Sea and the Gulf of Thailand. Both groups reflect the formula of the geographical approach. The three Southern provincial clustering groups may not be formulated based on the concept of cluster.

**Figure 1. Map of the three existing provincial clusters in the South of Thailand**



Accordingly, there is a suspicion that provincial clustering may not be formulated based on the economic justification of the concept of cluster. This study aims to develop indicators based on the concept of cluster, which may be useful for exploring provincial clustering through the spatial variation of factor scores to determine each province in Southern Thailand in terms of geographical cluster with the indicators that have been developed.

## **2. Concept of cluster**

The term cluster is used synonymously in literature using such terms as the industrial district, industrial cluster, agglomeration of economies, and others. The concept of cluster captures attention and is applied in different contexts. The Academic Development of the Global Cluster Initiative Survey (GCIS) presented information to support that the implementation of the cluster has been an important approach in the regional economic development policy since 2003. In the past decade, there are more than 500 cluster areas in North America, Europe, Australia, and New Zealand. An economic development agency based in North America and Europe has a set of policies consistent with the characteristics of regional cluster and is targeting support operations in economic development.

Porter (1990) associated the academic term industrial cluster with popularity and favour. He defined industrial cluster in terms of a concentrated area with interconnections between business units and institutions linked by commodities and complements. The definition of cluster is often used in different ways by academics such as Marshall (1890), Krugman (1991), Saxenian (1994), Hill and Brennan (2000), Van den Berg, Braun and van Winden (2001), Rosenfeld (2005), Cortright (2006), and Glaeser and Gottlieb (2009). Generally, the definitions used are mostly for the description and operation of the conceptual framework. Therefore, the wide range of author ideas depends on different terminology to expand and

clarify the different meanings of cluster. Furthermore, a wide range of ideas depends on the focus of the objectives, methodology, and unit of analysis in each study.

Most authors propose their own typologies of cluster in literature depending on their research objectives. For example, Markusen (1996) proposed the typology of industrial districts as cluster. Rosenfield (1997) described the characteristics of cluster based on the evolution of the cycle of cluster processes. Gordon and McCann (2000) proposed three basic types of cluster by processes: pure agglomeration economies, industrial complexes, and social networks. Enright (2003) posited cluster in various dimensions and also characterised cluster by relying on the state of development. Martin and Sunley (2003) categorised 10 different ways of defining clusters and Feser (2004) considered three dimensions of clusters: life cycle, linkage, and geography. Nonetheless, literature and empirical research capture the broad definition of cluster to provide three core consistent characteristics comprising proximity, linkage, and externalities. In this paper, three concepts of cluster are identified for a conceptual framework. The three concepts of cluster are based on the key features of each concept and the role of variable factors are considered and used for analysis, namely: spatial, functional, and micro-foundational.

### **(1) The Spatial Concept**

The key feature of spatial concept implies the proximity of economic agents in space. The location theory is crucial to the foundation of the cluster concept and the main idea used in the analysis of an economic space system. The theory explains the reasons for location decisions in relation to each economic activity in different areas. These are due to various factors such as natural resources, economic systems, social institutions, and the culture influencing the structure of economic activity in space. In the location theory, economic activity decisions are considered to be a major factor for minimising distance, resulting in a reduction in transportation and production costs as well as providing cheap labour. In the early stages of this theory, Von Thunen (1826) considered land use and allocation surrounding the city in order to provide the lowest production and transportation costs for the sale of goods. Alonso (1964) extended the Von Thunen idea to consider the issue of land use around the business centre of a district, known as a monocentric city model.

Marshall (1890), Weber (1929), Ohlin (1933), and Hoover (1937, 1948) defined the benefits and proposed a variety of explanations for firms locating with other spatial concentrations of economic agents to become agglomeration economies. The result of locating economic activity in one area affects the specialisation of labour as well as the issue of external economies in relation to the economies of scale. There are three major themes of economic benefit in terms of spatial concept: localisation, urbanisation, and Jacob's economies.

Even though the importance of localisation, urbanisation, and Jacob's economies on location decisions and the formation of urban areas have been widely discussed in terms of economic advantage, this may not provide a sufficient explanation for the location decisions of industries or the existence of agglomerations. This is because some spatial agglomeration may result from natural advantages. Ricardo (1986) describes comparative advantages in different areas as being due to specific input factors such as certain specialised production activities causing some industries to obtain an advantage over others.

The New Economic Geography (NEG) introduced by Krugman (1991) and Fujita, Krugman, and Venables (1998) describes the decision of the business units to group together and decide to locate close to their customers in the city. They obtain the benefit of low transportation costs, increased productivity and city or urban competition based on variety or diversity. The businesses are also strengthened and able to set prices under conditions where customers and suppliers can be moved freely to other areas by reason of economic incentive. Consumers or customers are more willing to accept the higher cost of living in the city by responding to the demand for a variety of products. The equilibrium of the NEG model shows the core-periphery structure, where economic agents are located in the core while the others are located on the periphery.

### **(2) The Functional Concept**

The spatial concept explains the reasons and crucial decisions of economic entities to be located in close proximity to one another. The relationship between economic agents leads to the local economy being associated with the production, exchange, and consumption of goods and services. In terms of function, there is a variety of terminology such as network

communication, input/output linkage, or functional region (urban) such as headquarters. The key feature in terms of functional concept underlines interaction and mutually beneficial cooperation between economic agents. Most studies on industrial clusters focus on the different kinds of linkages: production, intermediate goods or services, and marketing linkages that co-exist between industries. The direct and indirect linkages and interactions among industries have been in the form of core (pole/centre) and may dominate other spaces as peripheral.

Christaller (1933) and Losch (1940) introduced the central-place theory based on the economic agent trade-off between the cost of living and cost of transportation. The cluster of economic activity incorporated into the centre and other areas encourages a reduction in transportation costs with the possible density of agents in the central area. Harris (1954) proposed the concept of market potential analysis to measure the purchasing power in the core and periphery. This idea represents the self-reinforcing process in the concentration of economic activity as a driven or continuous reinforcement of the process.

Isard et al. (1959), Streit (1969), Czamanski and Ablas (1979), Roepke et al. (1974), and Howe (1991) proposed inter-industry linkages using input-output data from a regional economy. The major focus is on identifying key sectors which imply a form of industrial clusters and complexes seen primarily as geographical clusters in the form of inter-firms as an input-output linkage. Therefore, the mechanisms of industrial linkages give an economic advantage to firms located in close proximity to others of a similar nature.

Fujita and Ogawa (1982) created a multi sub-centre model to describe the city as a hub, on the assumption that the influence of external economies between each manufacturer diminishes by distance. Porter (1998) pointed out the concept of cluster through the interaction of business units via the supply chain. The advantage of logistical management in manufacturing systems is known as linkage between the buyer and seller. As a result, agglomeration economies in a cluster of economic activity create specialisation in production and enhanced interaction between suppliers and customers.

The NEG model explains the interaction between producers and consumers in the market and describes the growth of economic activity using the core and periphery model. The NEG model explains the relationship between externalities and distance and the opposing relationship between the centripetal forces that tend to pull together labour and producers in the form of co-location, and the centrifugal forces that tend to decline in coexistence with economic agents. The demand and supply side of economic agents in the aggregate market influence the forward and backward linkage among economic activities. Sellers can satisfy the demand of consumers by the low cost of transportation and specialisation of labour in the area, while buyers can achieve an adequate supply by a concentration of input, commodities, or complementariness.

### **(3) The Micro-foundational Concept**

The driving force factors of cluster and micro-foundation can explain the benefits of economic units deciding to locate in an area by micro-foundation. The key feature relies on a micro level that describes the economic behaviour of economic agents in an area. Von Thunen (1826), Weber (1920), Hoover (1937, 1948), and Losch (1954) presented the theory of location as a basic idea of the decision by economic agents to locate in a space as a cluster and described the economic benefit of the proximity of economic activity by two sides of business implementing transportation and transaction costs.

Porter (1990) proposed four important driving force factors for the cluster: local demand, circumstances of rivalry, elements of complementing economic activity, and input sharing. Cortright (2006) proposed seven micro-fundamental factors to explain the behaviour of economic activity consisting of labour market pooling, supplier specialisation, knowledge spillovers, entrepreneurship, path dependency and lock-in, culture through confidence, and communication with each unit of economic activity, providing a trust network for local demand. Labour market pooling, supplier specialisation, and knowledge spillovers are based on the concept known as Marshall Externalities or Marshall's Trinity. Hanson (2003) points out that the driving force for cluster also relates to the home market effect; consumption and economical rent.

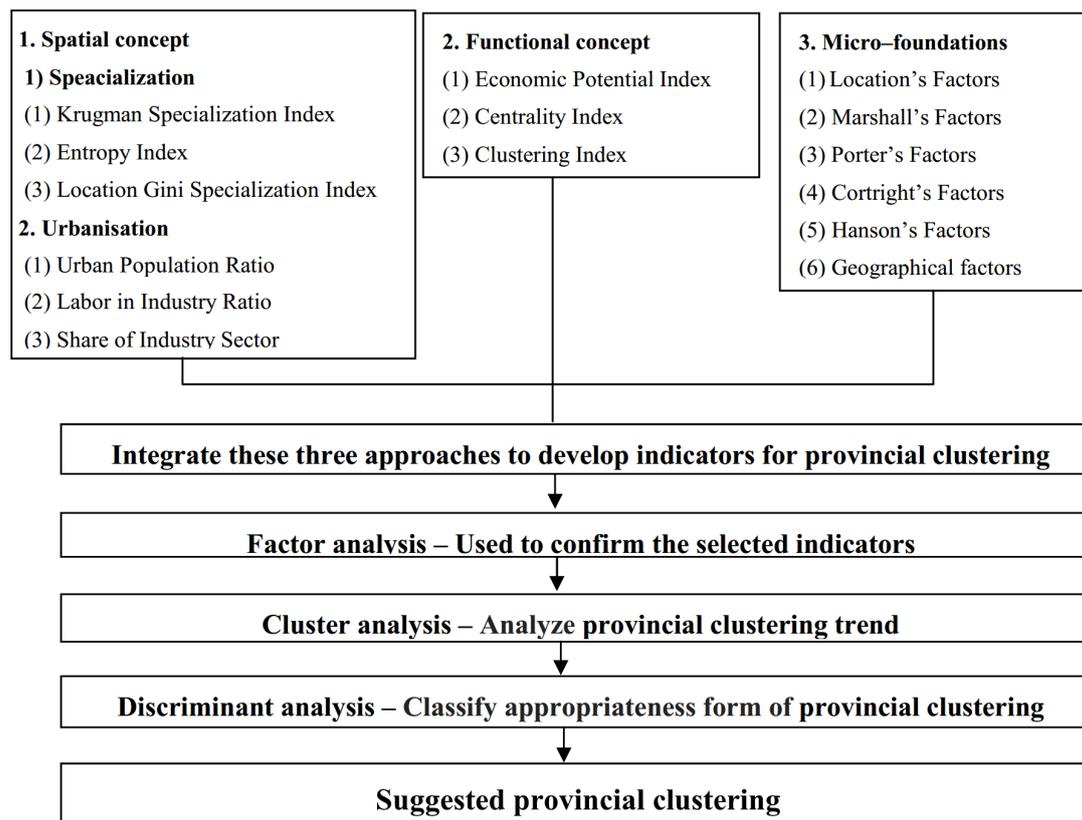
From the geographical viewpoint, Dicken and Lloyd (1990) proposed that cluster is caused by natural resources, climate, physical structure, communication, culture, and the local

economy. Cortright suggests that cluster in different phenomena can be composed of different elements and varies throughout the cycle of cluster. The micro-foundations are important for indicating the different phenomena of the cluster cycle and some factors may explain the formation of the cluster while others play a role in cluster growth.

### 3. Conceptual Framework

As mentioned in the previous section, a wide range of approaches and techniques are employed to analyse the consequences of geographical cluster and can be classified at national level, industry level, and business unit level. Porter (1996) proposed the concept to identify cluster as a blueprint for grouping economic activity associated with linkage to each other. In addition, it leads to the formulation of a policy for economic development. Anderson (2004) proposed a procedure to identify the nature of regional cluster: 1) defining a unit for analysis; 2) determining the economic indicators used in the analysis; 3) identification and selection of the economic activity as a cluster; 4) defining a cluster in each group; 5) creating a cluster map; and 6) explaining the relationship of the cluster. The second and third steps identify characteristics of the cluster with several techniques depending on the definition or unit of analysis. Much of the research uses single methodology and this definition has been debated. The definition of cluster measures its characteristics with a variety of different features.

**Figure 2. Conceptual approaches to integrate the concept of cluster and the development of indicators for provincial clustering**



Most empirical research presents measurements in three theme concepts of cluster. Firstly, the most commonly used to measure spatial concept emphasises sector composition resulting in a form of co-location for each similar economic activity known as localisation (specialisation/concentration), urbanisation, and Jacob's economies. Secondly, the functional concept is mostly used to measure underlying variables indicating interaction or relationships between agents. Lastly, the micro-foundational concept measures variables based on a literature review of tests proposed by authors. A wide range of disciplines have been relied on

by authors using different measurements and techniques. There is, therefore, no single approach or method for analysing the concept of cluster.

Limitations in empirical research of the cluster have not really explained or determined specific boundaries in terms of geographical cluster. Most research on cluster follows certain characteristics to determine the specifications of the business or industry in the area as cluster, and classifies or identifies cluster only in terms of one concept. This identifies the variables associated with the three concepts used to describe a cluster; spatial, functional, and micro-foundational. This study proposes the development of indicators to determine each Southern province as a provincial clustering. Therefore, this paper integrates the three concepts for determining provincial clustering as shown in Figure 2.

#### 4. Methodology

This paper describes the concept of cluster and aims to find facts to explain the phenomenon relating to the cluster concept. Panel data was collected from 14 provinces for the years 1996 through to 2010. The collection of secondary data sources associated and significant in meaning to explain the concept of cluster were used in the analysis. The units of analysis for this research are 14 provinces in the South of Thailand, comprising Chumphon, Ranong, Phang Nga, Surat Thani, Phuket, Krabi, Nakhon Sri Thammarat, Phatthalung, Trang, Satun, Songkhla, Pattani, Yala, and Narathiwat.

Analysis is defined through the following procedure. Firstly, the definition of cluster proposed is collected from an academic perspective. A conceptual framework is then formulated to develop indicators based on the concept of cluster. Next, indicators are collected and selected for the identification of a precise set of potential variables for provincial grouping (Table 1). The selected indicators reflect the clearest definition possible and are easy to interpret with no redundant measurement. Lastly, a factor analysis confirms variables and evaluates their ability as a set of indicators to be used for provincial grouping and is also applied to a set of variables by summarising many variables into a few factors. The analysis considers clustering trends in each year and declares them reasonable in the case of a group. Discriminant analysis considers the influence of each indicator and clarifies their appropriateness in the form of provincial clustering in each case.

**Table 1. Selected indicators to determine provincial clustering**

Concept of Cluster	Variable	Description
<b>1. Spatial Concept</b>		
<b>1.1 Specialisation</b>		
(1) Krugman Specialisation Index	K Specialise	The absolute difference between the share of $i^{\text{th}}$ sector in each province per share in the South
(2) Entropy Index	Entropy	The negative sum of sector shares multiplied by the natural logarithm of shares in each sector
(3) Location Gini Specialisation Index	LOCATION_Gini	The sum of the differences of the sector share by the addition of the differences of the weights of each sector, and the weights of the arithmetic mean obtained after the decreasing classification
<b>1.2 Urbanisation</b>		
(1) Urban Population Ratio	POP_Urban	Proportion of population in urban area

**Table 1. Selected indicators to determine provincial clustering (Cont.)**

<b>Concept of Cluster</b>	<b>Variable</b>	<b>Description</b>
(2) Labor in Industry Ratio	LABOUR_Indus	Proportion of labour in industry sector
(3) Share of Industry Sector	SHARE Indus	Proportion of industry sector
<b>2. Functional Concept</b>		
(1) Economic Potential Index	MKT_Poten	GPP in a province $p^{\text{th}}$ weighted by the summation of distance of all other provinces
(2) Centrality Index	Centrality	Proportion of $i^{\text{th}}$ sector of economic potential index with the total sector
(3) Clustering Index	Clustering	Proportion of $i^{\text{th}}$ sector to distance of all pairs of all provinces
<b>3. Micro–Foundational Concept</b>		
<b>3.1 Location theory</b>		
(1) Transportation	Transport	Proportion of manufacturing sector
(2) Transaction	Transaction	Proportion of electricity, gas and water supply sector
<b>3.2 Marshall's concept</b>		
(1) Supplier Specialisation	SUPPLIER_Special	Concentration of agriculture sector
(2) Knowledge Spillover	KHOW_Spill	Proportion of the workers with a bachelor's degree
(3) Labour Pooling	LABOUR_Pool	Proportion of workers
<b>3.3 Porter's concept</b>		
(1) Local Demand	LOCAL_Demand	Proportion of wholesale and retail trade sectors
(2) Rivalry	Rivalry	Sums up the squares of sector share in all economic activity in a province
<b>3.4 Cortright's concept</b>		
(1) Entrepreneur	Entrepreneur	Proportion of establishment
(2) Path Dependence	Path	Rate of change in establishment in a province
<b>3.5 Hanson's concept</b>		
(1) Home Market Demand	Deposit	Proportion of deposit
(2) Consumption	GDP_Per	Proportion of income per capita
(3) Rent Seeking	ECON_Rent	Proportion of tax revenue
<b>3.6 Geographical concept</b>		
(1) Physical	Physical	Proportion of telephone numbers
(2) Population	Population	Proportion of population
(3) Local Economy	Loan	Proportion of loan

## **5. Result of determination of provincial clustering**

### **(1) A set of variables using a factor by factor analysis**

The Kaiser-Meyer-Olkin (KMO) demonstrates the suitability of the variables for analysis. The KMO was 0.542 (i.e. greater than 0.5). It concludes that the variables are adequate using the factor analysis technique. The Bartlett's test of sphericity found that it is statistically significant, meaning that the 24 variables are correlated with each other and suitable for factor analysis techniques. Furthermore, communality extraction values of all variables in Table 3

have a value greater than 0.5 indicating that variance in each variable is accounted for as a set of variables and strong enough to respond in terms of factor.

**Table 2. The Kaiser-Meyer-Olkin measure of sampling adequacy and the Bartlett's test of sphericity**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.542
Bartlett's Test of Sphericity	Approx. Chi-Square	2013.286
	df	276
	Sig.	0.00

Factor analysis revealed 10 factors from 24 variables that have an Eigenvalue greater than one. The 10 selected factors together accounted for 76.11% of the total variance of variables (Cumulative percentage of Variance). In Table 2, the bold mark value of loading coefficients in 10 selected factors are correlated between variables and corresponding factors. Selected factors can be interpreted by a set of variables in each factor as follows.

**Table 3. Confirms suitability of 24 indicators and reveals 10 factors**

	Factor										Communalities Extractions
	1	2	3	4	5	6	7	8	9	10	
Transportation	<b>.876</b>										.914
GDP_Per	<b>.827</b>										.914
Centrality	<b>.813</b>										.681
Rivalry	<b>.702</b>										.752
LOCAL Demand	<b>.695</b>										.697
MKT_Poten		<b>.934</b>									.797
LABOUR_Pool		<b>.926</b>									.665
Deposit			<b>-.849</b>								.737
Loan			<b>-.815</b>								.604
ECON_Rent			<b>-.707</b>								.599
K_Specialise				<b>.916</b>							.768
POP_Urban				<b>.913</b>							.677
Physical					<b>.837</b>						.646
Entropy					<b>.664</b>						.668
LABOUR_Indus						<b>.907</b>					.849
Clustering						<b>.901</b>					.864
Entrepreneur							<b>.900</b>				.813
Path							<b>.889</b>				.812
Population								<b>-.829</b>			.599
Transaction								<b>.777</b>			.542
SUPPLIER_Special									<b>-.825</b>		.695
SHARE_Indus									<b>.734</b>		.728
LOCATION_Gini										<b>.799</b>	.709
KHOW_Spill										<b>-.696</b>	.575
Eigenvalues	3.83	2.33	2.08	1.96	1.66	1.48	1.35	1.31	1.28	1.05	
% of Variance	15.97	9.71	8.66	8.15	6.90	6.17	5.62	5.47	5.07	15.97	
Cumulative % of Variance	15.97	25.68	34.34	42.48	49.38	55.56	61.18	66.64	71.71	76.11	

The first factor consists of Transportation, GDP\_Per, Centrality, Rivalry, and LOCAL\_Demand variables, which reflect the economic fundamentals in the area. The second

factor consists of MKT\_Poten and LABOUR\_Pool variables, which reflect the accessibility of labor. The third factor consists of Deposit, Loan, and ECON\_Rent variables, which reflect economic potential. The fourth factor consists of K\_Specialise and POP\_Urban variables, which reflect the state of urbanisation. The fifth factor consists of Physical and Entropy, which reflect the state's geography. The sixth factor consists of LABOUR\_Indus and Clustering variables, which reflect labour in industry sector pooling. The seventh factor consists of Entrepreneur and Path variables, which reflect the status of the establishment. The eighth factor consists of Population and Transaction variables, which reflect population and transaction. The ninth factor consists of SUPPLIER\_Special and SHARE\_Indus variables, which reflect the concentration of the inputs. The tenth factor consists of LOCATION\_Gini and KHOW\_Spill variables, which reflect labour ability in the area.

Factor analysis presents the variables of three concepts of 14 provinces comprising a set of variables. The similar information of each variable as a factor indicates that at least one concept of cluster is embedded. This result is consistent with the previous section that discussed the definition and typology of cluster in a different way. Cortright (2006) suggests that not just one factor offers an explanation for cluster, and Gordon and McCann (2004) noted that the mechanisms of agglomeration economies operate simultaneously, often indirectly and cumulatively. That agglomeration process cannot be identified by only a single factor. Therefore steps should be taken to identify cluster factors and the interaction between each variable in those factors. These are important steps towards understanding the range of characteristics that describe and classify cluster with different phenomena.

#### (2) Analysing trends in each group by cluster analysis

The study groups together 14 provinces by using cluster analysis from the years 1996 through to 2010. Cluster analysis considers the provincial clustering trends of each group in each year. The 14 provinces are grouped starting from 2 to 13 for provincial clustering. These are organised into two provinces. Phuket has a unique feature not apparent in other provinces and cannot be identified as the primacy province. Classified into eight provincial clusters, the results of the grouping in each year show an unclarified pattern of cluster. It is suggested that each province has its own group.

Therefore, groupings of five different cases were considered since there are three to seven groups of province. In each case, forms of provincial clustering were categorised. Each form was determined by significantly important characteristics of cluster for use as a proximity criterion. The provincial borders located close together will be determined within the group as provincial clustering. Under the conditions above, any form of provincial clustering can be formulated into five cases as follows: Firstly, seven provincial clusters comprise 46 forms. Secondly, six provincial clusters comprise 39 forms. Thirdly, five provincial clusters comprise 43 forms. Fourthly, four provincial clusters comprise 26 forms and three provincial clusters comprise two forms.

#### (3) Classification of the appropriate forms in each group

##### - Significant variables.

Discriminant analysis determines the influence of each variable to classify a provincial group. Variable Deposit, Population, and Loan were found to be statistically significant at the 0.01 level; variable Transaction and ECON\_Rent are statistically significant at the 0.05 level, and the Transportation variable is statistically significant at the 0.10 level.

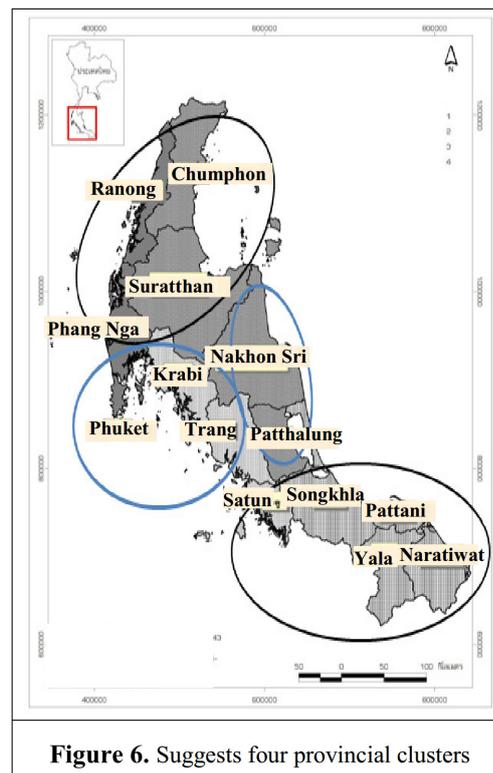
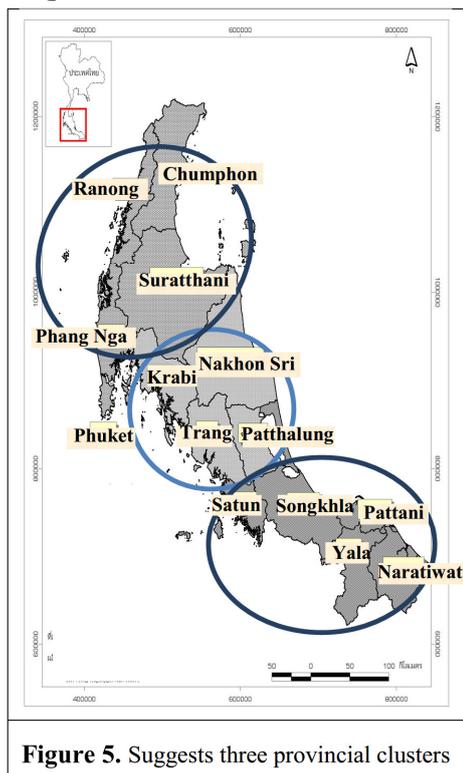
##### - Accurate classification of each form of provincial clustering

The most appropriate form of provincial clustering will be determined by the percentage of accuracy in the classification (Hit Ratio) and the probability of the membership of each province (Proportional Chance Criteria: CPRO) accruing during the classification of each form. The acceptance criteria for the appropriate form of provincial clustering are that the value of Hit Ratio should be greater than 1.25 of the CPRO. Therefore, the most appropriate form of provincial clustering is determined by the difference in Hit Ratio and CPRO.

**Table 4. Appropriate form of provincial clustering in each case**

Provincial Clustering	3 Groups	4 Groups	5 Groups	6 Groups	7 Groups	
					Form 1	Form 2
Chumphon	Chumphon	Chumphon	Chumphon	Chumphon	Chumphon	Chumphon
Surat Thani	Surat Thani	Surat Thani	Surat Thani	Surat Thani	Surat Thani	Surat Thani
Ranong	Ranong	Ranong	Ranong	Ranong	Ranong	Ranong
Phang Nga	Phang Nga	Phang Nga	Phang Nga	Phang Nga	Phang Nga	Phang Nga
Phuket	Phuket	Phuket	Phuket	Phuket	Phuket	Phuket
Krabi	Krabi	Krabi	Krabi	Krabi	Krabi	Krabi
Nakhon Sri	Nakhon Sri	Nakhon Sri	Nakhon Sri	Nakhon Sri	Nakhon Sri	Trang
Phatthalung	Phatthalung	Phatthalung	Phatthalung	Phatthalung	Phatthalung	Nakhon Sri
Trang	Trang	Trang	Trang	Trang	Trang	Phatthalung
Satun	Satun	Satun	Satun	Satun	Satun	Satun
Songkhla	Songkhla	Songkhla	Songkhla	Songkhla	Songkhla	Songkhla
Pattani	Pattani	Pattani	Pattani	Pattani	Pattani	Pattani
Yala	Yala	Yala	Yala	Yala	Yala	Yala
Narathiwat	Narathiwat	Narathiwat	Narathiwat	Narathiwat	Narathiwat	Narathiwat
<b>Hit Ratio</b>	52.38	49.05	49.52	47.62	45.24	
<b>C<sub>PRO</sub></b>	42.09	34.44	29.34	25.51	20.41	
<b>Difference</b>	10.29	14.61	20.19	22.11	24.83	

Under the economic concept of cluster, to determine 14 provinces as provincial clustering, Table 3 shows the appropriate groups in each case. For cases 5, 6, and 7 of provincial clustering, Phuket is the only province separated from another. Such a case represents a form of primary province (Phuket only). These results do not indicate provincial groups where at least two provinces are in geographical proximity as provincial clustering. As such, only new groups 3 and 4 are in an appropriate form for analysis using the indicators of the three concepts of cluster to show provincial clustering (Figure 5 and 6). This is because these exist in proximity and imply interactions and linkages among the provinces with the advantage of their co-location, which are also consistent with both the definition and goal of provincial clustering.



## **6. Conclusion**

This paper has developed indicators useful for provincial clustering in the Southern provinces of Thailand based on three major concepts of cluster: spatial, functional, and micro-foundational. The results from factor analysis show 24 indicators as variables to determine provincial clustering and reveal 10 selected factors that imply there is no single variable to explain or analyse the characteristics and process of cluster and cannot identify a single factor. Mechanisms of provincial cluster economies operate simultaneously and cumulatively. The results from cluster analysis determine a group trend during the period 1996 through to 2010. The study was categorised into two provinces. Phuket has a unique feature not apparent in other provinces. From the eighth provincial cluster onwards, the results of the grouping in each year show an unclarified pattern of cluster. Therefore grouping into five different cases was considered since there were three to seven groups of province. In each case provincial clustering was categorised in any form. Forms were determined in each case of provincial clustering using the proximity criteria that the boundaries of each province within the group are located near each other.

Discrimination analysis classifies the most appropriate forms in each case and the influence of each variable to classify a group of provinces. We found six variables: Deposit, Population, and Loan all of which reflect the economic potential of the area; variable Transaction and ECON\_Rent which reflect the population and transaction of space, and Transportation which was part of a variable factor reflecting the economic fundamentals. All variables fall under the micro-foundational concept. This means that the role of micro data is an important factor in Southern Thailand and affects the provincial clustering.

The results show that a suitable form of provincial clustering, as considered by the difference between the accuracy of classification (Hit Ratio) and the ratio of the probability of group membership of each province (CPRO), suggest that three and four provincial clustering groups within the group are closely located, making the provincial linkages consistent with the definition and goal of provincial clustering. Further research should aim at identifying the consequences of appropriate provincial clustering on economic development.

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