DIJEFA: Dinasti International Journal of Economics, Finance & Accounting
E-ISSN: 2721-303X
P-ISSN: 2721-3021
https://dinastipub.org/DIJEFA dinasti.info@gmail.com +62 811 7404 455
DOI: https://doi.org/10.38035/dijefa.v5i5

Factors Influencing Industrial Agglomeration in Indonesia

Hizbul Khootimah Az Zaakiyyah[1*]
[1]Universitas Diponegoro, Semarang, Indonesia, azzaakiyyahhizbulk@gmail.com.

[*]Corresponding Author: azzaakiyyahhizbulk@gmail.com[1]

Abstract: This study analyzes the factors affecting industrial agglomeration in Indonesia using panel data from 34 provinces during the 2012-2023 period. The analytical methods employed include Location Quotient (LQ) and panel data regression, with testing results indicating that the Fixed Effect model is the most appropriate. The findings reveal that economic growth and investment have a negative and significant impact on industrial agglomeration, while the Human Development Index (HDI) shows a negative but insignificant effect. On the other hand, population size has a positive and significant influence on agglomeration.

Keyword: Agglomeration, Economic Growth, Investment, HDI, Population Size.

INTRODUCTION

Economic development encompasses various efforts made by communities to expand economic activities and improve their living standards. One of the primary objectives of economic development is to enhance societal well-being through sustainable economic growth. Economic growth plays a central role in improving the quality of life, as it is closely related to increasing the capacity to produce and distribute goods and services. Industrial agglomeration, which refers to the concentration of economic activities in urban areas, is one of the key factors in creating economic efficiency. Through the geographical proximity of businesses, labor, and consumers, agglomeration facilitates the benefits of proximity economies, which are cost savings in production and distribution derived from close locations. This leads to increased productivity and efficiency, as explained by Montgomery in Kuncoro (2002).

Successful economic growth is marked by its positive impact on societal well-being, reflecting progress in economic development. According to Simon Kuznets (in Todaro, 2000), economic growth is defined as the sustained increase in a country's capacity to provide goods and services over the long term. This increase is driven by technological advancements, as well as structural adjustments in organizational aspects and economic philosophy. Kuznets also emphasized that economic growth involves increasing production and is associated with changes in a country's economic structure (Jhingan, 2012). In the process of economic modernization, industry plays a crucial role. The modernization of the industrial sector, according to Ucak (2015), is one of the key elements considered by classical economists such as Adam Smith as a primary driver of economic growth.

Industrial development aims to improve societal welfare through two main aspects: first, by increasing income levels, and second, by enhancing overall quality of life (Arsyad, 2010). Industrialization fulfills the physical needs of society and achieves broader goals of general well-being. In the long run, economic growth is typically accompanied by changes in economic structure. Economies that were once dominated by the traditional agricultural sector gradually transform into modern economies driven by the industrial sector. This shift is reflected in the increased contribution of the industrial sector to the gross domestic product (GDP) and the rise in per capita income. The development of the industrial sector adds value to raw materials, creates new jobs, and expands business opportunities, ultimately contributing to improved societal welfare. For instance, the GDP figures of Indonesia's industrial sectors highlight the significant role of industry in the national economy, as illustrated in Figure 1.

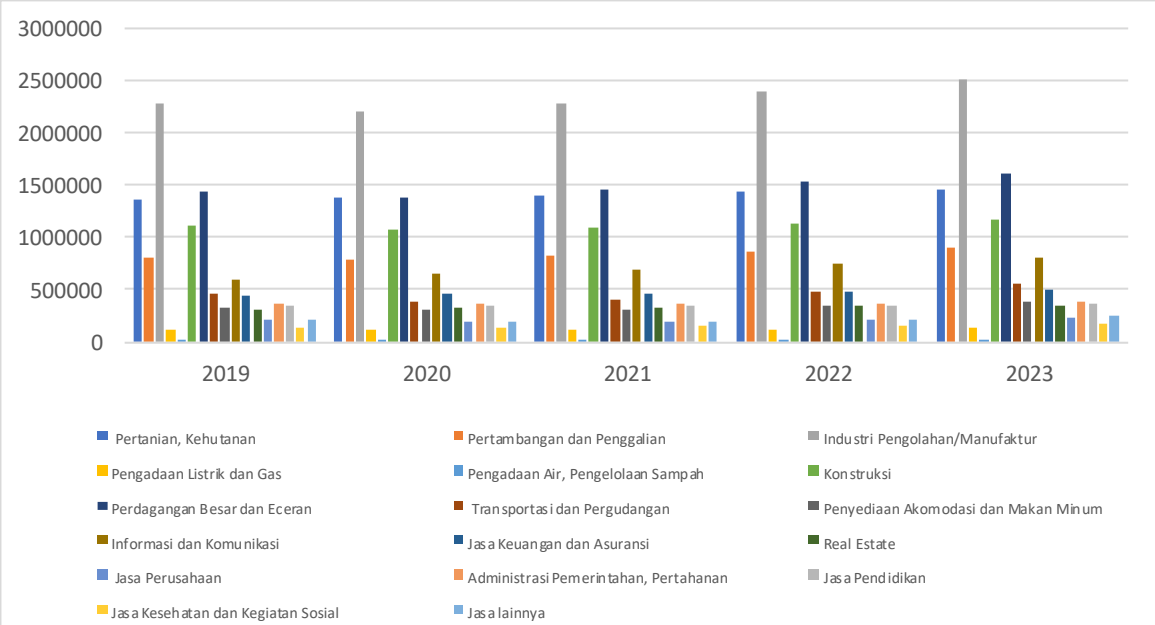

Figure 1. GDP of the Industrial Sector in Indonesia
Source: BPS, processed (2024)

Figure 1 shows that from 2019 to 2023, the manufacturing and processing sectors contributed the most to Indonesia's Gross Domestic Product (GDP). This industry generated higher GDP values compared to other sectors. When manufacturing companies concentrate in a particular region, this phenomenon is known as industrial agglomeration. In developing countries like Indonesia, economic development plans must prioritize the growth of the manufacturing industry due to its strategic role in driving progress across various other sectors, such as transportation, services, trade, and agriculture. Products from the manufacturing sector typically have higher value-added and profitability compared to those from other sectors.

Over time, attention to the agricultural sector tends to decrease as the manufacturing sector becomes more prominent in economic development strategies (Eriandy, 2021). Industrial agglomeration helps enhance efficiency through shared resource utilization, access to skilled labor, and improved infrastructure. Additionally, agglomeration fosters collaboration and innovation between companies, which in turn accelerates the growth and competitiveness of industries (Kuncoro, 2012). This industrial agglomeration phenomenon significantly impacts the performance and growth of the manufacturing sector in Indonesia. The proximity of companies creates an ecosystem that supports knowledge and technology

sharing. Moreover, businesses can take advantage of more effective supply and distribution networks, ultimately improving productivity and operational efficiency. Therefore, this study will focus on data related to manufacturing industry agglomeration in Indonesia to gain a deeper understanding of how agglomeration factors influence this sector.

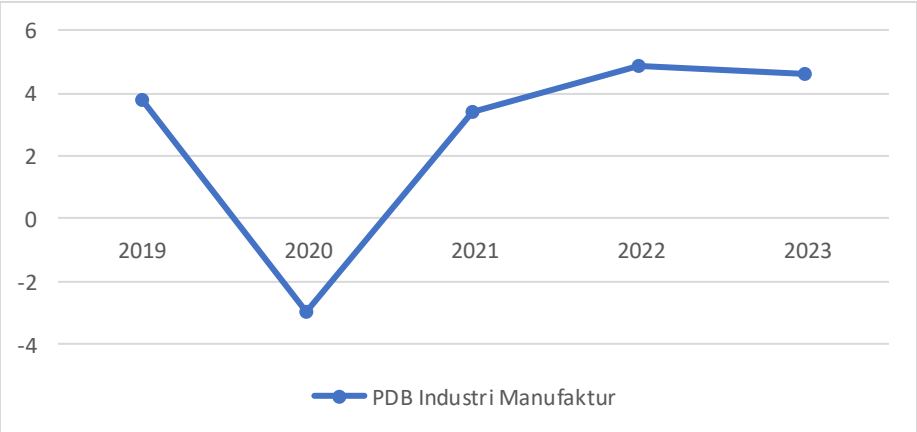

Figure 2. GDP Growth Rate of Manufacturing Industry
Source: BPS, processed (2024)

Based on data from Indonesia's Central Bureau of Statistics (BPS) presented in Figure 2, the growth rate of the manufacturing sector's GDP in Indonesia has shown fluctuations that reflect varying economic conditions over the past few years. In 2019, the growth rate of the manufacturing sector's GDP was recorded at 3.8%, indicating relatively stable economic conditions before any significant disruptions. However, in 2020, the growth rate sharply declined to -2.93% due to the substantial impact of the Covid-19 pandemic, which affected almost all sectors of the economy, including manufacturing. The pandemic caused disruptions in supply chains, a drop in demand, and restrictions on economic activities, all contributing to this sharp contraction.

In 2021, the manufacturing industry began to show signs of recovery, with growth reaching 4.89%. This figure reflects the positive response of the manufacturing sector to government stimulus and the global recovery after the pandemic. This positive trend continued into 2022, with the manufacturing sector's GDP growth remaining stable at 4.89%, indicating sustained recovery. However, in 2023, the growth rate slightly declined to 4.64%. Despite the slight decline, the overall trend remains positive. This decrease may be attributed to various factors, such as post-pandemic economic adjustments, global inflation, or new challenges faced by the manufacturing industry, including supply chain uncertainties or changes in international trade policies. Overall, this data indicates that Indonesia's manufacturing sector has demonstrated the ability to recover and grow after experiencing a significant contraction due to the Covid-19 pandemic. The fluctuations in GDP growth rates reflect the sector's resilience and adaptability in the face of various global and domestic economic challenges.

The manufacturing industry plays a strategic role as a key driver of economic development. Growth in this sector has the potential to boost other sectors, such as services, transportation, trade, and agriculture, which in turn accelerates overall economic growth. Manufacturing agglomeration, which refers to the concentration of manufacturing industries in specific regions, has significant economic and social impacts in Indonesia (Emalia, 2016). The process of agglomeration is influenced by many interrelated factors.

To understand the factors influencing industrial agglomeration in Indonesia, several key indicators must be considered. Understanding these factors is crucial for designing effective industrial policies and regional planning. One of the main indicators is economic growth, which serves as a primary driver of manufacturing agglomeration. Strong economic growth generates higher demand for manufactured products, increases production capacity, and attracts more industries to operate in the region. Economic growth also enhances the availability of better infrastructure and creates a more conducive environment for industries to thrive (Azwina et al., 2023). The overall trend of Indonesia's economic growth over recent years can be seen in Figure 3, which illustrates the nation's GDP growth trend.

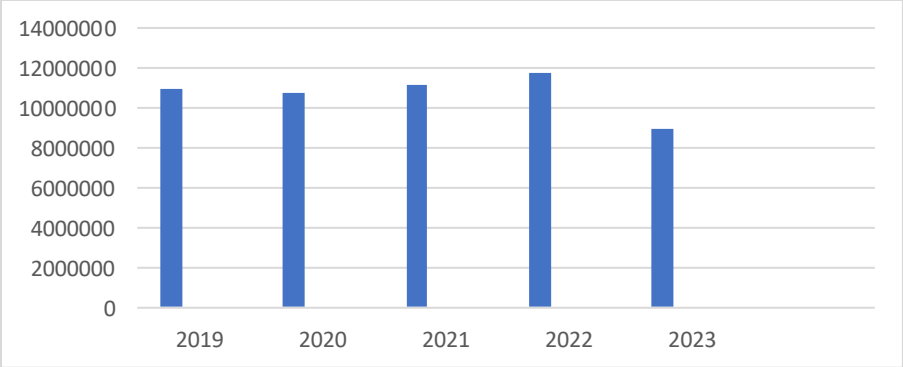

Figure 3. Indonesia's Gross Domestic Product (GDP)
Source: BPS, processed (2024)

Figure 3 illustrates Indonesia's Gross Domestic Product (GDP) from 2019 to 2023. In 2019, Indonesia's GDP was recorded at 10,949,155 million. In 2020, there was a slight decline, with GDP falling to 10,722,999 million. This decrease occurred at the peak of the COVID-19 pandemic, which affected the global economy, including Indonesia, leading to stability issues or declines in GDP across various economic sectors. In 2021, Indonesia's GDP began to recover with a significant increase to 11,120,059 million, reflecting the start of post-pandemic economic recovery. This upward trend continued into 2022, with GDP reaching 11,710,247 million, indicating a relatively strong and stable economic condition. However, in 2023, there was a sharp decline in Indonesia's GDP to 8,982,517 million. This significant decrease indicates new challenges affecting the national economy, such as global supply chain disruptions, inflation, or economic policies that might have led to slower growth. Therefore, this graph shows the fluctuations in Indonesia's GDP over the past five years, reflecting how the Indonesian economy has responded to various global and domestic conditions. The period from 2019 to 2023 has been marked by major challenges such as the pandemic, economic recovery, and global fluctuations impacting Indonesia's GDP growth.

In addition to economic growth, investment is also a crucial factor influencing industrial agglomeration (Silaen & Esther, 2015). According to Kasmir (2019), investment involves capital allocation in long-term activities across various industries. Significant investment in infrastructure, such as industrial zones, ports, and logistics facilities, creates an ecosystem that supports production and distribution efficiency. Government policies that promote investment, such as the establishment of Special Economic Zones (KEK), have spurred investment growth in Indonesia's manufacturing sector. This increase in investment directly contributes to production activities, ultimately boosting community income and creating new job opportunities. Investment also plays a key role in opening employment opportunities and improving community welfare, particularly for those who were previously unemployed (Simarmata & Iskandar, 2022).

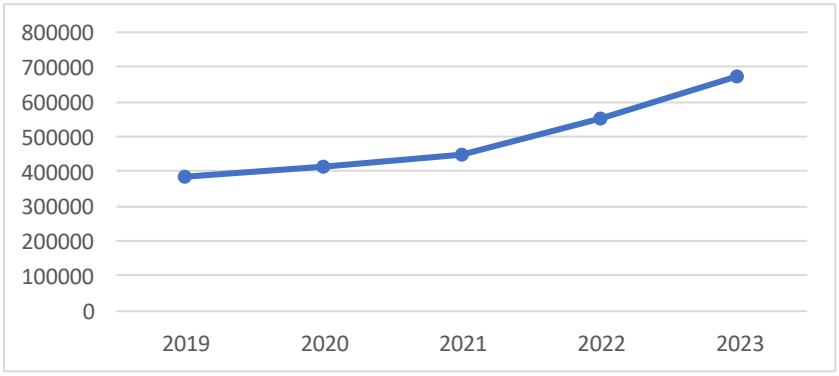

Figure 4. Realisation of Domestic Investment in Indonesia
Source: BPS, processed (2024)

Figure 4 illustrates the trend of increasing investment in Indonesia from 2019 to 2023. In 2019, investment was recorded at 386,498.4 billion rupiahs. Despite the COVID-19 pandemic impacting the world in 2020, investment in Indonesia continued to rise, reaching 413,535.5 billion rupiahs, indicating that Indonesia remained an attractive destination for investors. In 2021, investment further grew to 447,063.6 billion rupiahs, reflecting signs of post-pandemic economic recovery. The year 2022 saw a more significant increase, with investment reaching 552,769 billion rupiahs, driven by growing investor confidence in economic stability and pro-investment government policies. In 2023, investment surged sharply to 674,923.4 billion rupiahs. This consistent increase demonstrates that investors are increasingly confident in Indonesia's economic prospects despite global challenges. Indonesia's success in maintaining stability and attractiveness as an investment destination during difficult times highlights its strong economic resilience.

In addition to economic growth and investment, the Human Development Index (HDI) is also a crucial factor influencing industrial agglomeration (Putri Salsabila et al., 2019). The HDI measures the quality of life based on living standards, health, and education. Regions with high HDI tend to have a more skilled and productive workforce, which is vital for the manufacturing sector. The quality of human resources plays a critical role in enhancing productivity and economic growth (Windasari et al., 2021). Figure 5 shows the development of HDI in Indonesia from 2019 to 2023, illustrating how improvements in human resource quality contribute to the dynamics of industrial and overall economic growth.

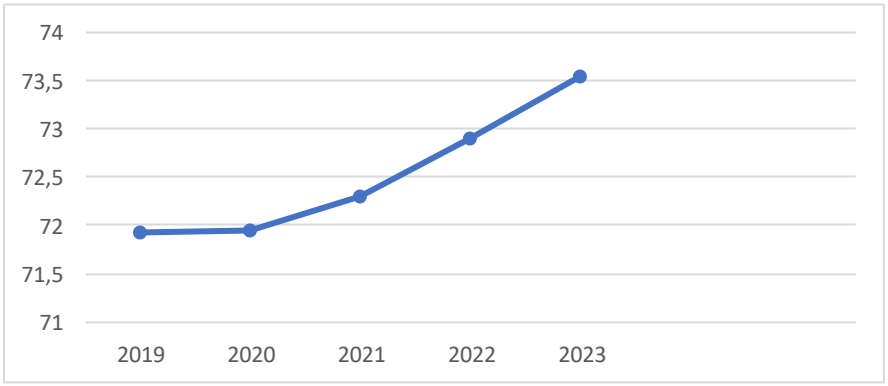

Figure 5. Human Development Index in Indonesia
Source: BPS, processed (2024)

Figure 5 above displays a positive trend in the Human Development Index (HDI) in Indonesia. In 2019, the HDI was recorded at 71.92, indicating a relatively good level of human development in Indonesia. Despite the COVID-19 pandemic in 2020, the HDI saw a slight increase to 71.94. This reflects social resilience and the country's ability to maintain living standards amid a crisis. A more significant increase occurred in 2021, when the HDI reached 72.29, reflecting economic recovery accompanied by improved social welfare. This positive trend continued into 2022 and 2023, with the HDI reaching 72.91 and 73.55, respectively. This ongoing improvement highlights the success of various government programs in enhancing access to and quality of public services, especially in education and health. The enhanced quality of life contributes to overall societal well-being and potentially supports broader economic growth (Rahmawati, 2019).

In addition to economic growth, investment, and HDI, population also plays a crucial role in influencing industrial agglomeration (Putri Salsabila et al., 2019). Regions with large populations offer a broad market for manufactured products and provide a plentiful labor force. Todaro (2006) notes that significant population growth drives economic growth by creating a larger market, which in turn boosts demand for various goods and services. Increased demand stimulates economic activity, scales up production, lowers production costs, and provides ample labor. This, in turn, can reduce poverty levels and enhance overall societal welfare.

Based on the above, this study aims to analyze in-depth how these factors influence manufacturing industry agglomeration in Indonesia. Factors such as economic growth, investment, HDI, and population size are considered critical in shaping industrial agglomeration dynamics. Economic growth creates a supportive environment, while investment strengthens infrastructure and industrial capacity. Improved living standards, reflected in the HDI, foster a more productive and innovative workforce. Meanwhile, a large population provides a vast market and abundant labor, which are key to driving economic activity.

This study will focus on all 34 provinces in Indonesia, differing from previous research that concentrated on a single province. Using recent data from 2012 to 2023, the study aims to gain a deeper understanding of the relationship between these factors and industrial agglomeration in Indonesia. The objective is to determine the extent to which economic growth, investment, HDI, and population size impact industrial agglomeration. With a better understanding of these relationships, the study hopes to provide valuable insights for policymakers to formulate more efficient, inclusive, and sustainable economic development strategies.

METHOD

Type and Source of Data

This research falls into the category of quantitative research that utilizes numerical data. The secondary data used are data collected and published by official agencies or institutions (Widarjono, 2012). The data source for this research is obtained from the Central Statistics Agency of Indonesia for the period from 2012 to 2023.

Operational Definitions of Variables

This study uses two types of variables: dependent and independent variables. The dependent variable, agglomeration, refers to the concentration of economic activity in urban areas caused by the advantages of proximity (economies of proximity), as described by Montgomery (Kuncoro, 2002). This includes the clustering of companies, workers, and consumers in one area. In this study, the agglomeration variable is calculated using a formula

that involves the manufacturing sector's GRDP in 34 provinces and Indonesia's GDP for the years 2012-2023, measured in percentage terms. The independent variables used are:

1. Economic Growth: According to Sukirno (2015), economic growth is a quantitative measure that reflects the development or progress of an economy in one year compared to the previous year. This research uses data from 34 provinces in Indonesia for the period 2012 to 2023, measured in billion rupiah.
2. Investment: According to Kasmir (2019), investment is defined as capital invested in activities that last for a considerable period across various business sectors. In this study, the investment variable refers to data on Domestic Investment Realization (PMDN) in 34 Indonesian provinces from 2012 to 2023, measured in billion rupiah.
3. Human Development Index (HDI): According to the Central Statistics Agency (2023), HDI measures human development achievement through three main dimensions of quality of life: longevity and health, knowledge, and standard of living. Data for the HDI variable is obtained from 34 provinces in Indonesia for the period 2012 to 2023.
4. Population: According to Nurdiman (2008), population refers to the number of people living in a country. The population variable in this study includes data from 34 provinces in Indonesia from 2012 to 2023, measured in number of individuals.

Analysis Method

In this study, data analysis is performed using Location Quotient (LQ) and quantitative panel data regression. Panel data consists of information on several specific objects over different time periods (Widarjono, 2012). For panel data regression analysis, EViews 12 software is used. Based on the definition of panel data, this analysis covers 34 provinces in Indonesia from 2012 to 2023. The models used in this research are:

1. Location Quotient (LQ): Descriptive analysis in this study refers to Nugroho & Wahyuni (2020) regarding the measurement of agglomeration values using Location Quotient (LQ). LQ is used to analyze the agglomeration of the manufacturing industry by comparing the proportion of the manufacturing sector's GRDP in each province with the proportion of the manufacturing sector's GDP at the national level in Indonesia. The Location Quotient (LQ) analysis measures the level of agglomeration at the district and provincial levels in sectoral production activities. Here is the LQ formula:

$$LQ\frac{Xij}{Xsj} = \frac{Xij/Xis}{Xsj/Xss}$$

Based on the equation:

Based on the equation:

X_{ij} is the GDP of sector i in province j,

X is the total GDP of sector i in Indonesia.

X_{sj} is the total GRDP of all sectors in province i,

X_{ss} is the total GDP.

This coefficient is used to measure economic agglomeration in Indonesia. The interpretation of the LQ value is that if LQ ij > 1, then province j has a high spatial concentration of sector i or there is agglomeration in the area.

2. Linear Regression with Panel Data

To observe the same individual units over a specific period, panel data regression combines cross-sectional data with time-series data. In general, panel data includes a larger number of subjects (N) and a shorter time period (T) (i = 1, 2, ..., N). Independent variables such as agglomeration, investment, HDI, and population are used for analysis. Therefore, the regression model used is as follows:

$$Aglo_{it} = \beta_0 + \beta_1 PE_{it} + \beta_2 Inves_{it} + \beta_3 IPM_{it} + \beta_4 JP_{it} + \varepsilon_{it}$$

PE = Dependent variable, namely Agglomeration using the LQ coefficient, β_0 = Constant, β_{1234} = Coefficient, PE = Economic growth value, Invest = Investment value, HDI = Human Development Index value, JP = Population value, i = 34 Indonesian Provinces, t = Years 2012-2023, e = Error terms.

RESULTS AND DISCUSSION

Location Quotient (LQ) Analysis

This research measures Location Quotient (LQ) to measure the agglomeration value of the manufacturing industry in 34 provinces in Indonesia from 2012-2023. The following LQ values are in table 1:

Table 1. Average LQ of Indonesian Provinces

No	Province	Value	No	Province	Value
1	Aceh	0.264167	18	Nusa Tenggara Barat	0.219342
2	Sumatera Utara	0.887662	19	Nusa Tenggara Timur	0.059148
3	Sumatera Barat	0.484942	20	Kalimantan Barat	0.768907
4	Riau	0.484942	21	Kalimantan Tengah	0.722909
5	Jambi	0.506659	22	Kalimantan Selatan	0.602586
6	Sumatera Selatan	0.876649	23	Kalimantan Timur	0.951077
7	Bengkulu	0.285273	24	Kalimantan Utara	0.43668
8	Lampung	0.853953	25	Sulawesi Utara	0.43668
9	Kepulauan Bangka Belitung	1.059078	26	Sulawesi Tengah	0.883421
10	Kepulauan Riau	1.848642	27	Sulawesi Selatan	0.644227
11	DKI Jakarta	0.578243	28	Sulawesi Tenggara	0.317534
12	Jawa Barat	2.032835	29	Gorontalo	0.193166
13	Jawa Tengah	1.616746	30	Sulawesi Barat	0.498407
14	DI Yogyakarta	0.591307	31	Maluku	0.262246
15	Jawa Timur	1.404232	32	Maluku Utara	0.533839
16	Banten	1.665433	33	Papua Barat	1.4918
17	Bali	0.310732	34	Papua	0.091205

Source: Research Data (2024)

Based on the research measuring the Location Quotient (LQ) values for 34 provinces in Indonesia from 2012 to 2023, the rankings from highest to lowest are as follows: West Java has the highest value with an LQ of 2.032835, followed by Riau Islands with an LQ of 1.848642 and Banten with an LQ of 1.665433. Central Java and West Papua follow with LQ values of 1.616746 and 1.491800, respectively. East Java recorded an LQ of 1.404232, while the Bangka Belitung Islands and East Kalimantan have LQs of 1.059078 and 0.951077, respectively. North Sumatra and Central Sulawesi show LQs of 0.887662 and 0.883421, while South Sumatra and Lampung have LQs of 0.876649 and 0.853953.

West Kalimantan, Central Kalimantan, and South Sulawesi have LQs of 0.768907, 0.722909, and 0.644227, respectively. South Kalimantan, Yogyakarta, and Jakarta record LQs of 0.602586, 0.591307, and 0.578243. North Maluku, Jambi, and West Sulawesi have LQs of 0.533839, 0.506659, and 0.498407, respectively. Riau and West Sumatra both have LQs of 0.484942, while North Kalimantan and North Sulawesi show LQs of 0.436680. Southeast Sulawesi, Bali, and Bengkulu record LQs of 0.317534, 0.310732, and 0.285273. Aceh has an LQ of 0.264167, followed by Maluku with an LQ of 0.262246. West Nusa Tenggara and Gorontalo record LQs of 0.219342 and 0.193166, respectively, while Papua and East Nusa Tenggara have LQs of 0.091205 and 0.059148.

The results indicate that an LQ value greater than 1 signifies economic agglomeration in the province. Provinces with LQ values greater than 1 include West Java, Riau Islands, Banten, Central Java, West Papua, East Java, and the Bangka Belitung Islands. This suggests that these provinces have a higher concentration of economic activity compared to the national average, indicating the presence of significant economic or industrial centers.

Panel Data Regression Analysis

The impact of the Human Development Index (HDI), investment, economic growth, and population on industrial agglomeration was analyzed using panel data regression with EViews 12. The best model for analysis was selected through three tests: the Chow test, the Hausman test, and the Lagrange Multiplier test. The results processed with EViews 12 are presented below.

Model Selection Tests

Chow Test

The Chow test is used to choose the best model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM). In this test, the p-value of the F-statistic and the alpha (α) level are considered. The hypotheses for the Chow test are:

H_0 = Common Effect Model

H_1 = Fixed Effect Model

If the p-value of the F-statistic is greater than 0.05 (α = 5%), H_0 is accepted, indicating that the Common Effect Model is more appropriate. Conversely, if the p-value of the F-statistic is less than 0.05 (α = 5%), H_1 is accepted, indicating that the Fixed Effect Model is more suitable. The results of the Chow test regression are as follows:

Table 2. Chow Test Results

Effects Test	Statistic	d.f.	Probability
Cross-section F	204.417254	(33,370)	0.0000
Cross-section Chi-square	1206.278779	33	0.0000

Source: data processed (2024)

Table 2 shows the Fixed Effect Model. The results, as presented in Table 2, indicate a cross-section F-probability value of 0.0000, which is smaller than the alpha (α) = 5%. This value suggests that H_0 is rejected, indicating that the Fixed Effect Model is the most appropriate for hypothesis testing. Subsequently, the Hausman test was conducted to choose between the Fixed Effect Model and the Random Effect Model.

Hausman Test

The Hausman test is conducted to determine the better model between the Fixed Effect Model (FEM) and the Random Effect Model. In this test, the choice is based on the p-value of the Chi-square statistic compared to the alpha (α) level. The hypotheses are as follows:

- H_0 = Random Effect Model
- H_1 = Fixed Effect Model

If the p-value of the Chi-square statistic is greater than 0.05 (α = 5%), H_0 is accepted, indicating that the Random Effect Model is more appropriate. Conversely, if the p-value of the Chi-square statistic is less than 0.05 (α = 5%), H_1 is accepted, suggesting that the Fixed Effect Model is more suitable. The results of the Hausman test regression are as follows:

Table 3. Hausman Test Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Probability
Cross-section random	10.363370	4	0.0347

Source: data processed (2024)

With a Chi-square p-value of 0.0347, which is less than the alpha (α) = 5%, the Hausman test rejects H_0, as shown in Table 3. This value is considered significant. The results indicate that the Fixed Effect Model is the most appropriate for hypothesis testing, and therefore, there is no need to conduct the Lagrange Multiplier test.

Fixed Effect Model (FEM) Estimation Results

The Fixed Effect Model is the best choice for estimating the impact of economic growth, investment, HDI, and population on agglomeration.

Table 4. Fixed Effects Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.065584	0.532395	-9.514713	0.0000
LOGPE	-3.70E-07	8.25E-08	-4.485404	0.0000
LOGINVEST	-0.018164	0.005541	-3.277972	0.0011
LOGIPM	-0.015400	0.021311	-0.722638	0.4704
PENDUDUK	0.514706	0.047900	10.74548	0.0000

Effects Specification			
Cross-section fixed (dummy variables)			
Root MSE	0.099947	R-squared	0.963250
Mean dependent var	0.731314	Adjusted R-squared	0.959575
S.D. dependent var	0.522003	S.E. of regression	0.104954
Akaike info criterion	-1.582083	Sum squared resid	4.075661
Schwarz criterion	-1.208484	Log likelihood	360.7449
Hannan-Quinn criter.	-1.434249	F-statistic	262.1087
Durbin-Watson stat	0.256619	Prob(F-statistic)	0.000000

Source: data processed (2024)

Based on the estimation results, the panel data analysis model of agglomeration in Indonesia can be formulated with the following regression equation:

AGLO = α -5.065584 - $\beta_1$3.698507*pe -β_2 0.018164*LOGINVEST - $\beta_3$0.015400*LOGIPM + $\beta_4$0.514706*LOGPENDUDUK + [CX=F]

Based on the estimation results, the coefficients and probabilities for each variable show distinct impacts. The interpretation of the results is as follows:

1. α = -5.065584: This indicates that if all independent variables (economic growth, investment, HDI, and population) are held constant, the economic agglomeration will reach a value of -5.065584.
2. β1 = -13.698507: This means that economic agglomeration will decrease by 13.698507 percent if economic growth increases by one percent, and vice versa. The probability value for economic growth is 0.0000, which is below the α = 5% threshold, indicating that economic growth has a significant impact on economic agglomeration.
3. β2 = -0.018164: This implies that investment has a significant effect on agglomeration. With a probability value of 0.0011, which is less than α = 5%, the agglomeration will decrease by 0.018164 percent if investment increases by one percent.
4. β3 = -0.015400: This shows that if HDI increases by one percent, agglomeration will decrease by 0.015400 percent. However, the probability value for HDI is 0.4704, which is greater than α = 5%, indicating that HDI does not have a significant impact on agglomeration.
5. β4 = 0.514706: This indicates that the estimated coefficient for population has a probability value of 0.0000, which is below α = 5%, showing that population has a significant impact on agglomeration. An increase of one percent in population will result in an increase of 0.514706 percent in agglomeration.

Statistical Test Results

F-Test

After interpreting the estimation results, an F-test was conducted. The purpose of the F-test is to determine how Indonesia's economic growth is influenced by the following variables: investment, HDI, population, and agglomeration. Based on the regression results, the F-statistic value is 262.1087, while the F-table value is 2.394. The F-statistic being greater than the F-table value indicates that economic growth, investment, HDI, and population significantly affect agglomeration in Indonesia. Additionally, all these variables have a significant impact on industrial agglomeration in Indonesia, as indicated by the F-statistics probability value of 0.000000, which is lower than $\alpha = 5\%$.

T-Test

Following the F-test, a T-test was conducted by comparing the t-statistic to the t-table and assessing the probability at an $\alpha = 5\%$ level. This test aims to determine the extent of the impact of each independent variable on the dependent variable.

Table 5. T-Test Results

Independent Variable	t-Statistics	Probability	Level α
Economic Growth	-4.485404	0.0000	5% = 0.05
Investment	-3.277972	0.0011	5% = 0.05
HDI	-0.722638	0.4704	5% = 0.05
Total Population	10.74548	0.0000	5% = 0.05

Source: data processed (2024)

Table 5 can be interpreted as follows:

1. Economic Growth: The probability is 0.0000 at an $\alpha = 0.05$ level, with a t-statistic value of -4.48540 and a t-table value of 1.649. This indicates that economic growth has a significant negative effect on industrial agglomeration.
2. Investment: The probability is 0.0011 at an $\alpha = 0.05$ level, with a t-statistic value of -3.277972 and a t-table value of 1.649. This shows that investment has a significant negative impact on industrial centers.
3. Human Development Index (HDI): The probability is 0.4704 at an $\alpha = 0.05$ level, with a t-statistic value of -0.722638 and a t-table value of 1.649. This indicates that HDI has an insignificant negative effect on industrial agglomeration.
4. Population: The t-statistic value is 10.74548 with a t-table value of 1.649, and the probability is 0.0000 at an $\alpha = 0.05$ level. This shows that population has a significant positive impact on industrial agglomeration.

Coefficient of Determination (R-squared) Test

The coefficient of determination (R^2) measures the extent to which independent variables, including economic growth, investment, Human Development Index (HDI), and population, contribute to the dependent variable (agglomeration). The panel data regression results show an R^2 value of 0.963250. This indicates that the independent variables can explain 96% of the variation in the dependent variable, while other external factors not included in the model account for the remaining 4%.

Analysis Discussion

Agglomeration Analysis Based on Location Quotient (LQ)

Based on the Location Quotient (LQ) analysis of 34 provinces in Indonesia, we can identify provinces with significant manufacturing agglomeration. This agglomeration is indicated by an LQ > 1, signifying a high concentration of manufacturing industries. The following are the provinces:

1. West Java

West Java has an LQ value of 2.032835, making it the province with the highest concentration of manufacturing industries in Indonesia. Major industrial areas such as Bekasi, Karawang, and Cikarang are significant manufacturing hubs, particularly in automotive, electronics, textiles, and food sectors. Excellent infrastructure, including highways like the Jakarta-Cikampek Toll Road and Tanjung Priok Port, supports manufacturing and product distribution. Additionally, West Java boasts a large and skilled workforce, along with numerous universities and training institutions that cater to industry needs. These factors make West Java a leading manufacturing center in Indonesia.

2. Riau Archipelago

With an LQ value of 1.848642, the Riau Archipelago shows significant manufacturing concentration, especially in Batam and Tanjung Pinang, which are special economic zones. Its geographic proximity to Singapore provides a competitive advantage in trade and logistics. Major industries in the area include electronics and shipbuilding, supported by government policies aimed at attracting foreign investment. Key infrastructure such as Batu Ampar Port and Hang Nadim Airport enhances logistics and distribution, establishing the Riau Archipelago as an important manufacturing hub in Indonesia.

3. Banten

Banten, with an LQ of 1.665433, has a high concentration of manufacturing industries. The province borders DKI Jakarta, providing easy access to a large market and major logistics facilities. The Cilegon Industrial Area is a center for heavy industries like steel and petrochemicals. Additionally, the chemical, logistics, and automotive sectors are also growing rapidly in Banten. Infrastructure such as Merak Port and toll roads supports product distribution, while access to Jakarta's labor market and availability of skilled workers contribute to industrial growth in the region.

4. Central Java

With an LQ value of 1.616746, Central Java excels in the textile, garment, and food industries. Cities like Semarang, Solo, and Pekalongan are major industrial centers. Local resource-based industries are supported by a growing number of medium-sized manufacturing companies and adequate infrastructure, such as the Tanjung Emas Port in Semarang and a good road network. Government industrial development programs and workforce training also help boost productivity in Central Java.

5. West Papua

West Papua has an LQ value of 1.4918, indicating emerging manufacturing potential in natural resource sectors such as mining and timber processing. Despite challenging geographic conditions, infrastructure development like ports and transportation networks aids in sector growth. Manufacturing in West Papua is primarily related to the processing of mining and timber products, contributing significantly to the local economy. Investments in infrastructure continue to support industrial sector growth in this region.

6. East Java

With an LQ value of 1.404232, East Java is one of the provinces with a diverse manufacturing sector. Surabaya, the second-largest city in Indonesia and a major trade center, supports industrial growth in East Java. Major industries in the region include shipbuilding (PT. PAL), petrochemicals (Petrokimia Gresik), and food and beverages (Unilever, PT. Multi Bintang). Good infrastructure, such as Tanjung Perak Port and toll roads, supports logistics and distribution. Numerous universities and training institutions in East Java also provide the skilled workforce needed by the manufacturing sector.

7. Bangka Belitung Islands

The Bangka Belitung Islands, with an LQ value of 1.059078, are known for their large tin mining industry, which is the main manufacturing sector in the region. Tin processing and

production constitute a major manufacturing sector that significantly contributes to the local economy. In addition to mining, the tourism sector is also rapidly growing in the Bangka Belitung Islands, supporting local economic growth. Port and transportation facility development in the region also strengthens the industrial and tourism sectors.

Provinces with an LQ > 1 indicate strong manufacturing agglomeration in Indonesia. Factors such as strategic location, special economic zones, good infrastructure, and supportive government policies have facilitated manufacturing industry growth in these provinces. This agglomeration not only boosts regional economies and creates new job opportunities but also enhances Indonesia's competitiveness and global integration in the global manufacturing supply chain.

This aligns with Alfred Marshall's Agglomeration Theory proposed in 1890. This theory posits that the benefits of industrial agglomeration arise from the efficiencies and advantages gained through various interactions and collaborations among firms within a concentrated area. The following illustrates how this theory applies to the provinces in Indonesia with a Location Quotient (LQ) > 1 in the manufacturing sector:

1. Geographic Proximity

Firms within an agglomerated area can benefit from easier access to raw materials, skilled labor, and larger markets. For example, West Java and East Java, being close to ports and well-developed logistics infrastructure, support the growth of the manufacturing industry.

2. Labor Efficiency and Specialization

With industry clusters, firms can take advantage of the efficiency derived from labor specialization and expertise available in the area. For instance, the textile industry in Central Java and the electronics industry in the Riau Archipelago can optimize local expertise to enhance productivity.

3. Collaboration and Innovation

Intensive interactions among firms within an agglomeration facilitate the exchange of information, ideas, and technology. This fosters innovation and the development of new products, which are crucial for improving global competitiveness.

4. Government Policy Support

Government policies that support infrastructure development, special economic zones, and investments in education and workforce training further amplify the positive effects of industrial agglomeration on regional economic growth.

Therefore, provinces with an LQ > 1 in the manufacturing sector in Indonesia not only demonstrate strong industrial concentration but also embody the principles outlined in Marshall's Agglomeration Theory. These industrial clusters contribute to Indonesia's economic growth, job creation, and enhanced global economic engagement.

Impact of Economic Growth on Industrial Agglomeration

The regression results indicate that economic growth has a negative and significant impact on industrial agglomeration. The negative coefficient suggests that each unit increase in economic growth is associated with a decrease in industrial agglomeration. Supporting research includes Henderson (2003), who found that rapid economic growth can lead to increased operational costs in industrial areas, reducing the attractiveness of agglomeration. Additionally, Puga (2010) demonstrated that poorly managed economic growth can lead to imbalances in costs and benefits in industrial areas, hindering industrial concentration. Glaeser & Gottlieb (2009) also found that rapid economic growth can diminish the economic benefits of agglomeration by increasing living and operational costs, prompting companies to relocate to areas with more stable economic conditions. The regression results from this study align with the idea that rapid economic growth can reduce industrial concentration in a

region. This highlights the importance of efficient economic growth management to maintain industrial agglomeration and support regional economic growth.

Impact of Investment on Industrial Agglomeration

The regression results show that investment has a negative and significant impact on industrial agglomeration. Previous studies supporting this finding include Hanson (1994), who discovered that uncoordinated or excessive investment in a region can lead to a reduction in agglomeration benefits due to increased competition for limited resources. Moreover, Martin & Sunley (1998) found that large investments in specific sectors can create economic imbalances and increase operational costs, which can subsequently reduce industrial concentration. Duranton & Puga (2004) also observed that excessive investment can lead to local market saturation, prompting firms to seek new locations with greater market potential. The regression results from this study support the notion that poorly managed investment can decrease industrial concentration in a region. This underscores the importance of efficient investment planning and management to sustain industrial agglomeration and support regional economic growth.

Impact of Human Development Index (HDI) on Industrial Agglomeration

The regression results show that the HDI does not have a significant impact on industrial agglomeration. This is supported by Audretsch & Feldman (2004), who found that although a high HDI correlates with various economic benefits such as increased productivity and innovation, its direct effect on industrial agglomeration is not always significant. This is because industrial agglomeration is often more influenced by factors such as physical infrastructure, government policies, and market conditions than by human development indicators directly. Additionally, Mellander & Florida (2021) showed that while a high quality of life represented by HDI can attract skilled and innovative labor, it does not always translate directly into industrial concentration if other factors like operational costs and local policies are not supportive. Moretti (2012) also noted that investments in education and health that improve HDI are important, but without a supportive business environment, these benefits may not be fully reflected in industrial agglomeration. The regression results indicating that HDI does not significantly impact industrial agglomeration are supported by this research. This emphasizes the importance of considering various factors beyond HDI in efforts to enhance industrial concentration and support regional economic growth.

Impact of Population Size on Industrial Agglomeration

The regression results show that population size has a positive and significant impact on industrial agglomeration. Supporting research includes Glaeser & Gottlieb (2008), who found that areas with larger populations tend to have higher levels of industrial agglomeration due to larger market scales and diverse human resources. A large population provides a broad consumer base and a varied labor force, supporting industrial growth and concentration. Storper & Venables (2004) demonstrated that increased population in urban areas can enhance social interactions and idea exchanges, driving innovation and industrial growth. Duranton & Puga (2023) also noted that areas with large populations offer various advantages, such as economies of scale, better market access, and more developed infrastructure, all of which contribute to increased industrial agglomeration. The regression results indicating that an increase in population positively impacts industrial agglomeration are supported by this research. This highlights the importance of a large and diverse population in supporting industrial concentration and regional economic growth.

CONCLUSION

This study aimed to investigate the factors influencing industrial agglomeration in Indonesia using panel data from 34 provinces over the period from 2012 to 2023. The analysis was conducted using panel data regression and Location Quotient (LQ). The Fixed Effect Model regression results indicate that several independent variables significantly affect industrial agglomeration as the dependent variable. Population size positively and significantly impacts industrial agglomeration, whereas economic growth and investment have a negative and significant impact. These findings suggest that poorly managed economic growth and investment can reduce industrial concentration, while an increase in population supports higher industrial agglomeration.

Based on the regression analysis results, several strategic measures are recommended to strengthen industrial agglomeration and support regional economic growth. First, the government should optimize policies to improve the efficiency of managing economic growth and investment. Second, significant investments in physical infrastructure and technology are necessary to support effective industrial operations. Third, there should be a focus on enhancing the quality of life, education, and access to healthcare to attract and retain skilled labor in the region. Fourth, careful planning in resource and investment management is essential to ensure economic and environmental sustainability. Lastly, strong collaboration between the government, industry, and the education sector is crucial to create an environment that fosters innovation and sustainable industrial growth. By implementing these measures, it is hoped that inclusive and sustainable economic growth in industrial agglomeration can be achieved.

REFERENSI

Adijaya, D. N. H. (2022). Analisis Faktor - Faktor Yang Mempengaruhi Aglomerasi Di Daerah Khusus Ibukota Jakarta. In *Science* (Vol. 7, Issue 1). Universitas Islam Indonesia.

Arsyad, L. (2010). *Ekonomi Pembangunan*. UPP STIM YKPN.

Audretsch, D. B., & Feldman, M. P. (2004). Knowledge spillovers and the geography of innovation. In *In Handbook of regional and urban economics: Vol. Volume 4* (pp. 2713–2739). Elsevier. http://www.sciencedirect.com/science/article/B7P64-4FFPH84-2R/2/2c557f0d93ea190abcc8a573e7d47217

Azwina, R., Wardani, P., Sitanggang, F., & Silalahi, P. R. (2023). Strategi Industri Manufaktur Dalam Meningkatkan Percepatan Pertumbuhan Ekonomi Di Indonesia. *Profit: Jurnal Manajemen, Bisnis Dan Akuntansi*, *2*(1), 44–55.

Duranton, G., & Puga, D. (2004). Micro-foundations of urban agglomeration economies. In *In Handbook of regional and urban economics* (Vol. 4, pp. 2063–2117). Elsevier. http://www.nber.org/papers/w9931

Duranton, G., & Puga, D. (2023). Urban Growth and Its Aggregate Implications. *Econometrica*, *91*(6), 2219–2259. https://doi.org/10.3982/ecta17936

Edward L. Glaeser, Hedi D. Kallal, José A. Scheinkman, & Andrei Shleifer. (1992). Growth in Cities. In *Journal of Political Economy* (Vol. 100, Issue 6, pp. 1126–1152).

Emalia, Z. (2016). Determinan Aglomerasi Industri Manufaktur di Provinsi Jawa Barat. *Jurnal Ekonomi Pembangunan*, *2013*, 145–151.

Eriandy, F. M. (2021). Analisis Aglomerasi Pada Koridor Ekonomi di Indonesia. *Jurnal Ekonomi Akuntansi Dan Manajemen*, *20*(2), 134. https://doi.org/10.19184/jeam.v20i2.25775

Glaeser, E. L., & Gottlieb, J. D. (2008). The Economics of Place-Making Policies. *Brookings Papers on Economic Activity*, 155–253. https://doi.org/10.3390/proceedings1060663

Glaeser, E. L., & Gottlieb, J. D. (2009). The wealth of cities: Agglomeration economies and

spatial equilibrium in the United States. *Journal of Economic Literature*, *47*(4), 983–1028. http://www.nber.org/papers/w14806

Hanson, G. H. (1994). Localization Economies, Vertical Organization, and Trade. *The American Economic Review*, *86*(5), 1266–1278.

Henderson, J. V. (2003). Marshall's scale economies. *Journal of Urban Economics*, *53*(1), 1–28. https://doi.org/10.1016/S0094-1190(02)00505-3

Jhingan M L. (2012). *Ekonomi Pembangunan dan Perencanaan*. Jakarta : Raja Grafindo Persada.

Kasmir. (2019). *Analisis Laporan Keuangan* (Edisi 1). Jakarta : PT Raja Grafindo Persada.

Kuchiki, A. (2002). Agglomeration of Exporting Firms in Industrial Zones in Northern Vietnam: Players and Institutions,. *International Joint Research Project. Japan Institute of Developing Economies.*

Kuncoro, M. (2002). *Analisis Spasial dan Regional, Studi Aglomerasi dan Kluster Industri Indonesia*. Yogyakarta : UPP AMP YKPN.

Kuncoro, M. (2012). *Masalah, Kebijakan Dan Politik Ekonomika Pembangunan*. Jakarta : Erlangga.

Liu, Y., Yang, M., & Cui, J. (2024). Urbanization, economic agglomeration and economic growth. *Heliyon*, *10*(1), e23772. https://doi.org/10.1016/j.heliyon.2023.e23772

Martin, R., & Sunley, P. (1998). Slow convergence? The new endogenous growth theory and regional development. *Economic Geography*, *74*(3), 201–227. https://doi.org/10.3166/ges.7.129-154

Mellander, C., & Florida, R. (2021). The Rise of Skills: Human Capital, the Creative Class, and Regional Development. In *Handbook of Regional Science* (Issue 266, pp. 707–719). https://doi.org/10.1007/978-3-662-60723-7_18

Moretti, E. (2012). *The new geography of jobs*. Houghton Mifflin Harcourt.

Mulyadi, S. (2008). *Ekonomi Sumber Daya Manusia Dalam Perspektif Pembangunan*. Jakarta : Rajawali Press.

Nugroho, Y. D., & Wahyuni, K. T. (2020). Aglomerasi Dan Dinamika Industri Manufaktur Pada Era Revolusi Industri 4.0 Di Koridor Ekonomi Jawa. *Seminar Nasional Official Statistics*, *2019*(1), 687–699. https://doi.org/10.34123/semnasoffstat.v2019i1.251

Nurdiman. (2008). *Ekonomi Kependudukan*. Jakarta : Raja Grafindo Persada.

Puga, D. (2010). The magnitude and causes of agglomeration economies. *Journal of Regional Science*, *50*(1), 203–219. https://doi.org/10.1111/j.1467-9787.2009.00657.x

Putri Salsabila, S., S, B., & Soeharjoto. (2019). Faktor-Faktor Yang Mempengaruhi Aglomerasi. *Media Ekonomi*, *27*(2), 133–140.

Rahmawati, Y. O. (2019). Analisis Pengaruh Indeks Pembangunan Manusia (Ipm), Tingkat Partisipasi Angkatan Kerja (Tpak), Dan Pengeluaran Pemerintah Di Sektor Kesehatan Dan Pendidikan Terhadap Pertumbuhan Ekonomi Di Indonesia Periode 1995-2017. *Jurnal Ilmiah Mahasiswa FEB Universitas Brawijaya*, 10–10.

Silaen, M. L. M., & Esther, A. M. (2015). Pengaruh Investasi Dan Tenaga Kerja Terhadap Pdrb Sektor Industri Di Provinsi Jawa Barat. *Media Ekonomi*, *23*(3), 189–198. https://doi.org/10.25105/me.v23i3.3521

Simarmata, Y. W., & Iskandar, D. D. (2022). Pengaruh Pengeluaran Pemerintah, Investasi, Jumlah Penduduk, Kemiskinan Terhadap Pertumbuhan Ekonomi Dan Indeks Pembangunan Manusia: Analisa Two Stage Least Square untuk Kasus Indonesia. *Jurnal Dinamika Ekonomi Pembangunan*, *5*(1), 78–94. https://doi.org/10.14710/jdep.5.1.78-94

Sodik, J., & Iskandar, D. (2007). Aglomerasi Dan Pertumbuhan Ekonomi: Peran Karakteristik Regional Di Indonesia. *Jurnal Ekonomi Dan Studi Pembangunan*, *8*, 117–129.

Storper, M., & Venables, A. J. (2004). Buzz: Face-to-face contact and the urban economy.

Journal of Economic Geography, *4*(4), 351–370. https://doi.org/10.1093/jnlecg/lbh027

Sukirno, S. (2015). *Ekonomi Pembangunan: Proses, Masalah dan dasar Kebijakan.* (Edisi Ke 2). Jakarta : Kencana.

Tarigan, R. (2012). *Ekonomi Regional Teori dan Aplikasi Edisi Revisi.* Jakarta : PT Bumi Aksara.

Tilaar, S. (2010). Tinjauan Sebaran Lokasi Aglomerasi Industri Di Indonesia. *Tekno*, *07*(52), 90–96.

Todaro. (2006). *Pembangunan Ekonomi* (Edisi ke 9). Jakarta : Erlangga.

Todaro P. Michael. (2000). *Pembangunan Ekonomi Dunia Ketiga* (Jilid I). Jakarta : Erlangga.

Ucak, A. (2015). Adam Smith: The Inspirer of Modern Growth Theories. *Procedia - Social and Behavioral Sciences*, *195*(284), 663–672. https://doi.org/10.1016/j.sbspro.2015.06.258

Wibowo, W. S. (2021). *Analisis Determinan Aglomerasi Industri Di Jawa Barat Tahun 2015-2019*.

Widarjono, A. (2012). *Ekonometrika Pengantar dan Aplikasinya*. Yogyakarta : UPP STIM YKPN Yogyakarta.

Windasari, M. D., Ningsih, S., & Pravasanti, Y. A. (2021). Analisis Pengaruh Aglomerasi Industri, Angkatan Kerja, Dan Human Capital Investment Terhadap Pertumbuhan Ekonomi Kabupaten/Kota Di Provinsi Jawa Tengah Tahun 2017-2019. *Jurnal Akuntansi Dan Pajak*, *22*(1), 372. https://doi.org/10.29040/jap.v22i1.2871

Wulandari, D., & Sakti, R. K. (2020). Analisis Pengaruh Pertumbuhan Ekonomi, Indeks Pembangunan Manusia, Aglomerasi Industri Pengolahan, Dan Angkatan Kerja Terhadap Disparitas Pendapatan. *Jurnal Ilmiah*, 1–15.

Zuliastri, F., Rindayati, W., & Asmara, A. (2018). Analisis Faktor Yang Memengaruhi Aglomerasi Industri Unggulan Daerah Dan Hubungannya Dengan Daya Saing Industri Daerah. *Jurnal Ekonomi Dan Kebijakan Pembangunan*, *2*(2), 113–134. https://doi.org/10.29244/jekp.2.2.2013.113-134