Local indicators of spatial association (LISA) of Indonesian workers

Caroline[1*], FX. Sugiyanto[2], Akhmad Syakir Kurnia[3], Soni Agus Irwandi[4]

[1]*Universitas Sultan Fatah, Demak, Central Java, Indonesia*

[2,3]*Universitas Diponegoro, Semarang, Central Java, Indonesia*
[4] *Sekolah Tinggi Ilmu Ekonomi Perbanas Surabaya, East Java, Indonesia*

A R T I C L E I N F O

A B S T R A C T

The migration of Indonesian workers abroad and that of foreign workers into Indonesia made problems for the economic growth of Indonesia and ASEAN. This study attempts to analyze the patterns of spatial interaction of labor that occur in Indonesia. It used the Euclidean distance, spatial weight matrix approach to calculate the Local Indicators of Spatial Association (LISA). This study took a sample of workers in ASEAN member countries with a focus on analysis on Indonesian workers during 2004-2018. Analysis was performed using spatial panel data. The results showed that there was a change in the pattern of spatial interaction of Indonesian workers, which in 2004 had a lot of spatial interactions with workers from countries with a large workforce. However, in 2018, they interacted spatially with workers from countries with few workers. Besides, the majority of Indonesian migrants work as low-ranking workers in ASEAN countries, while the majority of foreign workers from ASEAN countries work in managerial and professional levels. This implies that the Indonesian government needs to provide technical and managerial skills, soft skills, and English for migrant workers before working abroad so that they are better able to compete with foreign workers and subsequently receive better salaries.

A B S T R A K

Migrasi keluarnya tenaga kerja Indonesia ke luar negeri, dan migrasi masuknya tenaga kerja asing ke Indonesia menjadi masalah bagi pertumbuhan ekonomi Indonesia, dan ASEAN. Penelitian ini mencoba menganalisis pola interaksi spasial tenaga kerja yang terjadi di Indonesia. Metode penelitian ini menggunakan pendekatan matriks bobot spasial euclidean distance untuk menghitung Local Indicators of Spatial Association (LISA). Penelitian ini mengambil sampel pekerja di negara anggota ASEAN dengan fokus analisisnya pada pekerja Indonesia antara tahun 2004-2018. Analisis dilakukan menggunakan data panel spasial. Hasil penelitian menunjukkan bahwa adanya perubahan pola interaksi spasial tenaga kerja Indonesia yang semula pada tahun 2004 mereka banyak berinteraksi spasial dengan pekerja dari negara yang tenaga kerjanya banyak, namun di 2018 mereka banyak berinteraksi spasial dengan pekerja dari negara yang tenaga kerjanya sedikit. Selain itu, mayoritas migran Indonesia bekerja sebagai pekerja rendahan di negara ASEAN, sementara pekerja asing dari negara ASEAN mayoritas bekerja tingkat manajerial dan tenaga profesional. Hal ini menyiratkan bahwa pemerintah Indonesia perlu membekali keterampilan teknis dan manajerial, soft skill, dan bahasa Inggris bagi pekerja migran sebelum bekerja ke luar negeri agar mereka lebih mampu bersaing dengan pekerja asing dan selanjutnya memperoleh gaji yang lebih tinggi.

1. INTRODUCTION

The abundance of human capital departs from endogenous growth theory reasoning, which focuses on the influence of human capital on economic growth. Endogenous economic growth theory develops exogenous growth theories were only physical capital and capital influence economic growth. Several results of the study on

* Corresponding author, email address: [1]carolinehamboro@gmail.com

human capital spillover and human capital externalities related to economic growth have been studied by several researchers since several years ago (Castro Laszlo and Laszlo 2002; Feser 2003; Lucas Jr 1988; Romer 1990). They discussed the role of human capital by including human capital in the form of physical capital and uneducated labor. Human capital is defined as something related to the knowledge or characteristics of workers owned (whether innate or acquired) by workers (Lucas Jr 1988). Worker's knowledge or characteristics contribute to productivity (Raspe and Van Oort 2006). An externality effect from high growth economies occurred in an area that invests in the accumulation of human capital (Cabrales 2011; Mathur 1999). Thus, substantial investment in human capital accumulation will increase economic growth (Blundell, Dearden, Meghir, and Sianesi 1999; Wolff 2000).

Similar research on the externalities of human capital examines the external impact of education on land prices and wages. Moretti (2004) states that companies located in cities with growth in college graduates will increase productivity more quickly, compared to similar companies located in cities with slower college graduates. Estimates of differences in productivity between cities with high human capital and cities with low human capital occur because of differences in wages in the two cities. In this case, the manufacturing company will gain more profit if the existence of human capital is closer to it, both geographically and economically.

Caroline, Kurnia, and Firmansyah (2018) study the impact of human capital using the Euclidean Distance measurement method. They show that the pattern of Indonesian human capital spatial interaction converges to low-low (LL) area by 44.11 percent of the total sample located in LL areas namely North Kalimantan, Maluku, East Nusa Tenggara, Papua, West Papua, Riau, West Sulawesi, Central Sulawesi, Southeast Sulawesi, North Sumatra, West Sumatra, Gorontalo, East Kalimantan, North Sulawesi, North Maluku, the remaining 29.41 percent of the total sample was in the low-high (LH) area 20.58 percent of the total sample was in the high-high (HH) area, and 5.88 percent are in the high-low (HL) area. Caroline, Sugiyanto, Kurnia, and Firmansyah (2017) show that LISA's GDP per Capita 2015 distribution pattern, which is mostly 60 percent of the total sample, is clustered to LH areas: Malaysia, Cambodia, Vietnam, Myanmar, Thailand, Philippines. LISA Capital 2015 distribution pattern where part of LISA Capita 50% of all samples

clustered to LL: Brunei Darussalam, Cambodia, Lao People's Democratic Republic, and Vietnam. LISA MYS 2015 distribution patterns where some of LISA Capital's 50% distribution patterns from all samples cluster to LL areas: Singapore, Cambodia, Malaysia, Myanmar, and Vietnam. The distribution pattern of labor 2015 is mostly 70% of the total sample clustered to LL areas: Singapore, Brunei Darussalam, Cambodia, Malaysia, Myanmar and Vietnam, and Lao People's Democratic Republic.

The liberalization of labor flows reflected by labor migration is essential in integration in the ASEAN region, so research on the patterns of labor migration of 10 ASEAN countries needs to be conducted. Labor migration is a social phenomenon that occurs in the ASEAN region. Economic reasons that encourage workers to migrate into a country are the level of wages and income earned is higher than in the country of origin, while non-economic reasons that encourage workers to migrate into a country are the number of population, the amount of unemployment, the information easily obtained because of the sophistication of technology, adequate and easily accessible transportation facilities, the level of education in accordance with the criteria required by the destination country.

The entry into force of the AEC has both a beneficial and adverse effect. MEA has several advantages: (i) encourage increased exports and imports with the existence of a tariff-free and barrier-free system. Increased exports will increase Indonesia's competitiveness in the ASEAN market. Domestic needs will be easier to obtain from the entry of goods from abroad. (ii) AEC encourages the growth of foreign investment that can strengthen domestic capital resilience. Increased foreign investment means it will increase the likelihood of foreign investors exploiting domestic natural resources. (iii) there is an expansion of goods and services among ASEAN member countries. (iv) the opening of workforce fields. AEC also has adverse impacts, namely: (i) the entry of ASEAN products and services, (ii) the competitiveness of the quality of human capital of local workers with foreign workers.

The main objective of this study is to analyze the Local Indicators of Spatial Association (LISA) of Indonesian Workers on Indonesia's Economic Growth, especially labor migration into Indonesia and labor migration out of Indonesia. This study also examines the employment structure of Indonesian migrants in other ASEAN countries.

2. THEORETICAL FRAMEWORK AND HYPOTHESES

The framework of this study is the development of the economic growth model of Solow (1956), Mankiw, Romer, and Weil (1992) and Knowles and Owen (1995). They took into account the role of educated labor and the role of uneducated labor in its economic growth model (Moretti 2004). All these descriptions can be shown in Figure 1.
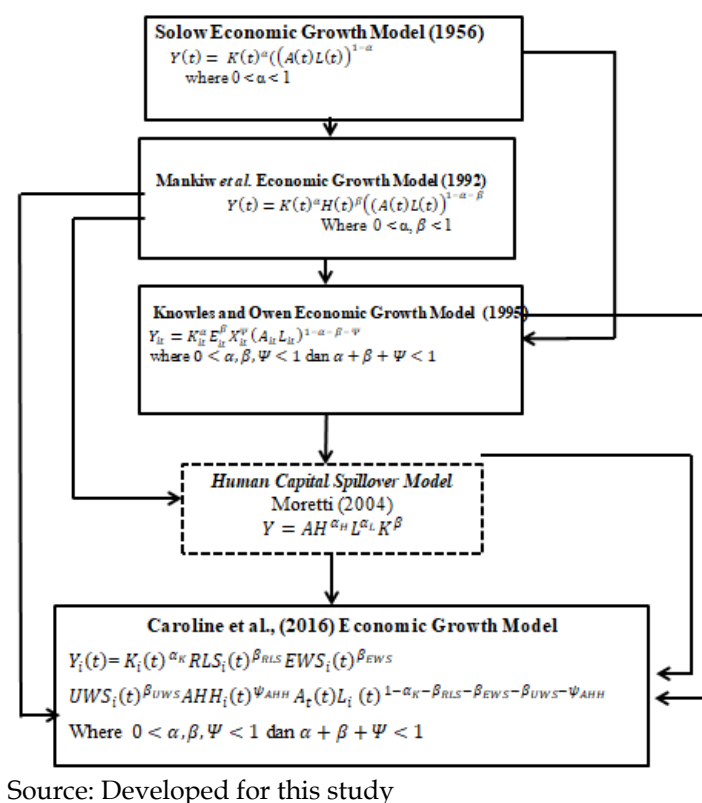

Solow Economic Growth Model (1956)
$$Y(t) = K(t)^{\alpha}\left((A(t)L(t)\right)^{1-\alpha}$$
where $0 < \alpha < 1$

Mankiw *et al.* Economic Growth Model (1992)
$$Y(t) = K(t)^{\alpha}H(t)^{\beta}\left((A(t)L(t)\right)^{1-\alpha-\beta}$$
Where $0 < \alpha, \beta < 1$

Knowles and Owen Economic Growth Model (1995)
$$Y_{it} = K_{it}^{\alpha}E_{it}^{\beta}X_{it}^{\Psi}(A_{it}L_{it})^{1-\alpha-\beta-\Psi}$$
where $0 < \alpha, \beta, \Psi < 1$ dan $\alpha + \beta + \Psi < 1$

Human Capital Spillover Model Moretti (2004)
$$Y = AH^{\alpha_H}L^{\alpha_L}K^{\beta}$$

Caroline et al., (2016) Economic Growth Model
$$Y_i(t) = K_i(t)^{\alpha_K}RLS_i(t)^{\beta_{RLS}}EWS_i(t)^{\beta_{EWS}}$$
$$UWS_i(t)^{\beta_{UWS}}AHH_i(t)^{\Psi_{AHH}}A_t(t)L_i(t)^{1-\alpha_K-\beta_{RLS}-\beta_{EWS}-\beta_{UWS}-\Psi_{AHH}}$$
Where $0 < \alpha, \beta, \Psi < 1$ dan $\alpha + \beta + \Psi < 1$

Source: Developed for this study

Figure 1
Conceptual Framework

3. RESEARCH METHOD

This research was conducted from 2004 to 2018 or 15 years. The choice of the time period is made by considering the limitations of the data used in the study. The sample of this study includes ASEAN member countries: Indonesia, Malaysia, the Philippines, Thailand, Singapore, Brunei Darussalam, Vietnam, Laos, Myanmar, and Cambodia. Description of the variables used per capita GDP, capital stock, and labor. The research data description can be seen in Table 1.

Table 1
Reseach Data Description

No.	Variables	Indicators	Units	Sources
1.	Economic Growth of ASEAN Member Countries	GDP per capita	US$	*World Bank*
2.	Stock of capital	Domestic Fixed Capital Formation (PMTB)	US$	*World Bank*
3.	Labor	Population aged 15 years and over who worked during the past week according to the highest education completed (not/not yet in university school) in the country	Orang	*World Bank*

Sources: world Bank (2019)

Local Indicators of Spatial Association (LISA)

Local spatial statistics are often referred to as Local Indicators of Spatial Association (LISA) or Local Moran I statistics, which are techniques for providing visual graphics about spatial grouping such as Moran's Scatterplot (Fotheringham, Brunsdon, and Charlton 2000; Haining and Haining 2003). Local spatial autocorrelation indicates individual contributions to global spatial autocorrelation. Local spatial autocorrelation is a value that is observed i positive (has in common) or negative (different) with neighbor observation, j. The Moran Index is between $-1 \leq |I| \leq 1$. This study adopted the Local Moran I statistics from Anselin (1995). The research period is from 2004 to 2018.

The Moran's-I-statistic model of spatial autocorrelation is locally written,

$$I_i = \frac{x_i - \bar{X}}{s_i^2} \sum_{j=1, j \neq i}^{n} w_{ij}(x_j - \bar{X})$$

Where :

$$S_i^2 = \frac{\sum_{j=1, j \neq i}^{n} w_{ij}(x_j - \bar{x})^2}{n-1}$$

$$Z_{I_i} = \frac{I_i - E[I_i]}{\sqrt{V[I_i]}}$$

$$E_{I_i} = -\frac{\sum_{j=1, j \neq i}^{n} w_{ij}}{n-1}$$

$$E[I^2] = A - B$$

$$A = \frac{n - b_{2i} \sum_{j=1, j \neq i}^{n} w_{i,j}^2}{n-1} b_{2i}$$

$$B = \frac{(b_{2i} - n) \sum_{k=1, k \neq i}^{n} \sum_{h=1, h \neq i}^{n} w_{i,k} w_{i,h}}{(n-1)(n-1)}$$

$$b_{2i} = \frac{\sum_{i=1, i \neq j}^{n} (x_i - X)^4}{\left(\sum_{i=1, i \neq j}^{n} (x_i - \bar{X})^2\right)^2}$$

$$V_{I_i} = E[I_i^2 - E[I_i]^2]$$

Information :

I_i is Local Moran's-I-statistics

N   is 10 ASEAN Member Countries (Indonesia, Malaysia, Philippines, Thailand, Singapore, Brunei Darussalam, Vietnam, Laos, Myanmar, and Cambodia);

$\bar{x}$ is the average value of x; x is the observed variable;

w_{ij} is an element of the spatial weight matrix that links observations of state i (the observed state) with its neighboring state, j using the Euclidean distance approach based on the coordinate point x and the coordinate point of a country.

The Moran Scatter Plot

The Local Moran's Index can also be represented in the form of The Moran Scatter Plot. This study adopts the concept of The Moran Scatter Plot from Dubé and Legros (2014) and Anselin (1995). The Moran Scatter Plot is divided into four quadrants, namely The High-High (HH) Quadrant, The High-Low (HL) quadrant, The Low-High (LH) quadrant, The Low-Low (LL) quadrant. Determination of the quadrant position in The Moran Scatter Plot based on the value of the variable in the observed state x_i^*; and the value of the variable in the neighboring country x_j^*. Figure 2 shows the Moran Scatter Plot.

where $x_i^* = x_i - \bar{x}$ $x_j = \sum_{j=1}^{N} w_{ij} x_j$; $x_j^* = x_j - \bar{x}$:
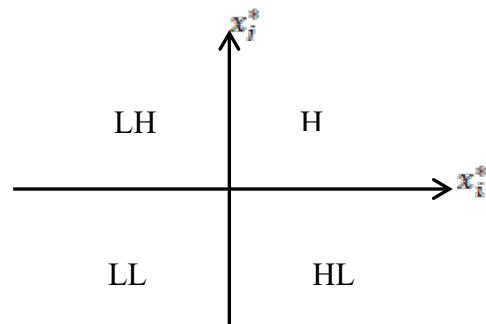
Sources: Fothering *et al.*, (2000), Haining (2003), Dube dan Legros (2014)

Figure 2
The Moran Scatter Plot

The High-High (HH) quadrant shows countries with high x values appear to be surrounded by other countries with high x values as well. The High-Low (HL) quadrant shows countries with high x values appear to be surrounded by other countries with low x values. The Low-High (LH) quadrant shows countries with low x values appear to be surrounded by other countries with high x values. The Low-Low (LL) quadrant shows countries with low x values appear to be surrounded by other countries with low x values as well.

4. DATA ANALYSIS AND DISCUSSION
Spatial Weight Matrix with Euclidean Distance Approach

Spatial weight matrix with Euclidean distance approach is the way to see the distance between one province and the others in Indonesia, By using this approach, the researchers can obtain the spatial weight matrix or spatial balancing (W) that is by using the information of coordinate point X (latitude) and coordinate point Y (longitude) from the neighborhood. The use of Euclidean Distance has some reasons such as: First, Indonesia and others are not only limited by the land only but also other countries that are limited by waters or sea. Second, the use of a spatial weight matrix through Euclidean Distance is expected to make the calculation easier.

This study was designed with the model of spatial autocorrelation method through Global Moran's I and Local Moran's I. The calculation of Global Moran's I and Local Moran's I was done using Euclidean Distance approach based on the coordinate point X and coordinate point Y of the countries. The units of Euclidean Distance were for 1 Euclidean Distance = 15,91 mills. The calculation of Euclidean Distance was done using GeoDa version 16.8. The spatial weight matrix of Indonesia can be seen in Table 1.

with the dependent variables represented by GDP per capita. Independent variables of capital. Other represented human capital in the form of labor in the form of internal and external ASEAN labor migration.

Economic Growth

Economic growth is represented by GDP per capita. Before calculating LISA, it will first calculate the spatial weight matrix of GDP per Capita of ASEAN member countries. The calculation of the spatial weight matrix in this study uses the Euclidean Distance approach with GeoDa September 2018 version. The results of the calculation of the spatial weight matrix using the Euclidean Distance approach are shown in Table 3. Brunei Darussalam's spatial weight matrices of economic growth in 2004 and 2018 are $z = 1.70$ and $Wz = 0.01$; $z = 1.08$ and $Wz = 0.11$.

The spatial weights matrices of Singapore's economic growth in 2004 and 2018 are $z = 2.03$ and $Wz = 0.05$; and $z = 2.45$ and $Wz = -0.09$. The spatial weight matrices of Indonesia's economic growth in 2004 and 2018 are $z = -0.47$ and $Wz = -0.52$; $z = -0.44$ and $Wz = -0.51$. The spatial weight matrices of Laos' economic growth in 2004 and 2018 $z = -0.59$ and $Wz = -0.49$; $z = -0.58$ and $Wz = -0.47$.

Table 2
Spatial Weight Matrix
with the Euclidean Distance Approach

No	Countries	Coordinate Point x	Coordinate Point y
1.	Brunei Darussalam	14.600	4.770
2.	Indonesia	122.870	10.990
3.	Cambodia	102.890	9.920
4.	Thailand	100.890	6.420
5.	Singapore	103.740	1.170
6.	Philippiness	119.470	4.590
7.	Malaysia	103.420	1.320
8.	Myanmar	97.800	8.820
9.	Lao PDR	103.77	18.49
10.	Viet Nam	106.14	8.61

Source: Output GeoDa (2019)

Local Indicators of Spatial Association (LISA) is a Local Moran's I analysis. This study uses LISA

Table 3
Spatial Weights Matrix of Economic Growth
with the Euclidean Distance Approach

	Countries	2004		2018	
		z	Wz	z	Wz
1	Brunei Darussalam	1.700	0.010	1.080	0.110
2	Indonesia	-0.470	-0.520	-0.440	-0.510
3	Cambodia	-0.600	0.520	-0.610	0.460
4	Thailand	-0.350	0.400	-0.320	0.290
5	Singapore	2.030	0.050	2.450	-0.090
6	Philippiness	-0.520	0.210	-0.510	0.280
7	Malaysia	-0.100	0.090	-0.010	0.050
8	Myanmar	-0.500	0.050	-0.450	0.160
9	Lao PDR	-0.590	-0.490	-0.580	-0.470
10	Viet Nam	-0.570	0.130	-0.570	0.110

Source: World Bank data that has been processed with the September 2018 version of GeoDa

Moran scatters plot is a tool used to see the relationship between standardized observations and standardized values of neighbors. Besides, Moran scatter plot can also be used to identify the balance and spatial influence (Anselin 1995). The Moran scatter plot shown in Figure 3 shows that economic growth in 2004 from Indonesia is located in Quadrant III. LL (Low-Low), showing that countries with low economic growth characteristics interact spatially with countries with low economic growth.

Moran scatterplot (Moran's I = 0.023)
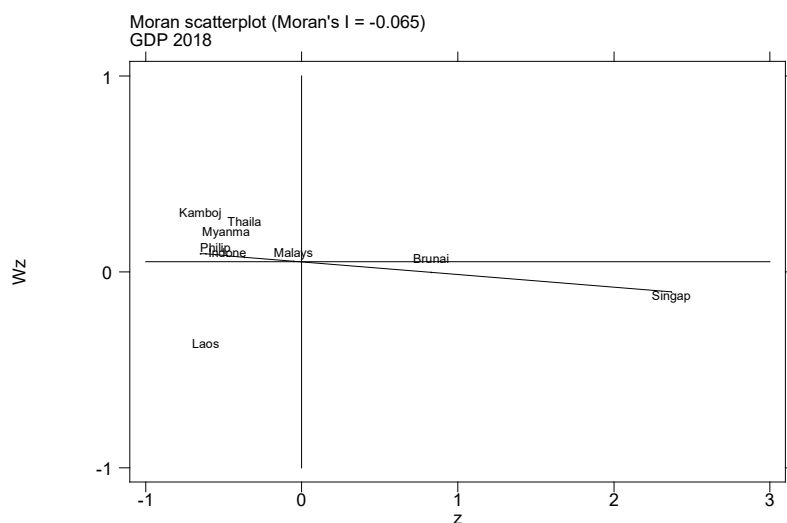GDP 2004
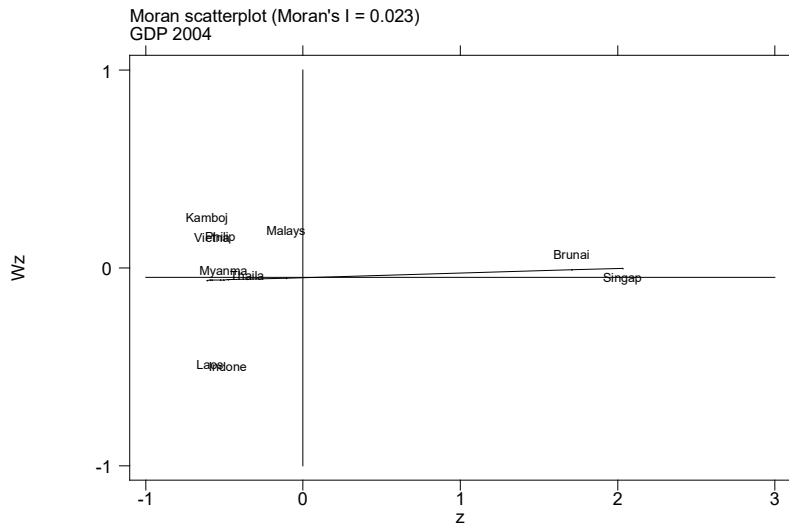
Source: Output Stata 13

Figure 3
The Moran Scatter Plot of Indonesia's Economic Growth 2004

Description:

z is the country's GDP per capita 2004

Wz is a 2004 spatial weighting matrix per capita of neighboring countries using the Euclidean distance approach.

Figure 4 identifies the spatial interaction patterns of Indonesia's economic growth in 2018 fixed in the position of Quadrant II, LL (Low-High). It shows that Indonesia, as a country with low economic growth characteristics, interacts spatially with countries with high economic growth.

Moran scatterplot (Moran's I = -0.065)
GDP 2018

Source: Output Stata 13

Figure 4
The Moran Scatter Plot of Indonesia's Economic Growth 2018

Description:

z is the country's GDP per capita 2018

Wz is a 2018 spatial weighting matrix per capita of neighboring countries using the Euclidean distance approach.

Table 4
Spatial Interaction Patterns of Economic Growth

		GDP 2004				GDP 2018	
HH	LH	LL	HL	HH	LH	LL	HL
-	Malaysia	Indonesia	Brunei Darussalam	Brunei Darussalam	Malaysia	Laos	Singapore
-	Thailand	Lao PDR	Singapore		Indonesia Thailand		
	Philippines Myanmar Vietnam				Philippiness Cambodian Vietnam		

Source: Processed data with Stata 13

Table 4 shows that there was a change in the pattern of spatial interactions of Indonesia's economic growth. At the beginning of 2004, Indonesia, with low economic growth characteristics interacted spatially with low economic growth countries. This is allegedly due to multilateral cooperation between Indonesia and other ASEAN member countries. Indonesia organized and supported the event to provide support for the 52nd year ASEAN Research and Development (ASEAN Science and Technology) Research and Development activities from 1 April 2018 to 3 April 2018 at the Center for Science and Technology Research, Serpong, South Tangerang attended by 22 delegates from 8 ASEAN countries such as Cambodia; Laos; Malaysia; Myanmar; the Philippines; Thailand and Vietnam.

Another thing is allegedly due to the realization of the form of economic cooperation in the ASEAN region with its trading partner countries, namely China, Japan, South Korea, India, Australia, and New Zealand, known as the Regional Comprehensive Economic Partnership (RCEP) in force since 2011. This evidenced by the export of Indonesia's Leading Manufacturing to the Regional Comprehensive Economic Partnership (RCEP).

According to the Ministry of Trade (2015), there is an excellent potential and resources in the unification of 15 RCEP member countries, both in terms of a total population reaching 3.4 billion (approximately 48% of the total world population), as well as total GDP in the range of USD 20 trillion. (40% of total world GDP), and total trade of USD 10.1 trillion (28% of world trade). Therefore, the

potential for RCEP cooperation is expected to provide greater benefits for the Indonesian economy compared to previous collaborations.

Capital

The Spatial Weight Matrix with the Euclidean Distance approach is identified in Table 5. where, among others, the Indonesia's spatial weight matrices in 2004 and 2018 are z = 2.50 and Wz = 0.14; z = 2.63 and Wz = 0.07. Brunei Darussalam's spatial weight matrices in 2004 and 2018 are z = -0.76 and Wz = -0.03; z = -0.68 and Wz = -0.08. Cambodia's spatial weight matrices in 2004 and 2018 are z = -0.77 and Wz = -0.30, z = -0.68 and Wz = -0.31. Vietnam's spatial weight matrices in 2004 and 2018 are z = -0.35 and Wz = -0.27; z = -0.24 and Wz = -0.29. Laos's spatial weight matrices in 2004 and 2018 are z = -0.76 and Wz = -0.18; z = -0.69 and Wz = -0.30.

Table 5
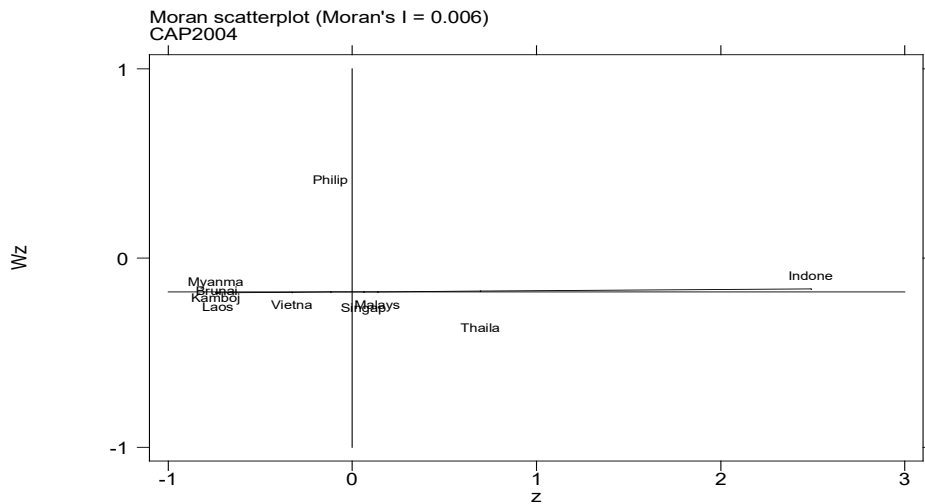**Capital Spatial Weight Matrix with Euclidean Distance Approach**

	Countries	2004		2018	
		z	Wz	z	Wz
1	Brunei Darussalam	-0.760	-0.030	-0.680	-0.080
2	Indonesia	2.500	0.140	2.630	0.070
3	Cambodia	-0.770	-0.300	-0.680	-0.310
4	Thailand	0.680	-0.500	0.250	-0.450
5	Singapore	0.040	-0.430	0.020	-0.460
6	Philippines	-0.140	0.900	-0.070	1.010
7	Malaysia	0.110	-0.440	0.170	-0.470

8	Myanmar	0.550	-0.250	-0.690	-0.220
9	Lao PDR	-0.760	-0.180	-0.690	-0.300
10	Viet Nam	-0.350	-0.270	-0.240	-0.290

Source: Processed data with Stata 13

Figure 5 shows the Moran scatter plot of Capital 2004 Indonesia in the position of Quadrant I, HH (High-High), showing an Indonesian country with high capital characteristics interacting spatially with countries with high capital.
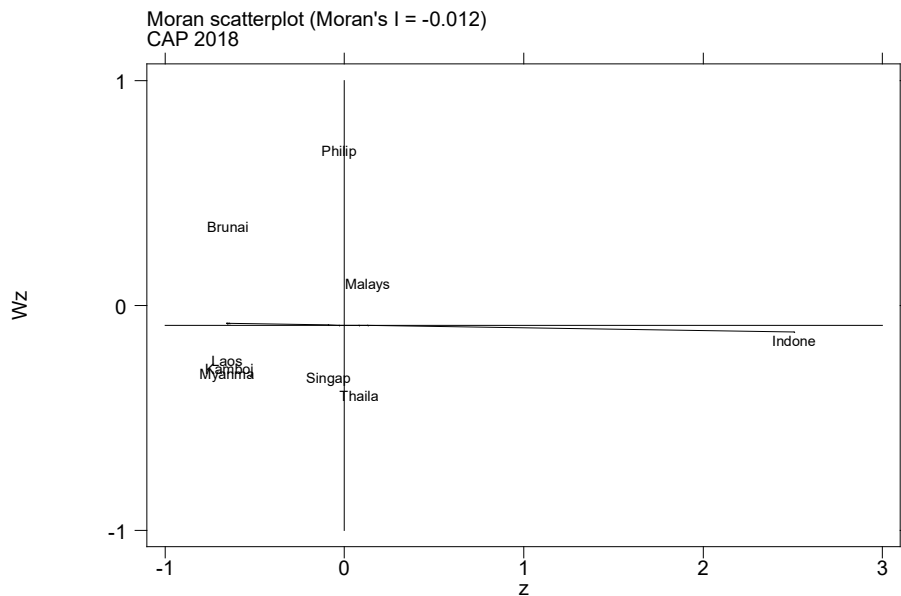

Source: Output Stata 13

Figure 5
The Moran Scatter Plot Capital Indonesia 2004

Description:

z is capital 2004

Wz is a spatial weight matrix of neighboring capital with the Euclidean distance approach

Figure 6 shows the Moran Scatter Capital of Indonesia in 2018 in the position of Quadrant I, HL (High-Low). It shows that Indonesia, as a country with high capital characteristics, interacts spatially with countries with low capital.

Source: Output Stata 13

Figure 6
The Moran Scatter Plot Capital Indonesia 2018

184

Description :

z is capital 2018

Wz is a spatial weight matrix of neighboring capital with the Euclidean distance approach

Table 7 shows that there is a change in the pattern of capital spatial interactions. Originally in 2004, Indonesia, with high capital characteristics, interacted with countries with high capital characteristics, but it appears in 2018 that Indonesia with high capital characteristics has spatial integration with countries with low capital characteristics. This is allegedly due to an increase in exports of goods and services from Indonesia to countries in the ASEAN Region, which are increasing.

Table 7
Capital Spatial Interaction Patterns

Capital 2004				Capital 2018			
HH	**LH**	**LL**	**HL**	**HH**	**LH**	**LL**	**HL**
Indonesia	Brunai Darussalam	Kamboja	Thailand	Malaysia	Brunai Darussalam	Kamboja	Indonesia
Malaysia	Philippines	Lao PDR	Singapore		Philipina	Lao PDR	Thailand
		Myanmar				Myanmar	Singapore
		Viet Nam				Viet Nam	

Source: Processed data with Stata 13

Labor

Table 8 identifies the spatial weight matrix of labor with the Euclidean Distance approach where the spatial weight matrix of Indonesian labor in 2004 and 2018 is z = 0.39 and Wz = 0.22; z = 2.70 and Wz = -0.32.

Table 8
Capital Spatial Weight Matrix with Euclidean Distance Approach

	Countries	2004		2018	
		z	**Wz**	**z**	**Wz**
1	Brunei Darussalam	-0.530	-0.320	-0.460	-0.190
2	Indonesia	0.390	0.220	2.700	-0.320
3	Cambodia	-0.480	-0.190	-0.420	-0.340
4	Thailand	2.730	-0.450	0.580	-0.430
5	Singapore	-0.510	-0.700	-0.450	-0.270
6	Philippines	0.220	0.050	-0.330	1.000
7	Malaysia	-0.440	-0.050	-0.410	-0.820
8	Myanmar	-0.300	-0.200	-0.360	-0.360
9	Lao PDR	-0.500	0.590	-0.440	0.110
10	Viet Nam	0.130	-0.100	-0.430	-0.300

Source: Processed data with Stata 13

Figure 7 shows the Moran scatter plot of Indonesian labor in 2004, which is in the position of Quadrant I, HH (High-High). It shows that a country with a characteristic of a large workforce interacts spatially with countries with a similar number of workforce. The countries in quadrant I are Indonesia and the Philippines.

Moran scatterplot (Moran's I = 0.108)
LAB 2004
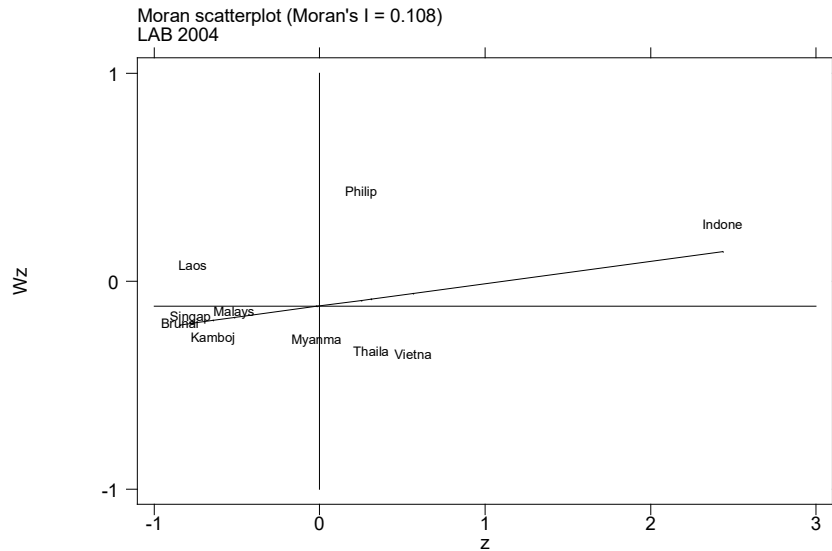
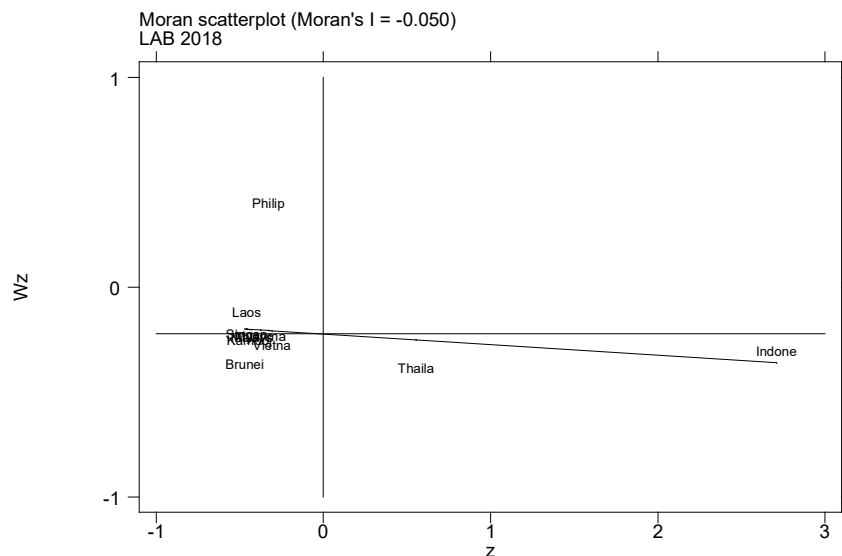Source: Output Stata 13

Figure 7
The Moran Scatter Plot Labor Indonesia 2004

Description:

z is labor 2004

Wz is a spatial weight matrix of neighboring labor with the Euclidean distance approach

Figure 8. shows the Moran scatter plot of Indonesian labor in 2018 is in the position of Quadrant IV, HL (High - Low) shows a country with a characteristic number of workers who interact spatially with countries with a small workforce. The countries listed in quadrant IV are Indonesia and Thailand.

Moran scatterplot (Moran's I = -0.050)
LAB 2018

Source: Output Stata 13

Figure 8
The Moran Scatter Plot Labor Indonesia 2018

Description :

z is labor 2018

Wz is a spatial weight matrix of neighboring labor with the Euclidean distance approach

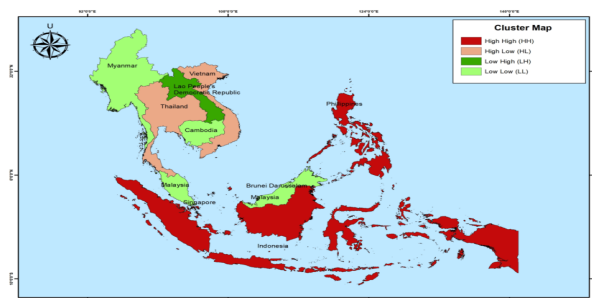Table 9 shows that there was a change in the pattern of spatial interaction of Indonesian workers between 2004 and 2018. It appears that Indonesia, with a characteristic of a large workforce, had much spatial interaction with countries having a similar workforce in 2014. This condition has changed in 2018, where Indonesia, as a country with a large workforce, interacts with a country that has few workers, namely Thailand.

Table 9
Distribution Patterns of Labor LISA 2004 and 2018

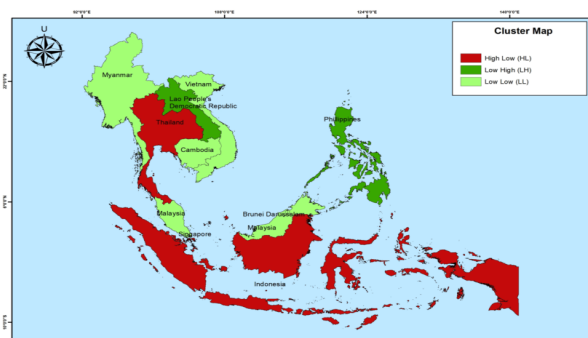| 2004				2018			
HH	**LH**	**LL**	**HL**	**HH**	**LH**	**LL**	**HL**
Indonesia	Lao PDR	Singapore	Thailand	-	Philippines	Singapore	Indonesia
Philippines		Malaysia	Viet Nam		Lao PDR	Malaysia	Thailand
		Brunei Darussalam				Brunei Darussalam	
		Cambodia				Cambodia	
		Myanmar				Myanmar	
						Viet Nam	

Source: Processed data with Stata 13

Changes in the pattern of spatial interaction of Indonesian workers between 2004 and 2018 are shown in Figure 9 and Figure 10. Figure 9 shows that Indonesia, with a hot spot region, namely Indonesia, with the characteristics of its workforce, has much spatial interaction with countries with a large workforce in 2004. The hot spots areas appear on the red LISA workforce map. In 2018, however, Indonesia, with a high labor force, has much spatial interaction with a country that has a low labor force, namely Thailand.

Source: Processed data with Stata 13

Figure 10
Map of LISA Labor Cluster 2018

Change in Spatial Interaction Patterns of Indonesian Workers, 2004 versus 2018

There was a change in the pattern of interaction of Indonesian workers between 2004 and 2018. In 2014, Indonesian workers who were a country with a large number of migrant workers interacted with workers who came from countries with large workers as well, namely the Philippines. This is different from the conditions in 2018, where Indonesian workers interact more with workers from Thailand who have small migrant workers. This study uses labor migration to represent Indonesian workers who work abroad. In the case of Indonesia, changes in the pattern of spatial interaction of Indonesian workers

Source: Processed data with Stata 13

Figure 9
Map of LISA Labor Cluster 2004

are due to labor migration into Indonesia, and labor leaving Indonesia both internally and externally to other ASEAN countries.

Table 10
Indonesian Migrant Workers to ASEAN Countries, 2004 and 2017

2004		2017	
Destination Countries		**Destination Countries**	
Malaysia	127,175	Malaysia	79,801
	92.40%		*94.49%*
Brunei Darussalam	6,503	Singapura	1,433
	4.72%		*1.70%*
Singapura	3,966	Myanmar	283
	2.88%		*0.34%*
Total	**137,644**	Thailand	326
			0.39%
		Philippines	2.003
			2.37%
		Viet Nam	605
			0.72%
		Total	**84,451**

Source: ILMS Database in ASEAN 2016, dan ILMS 2017, processed by authors
Note: The International Labor Migration Statistics = ILMS

Table 11 shows that there is a change in the pattern of spatial interaction of Indonesian migrant workers in the ASEAN region. In 2004, the Indonesian migrant workers the ASEAN countries such as Malaysia, Brunei Darussalam, and Singapore were 137,644 workers. In 2017, however, they migrated to six ASEAN countries, namely Malaysia, Singapore, Myanmar, Thailand, Philippines, and Vietnam, with a total of 84,451 workers. The number of Indonesian migrant workers migrating within the ASEAN region in 2017 is less than that of 2004.

Table 11
Indonesian Migrant Workers to ASEAN Countries by Education, 2004 and 2017

Education	2004	2017
Basic	138,821	100,708
Intermediate	269,561	155,730
Advanced	21,490	5,382
Total	**429,872**	**261,820**

Source: ILMS Database in ASEAN 2016, and ILMS 2017, processed by authors

Table 11 shows that there was a decrease in the number of migrant workers to ASEAN countries between 2004 and 2017, which decreased from 429,872 to 261,820 workers. Most of the Indonesian migrant workers to ASEAN countries have intermediate education (Junior and Senior High School).

Table 13 shows that most of the Indonesian migrants worked in the non-ASEAN Region in 2017. They mostly worked in India, namely 34.51% or 14,383 workers, followed by those who worked in Germany, namely 16.34% or 6,809 workers.

Table 12
Indonesian Migrant Workers to Non-ASEAN Countries in 2017

2017	
Destination Countries	
Australia	1,823
	4.37%
Bangladesh	6,672
	16.01%
Canada	768
	1.84%
Colombia	4,160
	9.98%
France	5,445
	13.06%
Germany	6,809
	16.34%
Hongkhong, China	1,619
	3.88%
India	14,383
	34.51%
Total	**41,679**

Sources: ILMS Database in ASEAN 2017, processed by authors

Table 14 shows the composition of Indonesian migrants by occupation. They generally worked in Elementary occupation, 327,720 workers in 2004, and 183,695 workers in 2017. The Indonesian workers came out with a position as Skilled agricultural, forestry & fishery increased from 2,689 in 2004 to 32,535 in 2017. Most Indonesian migrant workers work in areas that do not require high enough skills, namely elementary occupations (70.16 percent in 2017. This table also reveals a decrease in the number of migrants working as managers and professionals.

Table 14
Indonesian Workers Exit by Status 2004, and 2017 (Workers)

Occupation	**2004**	**2017**
Managers	3,860	157
Professionals	6,532	2,741
Technicians & associated professionals	3,674	1,615
Clerical support workers	3,910	1,534
Service & sales workers	30,095	2,364
Skilled agricultural, forestry & fishery	2,689	32,535
Craft & related trades workers	30,095	2,604
Plant & machine operators, & assemblers	63,986	34,575
Elementary occupations	327,720	183,695
Total	**472,561**	**261,820**

Sources: ILMS Database in ASEAN 2016, and ILMS Database in ASEAN 2017

Table 15 shows that migrant workers from ASEAN countries to Indonesia increased; namely, there were 12,635 workers in 2009 and became 128,642 in 2017. The migrant workers to Indonesia mainly came from Malaysia (60.79%) and Singapore (17.47%). While workers from Thailand who have close spatial relations with Indonesia are only 0.25 percent. Table 16 shows that migrants from other ASEAN countries working in Indonesia in 2017 were mostly professional workers, at 66.83 percent (85,974/128,642). The composition of these workers is 42,006 Technicians & associated professionals, 23,869 professionals, and 20,009 managers.

Table 14
Labor Migration Enters Indonesia Through Internal ASEAN 2009, and 2017 (Workers)

2009		**2017**	
Country of origin		**Country of origin**	
Malaysia	4,372	Malaysia	78,207
	34.60%		*60.79%*
Thailand	3,595	Singapore	22,473
	28.45%		*17.47%*
Filipina	2,628	Brunei Darussalam	8,511
	20.80%		*6.62%*
Singapore	1,740	Thailand	326
	13.77%		*0.25%*
Myanmar	166	Vietnam	197
	1.31%		*0.15%*
Viet Nam	118		
	0.93%		
Brunei Darussalam	9		
	0.07%		
Cambodia	5		
	0.04%		
Lao PDR	2		
	0.02%		
Total	**12,635**	**Total**	**128,642**

Source: ILMS Database in ASEAN 2016, and ILMS 2017

Table 15
Labor Migration into Indonesia Based on Status, 2017 (Worker)

	2017
Managers	20,099
Professionals	23,869
Technicians & associated professionals	42,006
Total	**85,974**

Source: ILMS Database in ASEAN 2017

Comparing Table 14 and Table 16, we can conclude that Indonesian migrant workers in other ASEAN countries work a lot in sectors with low skill requirements, such as construction workers and domestic helpers, while many foreign workers in Indonesia work as professionals and managers. This implies the need for Indonesian government policy to better equip technical and managerial skills through various professional certification programs for migrant workers before working abroad. Improving technical and managerial skills will be able to increase the salary of these workers (Li and Li 2007; Wang 2008). The training program for migrant workers also needs to include interpersonal skills and confidence (Williams and Baláž 2005). The government also needs to equip these workers with English-language communication skills, which are an absolute necessity for working abroad (Erling, Seargeant, Solly, Chowdhury, and Rahman 2015).

On the other hand, the Indonesian government needs to implement professional certification requirements for foreign workers working in Indonesia. In practice, foreign workers may occupy managerial or professional positions when, in fact, they do not have the skills required for the position. This can happen because the foreign workers are workers brought in by foreign companies investing in Indonesia. The application of professional certification requirements for foreign workers, and if possible, mastery of Indonesian, can reduce the flow of foreign workers to Indonesia.

This research is supported and strengthened by the results of research from Skeldon (1997) and Hugo (1993). Skeldon (1997) shows that migrants from Indonesia who work abroad have characteristics of low education, limited knowledge, and limited expertise with ages between 15 to 40 years working as domestic helpers or factory workers. It is different from the condition of migrants from countries such as Thailand, the Philippines, and South Korea with adequate education, adequate knowledge, and adequate expertise.

Similar to Skeldon (1997), Hugo (1993) mentions that the majority of Indonesian migrant workers have a low level of expertise. Generally, women are employed as domestic workers in Singapore, Malaysia, Saudi Arabia, Hong Kong, and Brunei Darussalam. Whereas male migrant workers mostly work in South Korea, Taiwan, and Japan. Besides, Kassim (1998) show that the quality of Indonesian migrant workers is aware of the rights they have received. It was stated that 82 percent of Indonesian migrant workers were women from rural areas with primary education, and 98 percent of them worked in the domestic or household sector. This condition has placed Indonesian women migrant workers working on 3D characters, namely Dirty, Dangerous, Difficult (dirty, dangerous work with a high degree of difficulty).

5. CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

The results showed that there was a change in the pattern of spatial interaction of Indonesian workers, which in 2004 had a lot of spatial interactions with workers from countries with a large workforce. However, in 2018, they interacted spatially with workers from countries with few workers. This is alleged because the number of Indonesian migrant workers migrating within the ASEAN countries decreases sharply in 2017, namely from 137,644 workers in 2017 to 84,451 workers in 2014. There are more Indonesian migrants working in other ASEAN countries compared to foreign workers from ASEAN countries who work in Indonesia. In addition, most Indonesian migrants work in the elementary occupation, while foreign workers from ASEAN countries work more as managers and professionals

There is some policy implication of these findings. The Indonesian government needs to provide technical and managerial skills, soft skills, and English for migrant workers before working abroad. The Indonesian government may also

implement professional certification requirements for foreign workers working in Indonesia to protect the flow of foreign workers coming to Indonesia

The limitation of this study is that it deals with limited data. It regarded the ASEAN labor migration only until 2017. Data on ASEAN labor migration 2018 will be published in November 2019. Therefore, a study on a similar purpose can be done in the future by considering this limitation.

REFERENCES

Anselin, L 1995, 'Local indicators of spatial association—LISA', *Geographical analysis,* vol. 27, no. 2, pp. 93-115.

Blundell, R, Dearden, L, Meghir, C, & Sianesi, B 1999, 'Human capital investment: the returns from education and training to the individual, the firm and the economy', *Fiscal studies,* vol. 20, no. 1, pp. 1-23.

Cabrales, CA 2011, 'Human capital externalities and growth', *Ensayos Sobre Politica Economica,* vol. 29, no. 66, pp. 12-47.

Caroline, S, Kurnia, AS, & Firmansyah, F 2018, 'Spatial Human Capital Interaction Pattern to Indonesian Economic Growth', *International Journal of Civil Engineering and Technology,* vol. 9, no. 1, pp. 713-727.

Caroline, S, Sugiyanto, FX, Kurnia, AS, & Firmansyah, F 2017, 'Human capital category interaction pattern to economic growth of asean member countries in 2015 by using GeoDa "geo-information technology data"', *Journal of Civil Engineering and Technology (IJCIET),* vol. 8, no. 11, pp. 889-900.

Castro Laszlo, K & Laszlo, A 2002, 'Evolving knowledge for development: the role of knowledge management in a changing world', *Journal of Knowledge Management,* vol. 6, no. 4, pp. 400-412.

Dubé, J & Legros, D 2014. *Spatial econometrics using microdata*: John Wiley & Sons.

Erling, EJ, Seargeant, P, Solly, M, Chowdhury, QH, & Rahman, S 2015. *English for economic development: a case study of migrant workers from Bangladesh.*

Feser, EJ 2003, 'What regions do rather than make: A proposed set of knowledge-based occupation clusters', *Urban Studies,* vol. 40, no. 10, pp. 1937-1958.

Fotheringham, AS, Brunsdon, C, & Charlton, M 2000. *Quantitative geography: perspectives on spatial data analysis*: Sage.

Haining, RP & Haining, R 2003. *Spatial data analysis: theory and practice*: Cambridge University Press.

Hugo, G 1993, 'Indonesian labour migration to Malaysia: trends and policy implications', *Southeast Asian Journal of Social Science,* vol. 21, no. 1, pp. 36-70.

Kassim, A 1998. *International migration and its impact on Malaysia.* Paper presented at the A Pacific Peace: Issues and Responses, Kuala Lumpur, ISIS, Kossoudji, SA.

Knowles, S & Owen, PD 1995, 'Health capital and cross-country variation in income per capita in the Mankiw-Romer-Weil model', *Economics letters,* vol. 48, no. 1, pp. 99-106.

Li, P & Li, W 2007, 'Economic status and social attitudes of migrant workers in China', *China & World Economy,* vol. 15, no. 4, pp. 1-16.

Lucas Jr, RE 1988, 'On the mechanics of economic development', *Journal of monetary economics,* vol. 22, no. 1, pp. 3-42.

Mankiw, NG, Romer, D, & Weil, DN 1992, 'A contribution to the empirics of economic growth', *The quarterly journal of economics,* vol. 107, no. 2, pp. 407-437.

Mathur, VK 1999, 'Human capital-based strategy for regional economic development', *Economic Development Quarterly,* vol. 13, no. 3, pp. 203-216.

Moretti, E 2004, 'Workers' education, spillovers, and productivity: evidence from plant-level production functions', *American Economic Review,* vol. 94, no. 3, pp. 656-690.

Raspe, O & Van Oort, F 2006, 'The knowledge economy and urban economic growth', *European Planning Studies,* vol. 14, no. 9, pp. 1209-1234.

Romer, PM 1990, 'Endogenous technological change', *Journal of political Economy,* vol. 98, no. 5, Part 2, pp. S71-S102.

Skeldon, R 1997, 'Rural-to-urban migration and its implications for poverty alleviation', *Asia-Pacific Population Journal,* vol. 12, no. 1, pp. 3-16.

Solow, RM 1956, 'A contribution to the theory of economic growth', *The quarterly journal of economics,* vol. 70, no. 1, pp. 65-94.

Wang, X 2008, 'An investigation into intergenerational differences between two generations of migrant workers', *Social Sciences in China,* vol. 29, no. 3, pp. 136-156.

Williams, AM & Baláž, V 2005, 'What Human Capital, Which Migrants? Returned Skilled Migration to Slovakia From the UK 1', *International Migration Review,* vol. 39, no. 2, pp. 439-468.

Wolff, EN 2000, 'Human capital investment and economic growth: exploring the cross-country evidence', *Structural Change and Economic Dynamics,* vol. 11, no. 4, pp. 433-472.