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# Diamond model and the export competitiveness of the agriculture industry from emerging markets: an exploratory vision based on a spatial effect study using a genetic algorithm

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## ABSTRACT

A deeper understanding of the comparative advantage of emerging markets in agricultural export can be gained by analysing the spatial connections of emerging markets through the framework provided by the diamond model. The geographic economics factors are transformed to interconnections of emerging markets by a genetic algorithm based on Mahalanobis distances. The spatial effect of geographic economics factors on export competitiveness of agriculture is further identified by spatial modelling. The irrigated land area, competitive labour cost, foreign direct investment (F.D.I.), and export market opportunity are important to further develop the export competitiveness of the agriculture industry from emerging markets based on spatial modelling. Also there is a spatial disturbances effect in agricultural export of emerging markets based on transformed interconnections structured by geographic economic factors. A fuzzy cluster analysis is further performed, and the stationary solution of clusters in dynamic transition across market segments is analysed by a Markov Chain. It is further found that the distribution of emerging markets with a higher level of export competitiveness can be more concentrated in clusters with lower levels of proportion. The findings of this research can offer support to global managers in further understanding the spatial effect of geographic economics factors on export competitiveness of agriculture from emerging markets.

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## 1. Introduction

With the development of theories referring to emerging markets, an increasing amount of research has concentrated on the export competitiveness of agriculture.

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The research is concerned on calculations of the export competitiveness, primarily based on revealed comparative advantage (R.C.A.) indexes. Zhang, Xu, and Wu (2006) reviewed the trade status of Shanxi agricultural products, and suggested concentrating on developing the agricultural product with comparative advantage in Shanxi, and optimizing the import and export structure of Shanxi agriculture products on the basis of comparative advantage, as well as promoting the quality of export product and improving its competitiveness in international market substantially. Cao, Feng, and Zhang (2011) also analysed export competitiveness of agricultural products between China and Central Asian countries by revealing comparable advantage index, and found that China's total agricultural products do not have comparable advantage, while the status of Central Asian countries have changed from comparable advantage into comparable disadvantage. China and Central Asian countries on specific categories of agricultural products have different advantage structures, and there can be vast bilateral trade potential on the basis of comparable advantage. In addition, Sufri (2012) found that corn, shrimp, crops, etc., in Indonesia have good prospects for the needs of domestic and export orientation.

Furthermore, researchers are also concerned with the identification of key determinants of export competitiveness. Liu and Revell (2009) discovered that emerging markets such as China have higher comparative advantages in labour-intensive agricultural products such as vegetables and that the performance of labour-intensive products is positively related to China's increase of share in world trade. Mwansakilwa, Tembo, and Mugisha (2013) also found that the supply and competitiveness of flower exports are positively influenced by domestic flower production, real G.D.P. and population of importing countries, relative depreciation of domestic currency and world export prices, while exports from competing countries and real interest rates were found to negatively influence flower exports. Monetary policies and exchange rate regimes that promote trade are suggested to enhance production and exporting. It is indicated in the literature that wage costs, irrigated land area, price index, export of the agriculture industry, domestic consumption demand, foreign direct investment (F.D.I.), and the exchange rate against U.S. dollars of different countries from emerging markets are important factors that influence the export competitiveness of the agriculture industry from emerging markets.

This research aims to analyse the export competitiveness of agriculture from emerging markets based on the diamond model. This research further reveals the effect of advantages on export competitiveness of agriculture from emerging markets, by addressing the spatial effect of resources based on interconnections across emerging markets. The effect of factors to represent the dimensions of diamond model is further analysed in a integrative system. The interconnections across emerging markets are transformed from geographic economics factors by a genetic algorithm based on Mahalanobis distance. The spatial effect of resources on export competitiveness of agriculture is further analysed by spatial modelling based on interconnections of emerging markets. The fuzzy cluster analysis is further performed to analyse the clustering attributes of market segmentation in export of agriculture from emerging markets. Furthermore, the stationary solution in dynamic transmission of different clusters is further analysed by a Markov Chain. The effect of geographic economics factors on export competitiveness of agriculture from emerging markets is studied

based on diamond model, by an exploration from integrative and dynamic vision. The findings of this research provides support to global managers in furthering their understanding of spatial effects of geographic economics factors on export competitiveness of agriculture from emerging markets.

## 2. Literature review

Porter (1980) pointed out that the competitive advantage of countries can be further analysed by assessing the resources and conditions in the national industrial environment. Porter (1990) further pointed out the diamond model in which the factor endowment, market demand, relevant industry, and firm strategy and rivalry are important resources that support the national competitiveness in different industries. In addition, the government policy and market opportunity are also important conditions that effect on national competitive advantage. Grant (1991) pointed out that the diamond theoretical framework offered an important explanation on the national competitiveness of industry by importing the functions of the national industrial condition on firm strategies. The factor endowment of an industry is important to offer input and supply for competitive advantages. Domestic market demand offers important motivation for continuous upgrading of technology in fulfilling consumer demand. The relevant industry also plays an important role in supporting the competition at global market. Rivalry between domestic firms can further encourage the competitiveness and sustainability of companies through enhanced competition. Furthermore, the government policy and market opportunities also have an effect on the industrial environment and national competitive advantages in the global market. Snowden and Stonehouse (2006) also pointed out that the diamond model is an important theoretical framework that analysed the microeconomic foundations to global competitiveness. The theory investigates the business context that effects on competition process, and the factors involved in the diamond structure are important determinants to the sustainable competition and production of companies.

The export competitiveness of agriculture has been a traditional support to emerging markets in global competition. The diamond model can offer an important framework in analysing the export competitiveness of agriculture from emerging markets. Furthermore, the interconnections of resources can offer support to the national competitive advantage, and the spatial effect of the resource interconnections on export competitiveness of agriculture from emerging markets can be further analysed based on the diamond theoretical framework. This research hypothesised the diamond model offers important framework to further reveal the dimensions that structure the export competitiveness of the agriculture industry from emerging markets.

H1: The diamond model is hypothesised to be supported in export competitiveness of the agriculture industry from emerging markets.

### 2.1. Land use and labour resources factors

Land use and labour resources can be an important factor to support export competitiveness of agriculture from emerging markets. Venables (2016) pointed out that the labour

and physical resources are important supports to the development of economic growth, and they are also important to the transformation of developing economies. In addition, Fitriani and Sumarminingsih (2015) pointed out that rationale land use for agricultural production is important in economic development. Lin and Lin (2008) also pointed out the advantage in labour costs offered by emerging markets to further support global competition.

H1a: The irrigated land of emerging markets has a positive relationship with the export competitiveness of agriculture.

H1b: The wage level of emerging markets has a negative relationship with the export competitiveness of agriculture.

## **2.2. Consumer demand condition**

The domestic consumption can be important motivation to enhance export competitiveness of the agriculture industry from emerging markets. Mceachern and Seaman (2005) analysed the competitiveness of British agriculture, and found that consumer views of meat production vary widely, while attributes towards producers were positive. Furthermore, Krugman (1980) revealed that home market effects can offer countries a comparative advantage in their cross-border trade by increasing returns from economies of scale. Companies are more likely to concentrate on t production in proximity to their domestic markets, aiming to achieve economies of scale and to save on transportation costs.

H1c: The consumption of emerging markets has negative relationship with the export competitiveness of agriculture.

## **2.3. F.D.I. support**

The F.D.I. inflow can offer support to export competitiveness of agriculture from emerging markets by a spillover effect on associated industries. Zhang, Li, Li, and Zhou (2010) pointed out that the F.D.I. from foreign companies can encourage the technological upgrading and managerial efficiency of domestic companies. Shiralashetti and Hugar (2009) also pointed out that F.D.I. can motivate G.D.P. growth rate, growth in industry and service sector, reduction in unemployment, reduction in poverty, improvement in standard of living, increase in foreign exchange reserves, increase in exports, and improvement in stock market. The positive network effect of F.D.I. can encourage the further development of relevant industry that support the export competitiveness of agriculture from emerging markets.

H1d: F.D.I. in emerging markets has a positive relationship with the export competitiveness of agriculture

## **2.4. Price competition**

The price level of agriculture products can offer support to the export competitiveness of the agriculture industry from emerging markets in global competition. The industry-based view proposed by Porter (1981) pointed out that the rivalry of companies can be

important motivation for companies to enhance competitiveness and sustainability. Manova and Zhang (2012) pointed out that the pricing strategy of export companies can be important in competition in the global market. Companies working with competitive pricing strategies can be encouraged to further enhance the competitiveness in agriculture.

H1e: The price level of agriculture in emerging markets has a positive relationship with the export competitiveness of agriculture.

## **2.5. Export opportunity and exchange rate policy**

The agricultural exports and the exchange rate in emerging markets can be important market opportunities and government policy that effects the export competitiveness of agriculture in emerging markets. Lado, Martinez-Ros, and Valenzuela (2004) pointed out that the marketing strategy of export companies can vary at different destinations. Krauthem (2013) also pointed out that the export companies need to make decisions on different corporate strategies in competing at different markets. The increase of export based on enhanced involvement of global market by emerging markets further offers support export competitiveness, and strengthen the power of emerging markets in global business negotiation based on the increase of market share. Furthermore, Coates (2015) pointed out that the cost-benefit of financial regulation of the exchange rate can be important to the economy. The foreign exchange rate in emerging markets also can be important to export competitiveness of agriculture. Also the foreign exchange rate policy can have important effect on export competitiveness of the agriculture industry for bulk commodity transaction.

H1f: The export of emerging markets has a positive relationship with the export competitiveness of agriculture.

H1g: The foreign exchange rate of emerging markets has a positive relationship with the export competitiveness of agriculture.

Export competitiveness can be further influenced by interconnections of resources across different countries based on the diamond theoretical framework. With further development of research in this area, Burianova and Belova (2012) analysed the impact of crisis on Czech agrarian trade comparative advantage development in relation to selected trade partners based on the R.C.A. index generated from agricultural foreign trade of the Czech Republic. Ortega and Valencia (2011) analysed the international competitiveness of agriculture industrial products of the State of Michoacan, and also pointed out that measuring international competitiveness in the agribusiness sector offers a clear, comprehensive, and multifunctional agriculture complex reality.

H2: The interconnections of emerging markets have a spatial effect and negative relationship with the export competitiveness of agriculture.

Snowdon and Stonehouse (2006) pointed out that Porter suggested the cluster of entities involved in the competition system be further analysed in referring to interconnections based on diamond model. Bowen Jr and Leinbach (2006) pointed out that the diamond model offers important theoretical framework to analyse the channels that local characteristics effect on navigation of opportunities and pressures at

different locations. Kamath, Agrawal, and Chase (2012) further pointed out that the functioning system of diamond model is based on integrative structure that formulate the success of clusters in economics of geography. Antle and Stoorvogel (2006) indicated that complexity of specific spatial attributes can have important effects on ecosystem services of crops. Anselin, Bongiovanni, and Lowenberg-DeBoer (2004) pointed out that there is a spatial autocorrelation site-specific effect of regional conditions on corn products. The interconnections of geographic economics factors based on diamond model can have spatial effect on export competitiveness of the agriculture industry.

### 3. Research method

#### 3.1. Measurement of export competitiveness

The R.C.A. index is used to measure the export competitiveness of the agriculture industry from emerging markets. Esterhuizen et al. (2006) pointed out that the Balassa method supports the definition developed on competitiveness, and the method of revealed comparative advantage (R.C.A.) allows for the measurement of competitiveness under real world conditions. In addition, Kathuria (2013) analysed the comparative advantage of India and Bangladesh for the clothing sector in the world export trade with the help of Balassa's index of the R.C.A., and revealed that the share of clothing sector in India's total merchandise exports has come down during the period, and India has been able to maintain its comparative advantage in articles of apparel and clothing accessories, knitted or crocheted during the study period. According to Balassa (1987), the R.C.A. is:

$$X_{RCAi} = (X_i/X_{iw})/(X/X_w)$$

$X_i$  is the value of national exports of business  $i$ ,  $X_{iw}$  is the value of total world exports of business  $i$ .  $X$  is the value of national exports in all industries, and  $X_w$  is the value of total world exports in all industries. This index normalises for the country's share in total world trade.

#### 3.2. Identification of Mahalanobis distance

The Mahalanobis distance of each two countries is measured on the basis of export competitiveness and its determinants, which include wage of emerging markets, irrigated land area of emerging markets, price index of agricultural products in emerging markets, consumer demand, F.D.I., export of the agriculture industry, and the exchange rate of U.S. dollars to the local currency in emerging markets. The application of Mahalanobis distance can be helpful to overcome the different scales of variables in structuring the interconnections of emerging markets. The Mahalanobis distance is measured by:

$$d_{ij} = \sqrt{(x_i - x_j)^T \sum^{-1} (x_i - x_j)}$$

Mahalanobis distance overcomes the different scales across different variables in measuring the distances of country nodes. The data is collected from emerging

markets as following: China, India, Indonesia, Malaysia, Pakistan, Philippines, South Korea, Thailand, Czech Republic, Hungary, Poland, Russia, Argentina, Brazil, Chile, Colombia, Mexico, Peru, Egypt, Israel, Jordan, Morocco, South Africa and Turkey. The countries with emerging markets are selected from the M.S.C.I. emerging markets index. The annual data from 1997 to 2006 is obtained from Euro Monitor database, and the sample size is 240. For the comparison between different countries, the values in the domestic currency are all changed to U.S. dollars according to the temporary exchange rate. The value consumption and export of the agriculture industry is measured by millions of U.S. dollars. The wage level is measured by U.S. dollars and irrigated land area is measured by thousand hectares.

### **3.3. Transformation of spatial matrix**

The genetic algorithm is further performed based on the objective of minimising the error in the transformation of dimensions based on export competitiveness and country level factors in emerging markets into two visionary dimensions. The objective function is:

$$E = \sum_{i < j}^n ((d_{ij}^* - d_{ij})^2 / d_{ij}^*) / \sum_{i < j}^n d_{ij}^*$$

$d_{ij}$  is the Mahalanobis distance between the emerging markets based on export competitiveness and country level factors, and  $d_{ij}^*$  is the Mahalanobis distance of emerging markets based on the two dimensions. The transformation of interconnections across emerging markets in export of agriculture can be helpful to overcome the curse of dimensions issue in further analysing the effect of geographic economics factors on export competitiveness. The objective function aims to minimise the errors between these two distances in the transformation based on nonlinear mapping.

### **3.4. Analysis of spatial effect**

The interconnections across emerging markets are further structured based on the two dimensions transformed from the geographic economics factors by genetic algorithm, which overcomes the curse of dimensions that affect the performance of analysis due to analysis based on over complex dimensions. The spatial regression analysis is further performed to analyse the spatial effect of geographic economics factors on export competitiveness of emerging markets based on the interconnections across different markets by the geographic economics factors. The spatial autoregressive model with spatial autoregressive disturbances (S.A.R.A.R.) is performed to estimate the spatial lag effect and spatial disturbances effect of resources based on diamond model in support to export competitiveness of the agriculture industry from emerging markets.



### 3.5. Fuzzy cluster analysis

The fuzzy analysis is further performed based on dimensions developed by generic algorithm, and different clusters of emerging markets based on export competitiveness and its determinants are visualised. The number of clusters in the fuzzy cluster analysis is identified by Xie–Beni index (Xie & Beni, 1991). The Xie–Beni Index is as following:

$$V_{XB} = \frac{\sum_{i=1}^c \sum_{j=1}^n \mu_{ij}^2 |x_i - v_i|^2}{n \min_{i \neq j} |v_j - v_i|^2}$$

$V_{XB}$  is the Xie–Beni index,  $X_i$  is the database of local conditions and transportation facilities, and  $v_i$  is the vector of centroids. The minimum  $V_{XB}$  leads to an optimal number of clusters in the fuzzy cluster analysis. The data involved in the fuzzy cluster analysis are standardised.

### 3.6. Markov Chain analysis

The stationary solution of clusters in market segmentation is further analysed by a Markov Chain. The transition matrix of the clusters across different segments is as follows:

$$P_{(transition)} = \begin{pmatrix} P_{c_1c_1} & P_{c_1c_2} & \cdots & P_{c_1c_i} \\ P_{c_2c_1} & P_{c_2c_2} & \cdots & P_{c_2c_i} \\ \vdots & \vdots & \ddots & \vdots \\ P_{c_i c_1} & P_{c_i c_2} & \cdots & P_{c_i c_i} \end{pmatrix}$$

$P_{(transition)}$  is the transition matrix of clusters, and  $P_{c_1c_i}$  represents that probability that Cluster 1 is transited to Cluster  $i$ . Furthermore,  $\delta_i$  represents that stationary solution of probability for Cluster  $i$  in transition of different market segments, the stationary solution can be identified by the Markov Chain as follows:

$$\begin{aligned} P_{c_1c_1} \delta_1 + P_{c_2c_1} \delta_2 + \cdots + P_{c_i c_1} \delta_i &= \delta_1 \\ P_{c_1c_2} \delta_1 + P_{c_2c_2} \delta_2 + \cdots + P_{c_i c_2} \delta_i &= \delta_2 \\ &\vdots \cdot \vdots \\ P_{c_1c_i} \delta_1 + P_{c_2c_i} \delta_2 + \cdots + P_{c_i c_i} \delta_i &= \delta_i \\ \delta_1 + \delta_2 + \cdots + \delta_i &= 1 \end{aligned}$$

The clusters of emerging markets is identified by the fuzzy cluster analysis, and the stationary solution in transition of clusters at different market segmentations is performed by the Markov Chain.

## 4. Result

The Mahalanobis distance across different countries from emerging markets is measured on the basis of export competitiveness of agriculture and geographic economics

factors, which include wage rates, irrigated land area, price index of agricultural products, consumer demand, F.D.I., export of agricultural products, and the exchange rate of U.S. dollars to the local currency.

Figure A1 shows the vision of market segments in two dimensions developed from the export competitiveness and factors that influence it by a nonlinear mapping based on a genetic algorithm. The dimensions of export competitiveness and geographic economics factors have been transformed to two dimensions by the genetic algorithm. Figure A2 further shows that the best fitness and mean of generation fitness are gradually convergent in the transformation of geographic economics factors into interconnections of emerging markets by genetic algorithm.

Table A1 shows the spatial effect of geographic economics factors on export competitiveness from emerging markets. The spatial weight the markets in export of agriculture is structured by the interconnections based on transformation of geographic economics factors by genetic algorithm. It is found that the interconnections of emerging markets have a negative spatial disturbances effect on export competitiveness of the agriculture industry, with a significant spatial disturbances effect represented by  $\rho$ .

It is found that the diamond model is supported in explaining the export competitiveness of the agriculture industry from emerging markets, and H1 is supported. The irrigated land of emerging markets has a positive relationship with the export competitiveness of the agriculture industry in spatial effect, and H1a is supported. The wage level of emerging markets has a negative relationship with the export competitiveness of the agriculture industry, and H1b is supported. Therefore, the land and labour factors based on the diamond theoretical framework have an important effect on the export competitiveness of the agriculture industry from emerging markets.

It is also found that the market demand has an important effect on the export competitiveness of the agriculture industry from emerging markets by concerning spatial effect. The F.D.I. of emerging markets has a positive relationship with the export competitiveness of the agriculture industry, and H1d is supported. The F.D.I. can offer further support to the relevant industry based on a network effect, and is also important to the export competitiveness of agriculture from emerging markets. However, it is found that the consumption of emerging markets has a negative relationship with the export competitiveness of the agriculture industry in spatial effect, and H1c is not supported. In addition, the price level of agricultural products is found to have no significant effect on export competitiveness in agriculture from emerging markets, and H1e is not supported.

Furthermore, it is found that the export of emerging markets has a positive relationship with the export competitiveness of the agriculture industry in spatial effect, and H1f is supported. The market opportunity is important to the export competitiveness of the agriculture industry from emerging markets by concerning spatial effect. But the foreign exchange rate is found to have no significant effect on export competitiveness in the agriculture industry from emerging markets, and H1g is not supported.

It is also found that geographic economics factors have a spatial disturbances effect on the export competitiveness of the agriculture industry from emerging markets, and H2 is supported. The interconnections of emerging markets have negative spatial

disturbances effects on export competitiveness across the markets. Cliff and Ord (1981) pointed out that the S.A.R.A.R. model can be applied to further analyse the combination of the spatial autoregressive effect and the spatial disturbances effect. The result shows that the random issues occurred on export of agriculture can have spatial autocorrelation in emerging markets. The random issues which may be caused by natural and environmental changes can have a negative spatial autocorrelation in export of agriculture from emerging markets.

Table A2 shows the Xie–Beni index that offer help to identify the number of clusters. It is found that the Xie–Beni index arrives at lowest level of 0.0972 when cluster number is 9. Therefore, the rational identification of the cluster number in fuzzy cluster analysis to the emerging markets is nine clusters.

Figure A3 shows the nine different clusters in market segmentation of emerging markets based on geographic economics factors and export competitiveness of agriculture by fuzzy cluster analysis. Each colour represents a different cluster in market segmentation of emerging markets. Table A3 further shows the mean of export competitiveness and its determinants at emerging markets in the fuzzy cluster analysis.

It is found that country clusters with a higher level of export competitiveness have a higher level of agricultural export, a lower level of domestic consumption, a lower level of price index, a lower level of exchange rate to U.S. dollars, and a lower level of wage. It is also found that country clusters with a lower level of export competitiveness have a higher level of domestic consumption, a higher level of price index, and a higher level of wage. And the average level of dimensions at different clusters of emerging markets are shown in Figure A4.

Furthermore, the transition of clusters in emerging markets is analysed by a Markov Chain. The probability of one step transition across different clusters is as following:

$$P_{(transition)} = \begin{pmatrix} 12.00\% & 8.00\% & 12.00\% & 12.00\% & 12.00\% & 12.00\% & 8.00\% & 12.00\% & 12.00\% \\ 7.69\% & 19.23\% & 0.00\% & 19.23\% & 15.38\% & 11.54\% & 11.54\% & 7.69\% & 7.69\% \\ 0.00\% & 20.00\% & 13.33\% & 13.33\% & 0.00\% & 13.33\% & 13.33\% & 0.00\% & 26.67\% \\ 8.57\% & 5.71\% & 2.86\% & 14.29\% & 14.29\% & 11.43\% & 11.43\% & 11.43\% & 20.00\% \\ 32.00\% & 4.00\% & 0.00\% & 20.00\% & 20.00\% & 8.00\% & 4.00\% & 0.00\% & 12.00\% \\ 4.55\% & 9.09\% & 9.09\% & 22.73\% & 0.00\% & 13.64\% & 18.18\% & 13.64\% & 9.09\% \\ 13.64\% & 22.73\% & 4.55\% & 4.55\% & 22.73\% & 0.00\% & 18.18\% & 4.55\% & 9.09\% \\ 22.22\% & 0.00\% & 11.11\% & 11.11\% & 0.00\% & 27.78\% & 5.56\% & 16.67\% & 5.56\% \\ 7.14\% & 10.71\% & 10.71\% & 21.43\% & 10.71\% & 7.14\% & 14.29\% & 10.71\% & 7.14\% \end{pmatrix}$$

The stationary solution of the transition across different clusters in market segmentation of emerging markets is as following:

$$\delta = (12.22\% \ 10.62\% \ 6.59\% \ 15.50\% \ 11.55\% \ 11.09\% \ 11.65\% \ 8.85\% \ 11.94\%)$$

It is found that the distribution of different clusters in the stationary solution can be similar to each other. It is also found that the distribution of emerging markets with higher level of export competitiveness in agriculture at Cluster 3 can be at a lower proportion across different clusters, and the higher level of export

competitiveness of agriculture can be concentrated in emerging markets at Cluster 3. The distribution of emerging markets with lower level of export competitiveness in agriculture Cluster 4 can be a higher proportion in comparison to proportions of other clusters. The distribution of emerging markets with lower level of export competitiveness at stationary solution can be more relaxed. Furthermore, the distribution of other clusters are in similar proportions to each other.

The global managers in cross-border agriculture industry can take advantage of irrigated land area, competitive labour cost, F.D.I., and export market opportunity to further develop the export competitiveness of the agriculture industry from emerging markets. The global managers also need to be cautious on strategic decisions in expansion of agriculture in global market, and the spatial disturbances in market conditions can have a negative effect on the competitiveness of agriculture from emerging markets. It is further suggested that global managers should be adaptive to industrial conditions in competition at global market.

## 5. Conclusion

The development of economy in emerging markets has been providing an important driven power to the international trade business in the global market. The export competitiveness of agricultural is important to the enhanced international involvement of emerging markets. The relationship between export competitiveness and geographic factors that influence it can be a functional result of the system of connections between markets. The R.C.A. approach is employed to define the export competitiveness of agricultural industries in emerging markets.

This research further reveals the relationship of export competitiveness and geographic economics factors by analysing the spatial connections of country nodes in emerging markets. The Mahalanobis distance is measured to identify the closeness of country nodes in the spatial connections of emerging markets, on the basis of their export competitiveness and geographic economic factors, including wage of emerging markets, irrigated land area of emerging markets, price index of agricultural products in emerging markets, consumer demand, F.D.I., export of the agriculture industry, and exchange rate. The transformed spatial connections of countries in emerging markets are visualised in this research, based on their export competitiveness of the agriculture industry and geographic economic factors by using genetic algorithm. The data visualisation based on transformed spatial interconnections of emerging markets further reveals the segmentation of emerging markets in a two dimensional vision, based on export competitiveness and geographic economic factors. The geographic economic factors have effects on the export competitiveness of the agriculture industry, and the relationship between geographic economic factors and the export competitiveness of the agriculture industry has been revealed in the spatial connections of emerging markets.

This research finds a spatial disturbances effect of geographic economics factors on export competitiveness of the agriculture industry from emerging markets based on the diamond model framework. It also found that emerging markets with a higher level of irrigated land, a lower level of wage cost, a higher level of F.D.I., a higher level of agricultural export have a higher level of export competitiveness, by

concerning the spatial effect across the emerging markets. The findings of this research can offer support to global managers in better understanding the effect of geographic economics factors on export competitiveness of the agriculture industry from emerging markets. A higher level of irrigated land, a lower level of wage cost, a higher level of F.D.I., a higher level of agricultural exports offer emerging markets a higher level of export competitiveness in the agriculture industry.

The fuzzy cluster analysis further shows the segmentation of emerging markets. Different factors that have influence on the export of agriculture and the relationship between determinants and the export competitiveness of agricultural business have been revealed. This research finds that clusters with a higher level of export competitiveness have a higher level of agricultural export, a lower level of domestic consumption, a lower level of price index, a lower level of exchange rate to U.S. dollars, and a lower level of income. In addition, it is found that clusters with a lower level of export competitiveness have a higher level of domestic consumption, a higher level of price index, and a higher level of wage cost.

Markov Chain analysis is further performed to identify the stationary solution of transitions across clusters in emerging markets. It is found that the emerging markets with higher level of export competitiveness can be more concentrated in cluster with lower level of proportion in stationary solution. It is also found that the emerging markets with lower level of export competitiveness can be more relaxed in clusters with higher levels of proportion in stationary solutions. Emerging markets involved in other clusters are in similar distribution from each other.

This research offers support to global managers in their future decisions regarding the export competitiveness of agricultural business from emerging markets. The global managers can further take advantage of these geographic economics factors at involvement in competition of the agriculture industry from emerging markets. Also, global managers should be cautious on negative spatial disturbances effect of inter-connections of resources, and should be adaptive to different industrial conditions in making decisions based on the export competitiveness of the agriculture industry from emerging markets.

This research is focused on the export competitiveness of the agriculture industry from emerging markets. The research of competitive industries from emerging markets can be further developed in the future. Also the research of export competitiveness from both emerging markets and other country clusters can be further developed. This research studied the macro-level explanation to export competitiveness of the agriculture industry from emerging markets, and micro-level explanations can be further developed.

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## Appendix

**Table A1.** Spatial effect of geographic economics factors on export competitiveness from emerging markets.

	Model1	Model2	Model3	Model4	Model5	Model6	Model7
Export	0.00023***	0.00026***	0.00028***	0.00031***	0.00031***	0.00032***	0.00032***
Consume		-7.39e-06***	-9.28e-06***	-14.3e-06***	-23e-06***	-25e-06***	-23.7e-06***
Wage			-0.00015***	-0.00013***	-0.00014***	-0.00014***	-0.00014***
Land				24e-06***	31e-06***	35e-06***	33.2e-06***
F.D.I.					41.7e-06***	47.5e-06***	44e-06***
Exchange Price						55.3e-06	52.4e-06
lambda	-0.00075	-0.00064	-0.0005	-0.00047	-0.00041	-0.00044	-0.0004
rho	-0.00194	-0.00238	-0.00315	-0.0028	-0.0151***	-0.0148***	-0.015***
N	240	240	240	240	240	240	240

\*\*\* $P < 0.005$ .

Source: Authors' own estimations.

**Table A2.** Xie–Beni index of fuzzy cluster analysis for emerging markets in agriculture export.

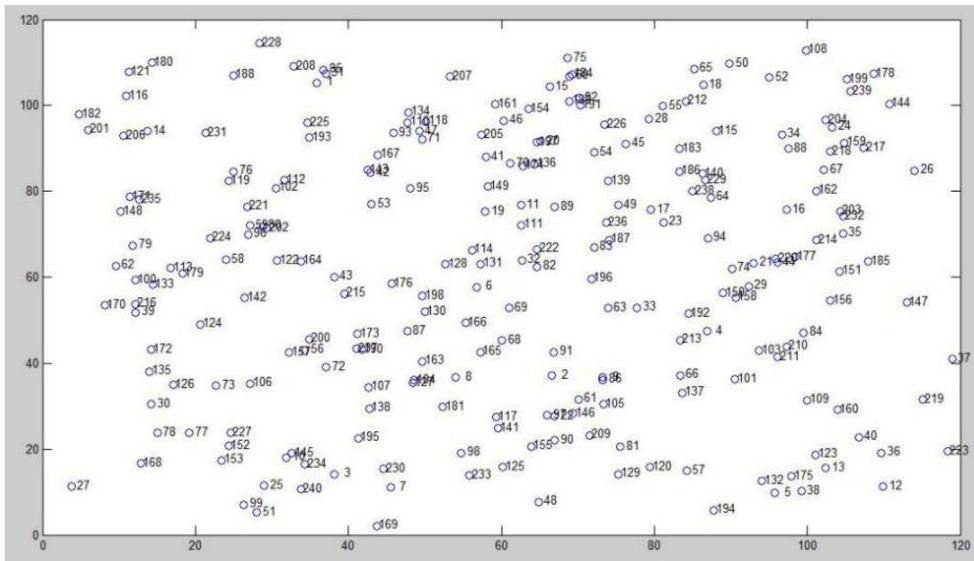
Cluster number	2	3	4	5	6	7	8
X-B Index	0.3125	0.1466	0.1141	0.1748	0.1637	0.1507	0.1043
Cluster Number	9	10	11	12	13	14	15
X-B Index	0.0972	0.1224	0.1447	0.1125	0.1117	0.1793	0.2115

Source: Authors' own estimations.

**Table A3.** Mean of export competitiveness and geographic economics factors in fuzzy cluster analysis.

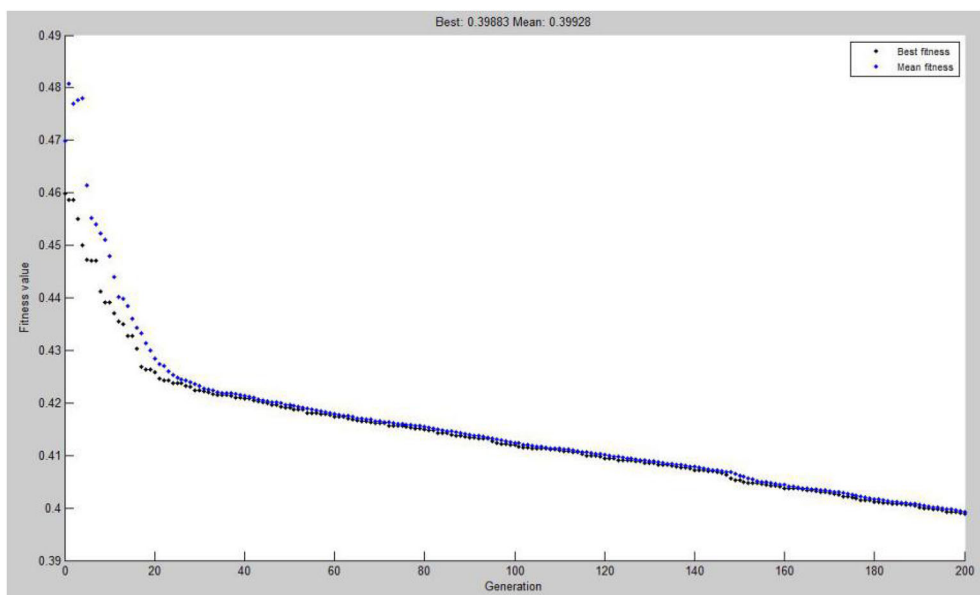
Cluster	R.C.A.	Consume	Price	Exchange	F.D.I.	Wage	Export	Land
1	1.73	64750.86	482.31	1490.02	10649.77	2577.73	1441.75	10255.23
2	2.07	50484.93	234.99	64.07	8397.95	3032.72	1482.24	10763.87
3	2.15	57386.13	195.29	1477.19	5641.18	3717.26	2165.29	7380.11
4	1.80	30546.67	163.11	414.68	5460.39	3363.97	603.89	4114.64
5	2.01	15581.82	138.39	98.19	3053.18	2566.49	229.03	2905.74
6	1.89	53723.33	311.11	240.97	6994.74	3823.84	1341.04	10296.96
7	1.79	38085.91	379.96	451.96	7167.52	3544.20	1001.06	7222.16
8	1.66	72039.39	197.34	322.36	16072.18	4478.40	1995.84	9093.77
9	1.81	33516.58	316.67	537.72	4705.95	3308.39	585.98	4218.24

Source: Authors' own estimations.

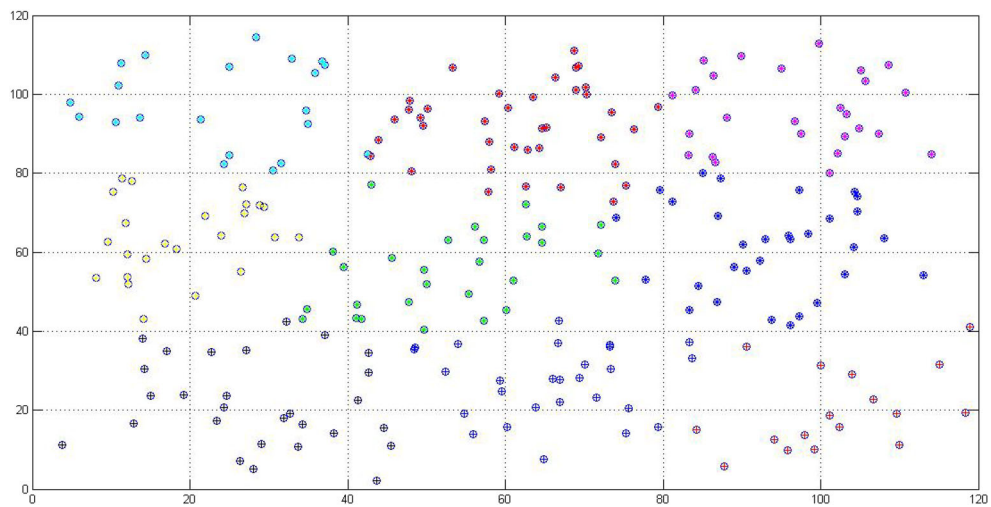


**Figure A1.** Spatial distribution of emerging markets based on interconnections by transformation of genetic algorithm. Source: Authors' own estimations.

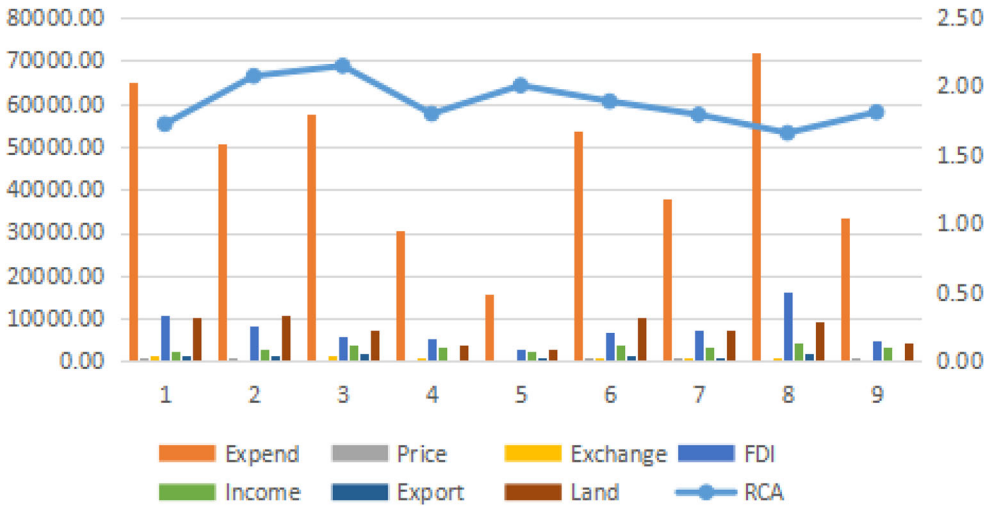




**Figure A2.** Fitness of genetic algorithm for transformation of interconnections across emerging markets. *Source:* Authors' own estimations.



**Figure A3.** Visualisation of fuzzy cluster analysis for emerging markets in export of agriculture. *Source:* Authors' own estimations.



**Figure A4.** Result of fuzzy cluster analysis for emerging markets in agriculture export. *Source:* Authors' own estimations.