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THE IMPACT OF INDUSTRIAL AGGLOMERATION ON LABOR MISALLOCATION IN EAST JAVA

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ABSTRACT

Agglomeration is believed to offer various advantages to firms located within its area. One such benefit is the potential reduction in labor misallocation. However, theoretical expectations do not always align with real-world practices. This study aims to analyze the impact of industrial agglomeration areas on the degree of labor misallocation in East Java by utilizing panel data from the Large and Medium Manufacturing Industry Survey (IBS) for the period 2010–2015. The analysis employs a fixed effects panel regression method. The findings reveal that firms located within agglomeration areas experience a labor misallocation level 2.52 times higher than those outside such areas. Additionally, a 1% increase in the number of workers leads to a 0.122% increase in labor misallocation. Exporting firms tend to exhibit a higher level of misallocation compared to non-exporting firms, by 1.926 points. Moreover, the study finds that a higher Herfindahl-Hirschman Index (HHI) among firms also contributes to greater labor misallocation. Specifically, a one-point increase in the HHI is associated with a 0.7% rise in labor misallocation.

Keywords: *Industrial Agglomeration, Labor Misallocation, East Java, Gerbangkertosusila*

ABSTRAK

Aglomerasi dipercaya bisa memberikan manfaat terhadap perusahaan yang berada di dalamnya. Salah satu manfaat yang bisa didapat adalah menurunkan tingkat misalokasi tenaga kerja. Namun, teori tidak bisa selalu berjalan sejajar dengan praktik lapangan. Penelitian ini bertujuan untuk menganalisis pengaruh wilayah aglomerasi industri terhadap tingkat misalokasi tenaga kerja di Jawa Timur dengan menggunakan data IBS (Industri Besar Sedang) tahun 2010 – 2015. Metode yang digunakan adalah regresi data panel fixed effect. Hasil penelitian menunjukkan bahwa perusahaan yang berada di dalam wilayah aglomerasi memiliki tingkat misalokasi tenaga kerja 2,52 kali lebih tinggi daripada perusahaan yang berada di luar wilayah aglomerasi. Hasil lain menunjukkan bahwa penambahan 1% jumlah tenaga kerja akan meningkatkan misalokasi tenaga kerja sebesar 0,122%. Selain itu, perusahaan yang melakukan ekspor cenderung memiliki tingkat misalokasi yang lebih tinggi daripada perusahaan yang tidak melakukan ekspor sebesar 1,926 poin dan semakin tinggi indeks HHI antar perusahaan, maka juga akan semakin meningkatkan misalokasi tenaga kerja. Peningkatan sebesar 1 satuan HHI, maka akan meningkatkan misalokasi tenaga kerja sebesar 0,7%.

Kata Kunci: *Aglomerasi Industri, Misalokasi Tenaga Kerja, Jawa Timur, Gerbangkertosusila*

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Introduction

Industrial agglomeration refers to an economic condition characterized by the geographic concentration of industries aimed at enhancing productivity through positive externalities such as knowledge spillovers, input sharing, and labor pooling (Anderson & Lööf, 2011; Marshal, 1920; Xu, 2009). Empirical evidence indicates that industrial agglomeration can generate various positive effects, particularly for workers in agglomerated areas, where work experience in major cities tends to yield higher wages compared to non-agglomerated regions (Carlsen et al., 2016; D'Costa & Overman, 2014; Matano & Naticchioni, 2011). Additionally, agglomeration has been shown to increase firm productivity; for instance, firms located in agglomerated areas of France are, on average, 9.7% more productive than those in non-agglomerated areas (Combes et al., 2012). These findings underscore the potential benefits of agglomeration for both firms and workers. Nevertheless, such productivity gains do not automatically imply an efficient allocation of resources. In fact, recent debates highlight that agglomeration may also exacerbate labor misallocation, thereby reducing its net economic benefits.

However, despite its positive impacts, it is important to consider the potential negative effects of agglomeration. In practice, theoretical assumptions do not always align with real-world conditions. Heise & Porzio (2022) argue that agglomeration often leads to spatial frictions, including home bias, moving costs, spatial search costs, and regional comparative advantage. Home bias occurs when workers prefer to be employed in locations close to their residences, driven by factors such as convenience, accessibility, and strong social ties. This condition contributes to spatial frictions such as moving costs—which include daily transportation expenses, time costs, and health costs—as well as spatial search costs, which refer to expenditures incurred when seeking employment in different or distant locations. Moreover, regional comparative advantage highlights a region's superiority in specific sectors compared to others. These spatial frictions reveal the complexity and potential downsides of agglomeration. Furthermore, Ji et al. (2018) note that agglomeration can trigger a crowding effect that exacerbates labor misallocation, resulting in problems such as environmental pollution, capital spillovers, and increased operational costs, ultimately pushing firms to relocate from agglomerated areas to mitigate these negative effects. This evidence suggests that while agglomeration may offer benefits, these can be offset by significant drawbacks, necessitating further investigation into its overall impact.

In the context of Indonesia, Wibowo & Kudo (2019) demonstrate that industrial agglomeration across 44 cities and regencies contributes positively to labor productivity in terms of output share. However, it also has a negative effect related to labor density, where an increase of 1,000 workers per square kilometer reduces productivity by IDR 670 per worker. These findings suggest that while agglomeration can enhance productivity, it also presents challenges associated with labor misallocation. This indicates that the issue of misallocation is not merely theoretical but has already manifested in Indonesia's industrial landscape, reinforcing the need for empirical investigation at the firm and regional levels. Furthermore, the study highlights that industrial concentration on the island of Java has led to significant productivity disparities between Java and non-Java regions, underscoring the need for balanced regional development policies. This research highlights the dual nature of agglomeration effects in Indonesia, emphasizing the importance of strategic infrastructure investment and policy interventions to mitigate their negative impacts while amplifying their benefits.

East Java is one of Indonesia's leading provinces, contributing 14.22% to the national GDP in the fourth quarter of 2023 (Direktorat Jenderal Perbendaharaan, 2024). This substantial contribution is supported by several key factors. In 2023, East Java had a population of 41.64 million (Qolbi et al., 2024), providing a large and diverse labor force that supports various economic sectors, particularly manufacturing and services. Moreover, East Java is home to

the Gerbangkertosusila agglomeration area, which includes Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo, and Lamongan. This agglomeration is the second largest in Indonesia, after Jakarta, which includes Bogor, Depok, Tangerang, Bekasi, and Cianjur (collectively known as Jabodetabekjur) (Rustiadi et al., 2021). Centered in Surabaya—the provincial capital—Gerbangkertosusila functions as both the economic and administrative hub of the region. The area benefits from well-developed infrastructure, such as the Tanjung Perak seaport, Juanda international airport, and an extensive toll road network, all of which facilitate economic activity and trade (Kementerian Perhubungan, 2023). Additionally, local government policies that are business- and investment-friendly play a crucial role in promoting economic growth. Initiatives such as industrial zone development, improvements in education and vocational training, and support for micro, small, and medium enterprises (MSMEs) contribute to a favorable business environment. These factors have collectively enabled East Java to achieve significant progress and establish itself as one of the main pillars of Indonesia's economy. However, the very scale of industrial concentration and the size of its labor force also raise critical questions regarding allocation efficiency. The dense clustering of industries may generate productivity gains, yet it could equally exacerbate labor misallocation due to sectoral imbalances, congestion, or limited labor mobility. This makes East Java a particularly relevant case for investigating the complex link between agglomeration and labor allocation efficiency.

Given the prominence of industrial agglomeration and the sizable labor force in East Java, understanding the relationship between these two factors is of considerable importance. Despite the extensive literature on industrial agglomeration and productivity, empirical studies that directly link agglomeration to labor misallocation remain scarce, particularly in developing economies. Most prior research has emphasized the productivity-enhancing role of agglomeration at the national or cross-country level, with limited attention to its potential adverse effects on labor allocation efficiency. In Indonesia, studies have primarily focused on aggregate productivity outcomes, leaving unexplored how agglomeration may exacerbate or alleviate misallocation at the firm level. This omission is particularly relevant because labor misallocation has direct implications for productivity, efficiency, and the effectiveness of regional development strategies.

This gap is especially evident in East Java, where the Gerbangkertosusila metropolitan area constitutes one of the country's largest industrial hubs. Despite its economic significance, no prior research has systematically examined whether the concentration of industries in this region leads to more efficient labor utilization or, conversely, contributes to greater misallocation. Addressing this gap is critical not only for extending the literature on agglomeration and labor economics but also for generating evidence-based insights for regional policy in Indonesia. Accordingly, this study aims to investigate the impact of industrial agglomeration on labor misallocation in East Java. Specifically, it inquires whether industrial agglomeration contributes to a reduction in labor misallocation by enhancing productivity and labor matching, or whether it instead exacerbates misallocation through crowding effects, market concentration, and spatial frictions. By addressing this question, the study aims to analyze the dynamics of agglomeration and its impact on labor allocation efficiency, while providing policy recommendations to reduce misallocation and enhance regional productivity.

Literature Review

Resource Allocation and Misallocation

Resource allocation is the process of distributing a firm's limited resources in order to achieve its objectives (Ansoff, 1965; Chandler, 1962). Conversely, resource misallocation, as defined by Porter (1991), refers to the use of resources in a manner misaligned with corporate strategy and goals, which can hinder economic growth and reduce production efficiency (Baumol, 1969; Rumelt, 2011). Baumol (1969) noted that resource misallocation occurs when firms fail to allocate their resources optimally toward the most productive activities, while Rumelt (2011) emphasizes the importance of long-term strategies to prevent inefficient

allocation. In the broader economic context, misallocation is particularly relevant in labor markets, where divergences between wages and the value of the marginal product of labor (VMPL) reduce aggregate productivity. This theoretical foundation highlights the importance of examining how structural and spatial factors, such as industrial agglomeration, influence labor allocation.

Agglomeration Theory

Agglomeration theory, originating from Marshall (1920), identifies two major forms of agglomeration economies: localization and urbanization. Localization refers to the benefits from proximity to similar industries, while urbanization relates to the advantages of large urban areas. Modern perspectives expand on these ideas by incorporating natural resources, technological advancements, and infrastructure (Marshall, 1920). In Indonesia, the concept is formalized through Law No. 26 of 2008 on National Spatial Planning, which aims to balance economic, social, and environmental considerations. Concrete examples include Jabodetabekjur and Gerbangkertosusila, both evolving into major economic hubs (Firman, 2009). These developments show how agglomeration shapes growth, yet they also raise questions regarding its efficiency. While clustering may enhance productivity through spillovers and input sharing, it may also generate frictions, congestion, and labor misallocation, making empirical investigation essential.

Productivity

Productivity, broadly defined as the ratio of output to input (Busro, 2018; Syverson, 2011), reflects efficiency in the use of production factors such as capital, labor, and raw materials. Effective management practices and organizational capacity also influence productivity (Bloom & Van Reenen, 2007). In addition, technology (Acemoglu & Restrepo, 2018). Human capital (Becker, 1994) and institutional factors (Djankov et al., 2006) play critical roles. A widely used measure is Total Factor Productivity (TFP), defined as the ratio of Gross National Product to total labor and capital input (Radyanto, 2005). At the firm level, TFP captures the efficiency of utilizing labor, capital, and technology. Solow (1957) demonstrated TFP as a driver of growth, while Felipe (1997) emphasized its link to R&D and managerial capability. Thus, productivity analysis extends beyond simple output–input measures, underscoring that efficient labor allocation is central to sustaining long-term growth.

The existing literature presents mixed evidence on the relationship between agglomeration and labor outcomes. On the positive side, studies such as Combes et al. (2012), D'Costa & Overman (2014), Carlsen et al. (2016), and Matano & Naticchioni (2011) highlight that agglomeration enhances wages, productivity, and labor matching. In contrast, Heise & Porzio (2022) and Ji et al. (2018) emphasize the negative consequences, showing that agglomeration may intensify spatial frictions, congestion, and crowding effects that exacerbate misallocation. These divergent results suggest that the impact of agglomeration is context-dependent, shaped by regional labor market conditions, infrastructure, and institutional frameworks. In the Indonesian setting, and particularly in East Java where Gerbangkertosusila functions as one of the country's largest industrial hubs, this debate remains unresolved. Whether agglomeration improves allocation efficiency or instead aggravates labor misallocation is an open empirical question that this study seeks to address.

Methodology

Dataset

This study utilizes data from the IBS (Large and Medium Manufacturing Industry Survey) conducted by Statistics Indonesia (BPS). The IBS survey is designed in collaboration with the Ministry of Industry, the National Development Planning Agency (Bappenas), and other relevant institutions (BPS, 2023). The primary aim of the survey is to collect complete, accurate, relevant, and timely statistical data on large and medium-sized manufacturing

industries for development planning, particularly in the manufacturing sector. The study focuses on the period from 2010 to 2015. This timeframe was selected because the IBS datasets during these years include the regional (location) variable, which is not available in datasets from 2015 onward. The inclusion of location information is crucial for this study's spatial and agglomeration-based analyses.

In addition to describing the dataset, it is important to define the variables used in the empirical analysis. Table 1 provides the definitions, units of measurement, and data sources for all variables employed in this study. This table clarifies the construction of the dependent variable (labor misallocation), the explanatory variables related to agglomeration, and the control variables such as export status, industry concentration, output, capital, and labor.

Table 1: Variable Definition Table

Variable	Definition	Unit	Data Source
Labor misallocation	The difference between the value of the marginal product of labor (VMPL) and the wage paid to labor. Absolute value and log transformation are used for empirical analysis.	IDR (million) per worker (absolute), log-transformed	Author's calculation based on IBS
VMPL	Value of Marginal Product of Labor, computed from the estimated marginal elasticity of labor × firm revenue	IDR (million) per worker	Author's calculation based on IBS
Wage	Total firm wage expenditure is divided by the number of workers, then transformed into a log for estimation	IDR (million) per worker; log-transformed	IBS (BPS)
Agglomeration (Dummy)	1 = firm located in Gerbangkertosusila metropolitan area (East Java agglomeration); 0 = otherwise	Binary (0/1)	Author's classification using IBS regional codes
Agglomeration (Size)	Number of workers in the agglomerated area (Gerbangkertosusila), log-transformed for estimation	Persons; log of persons	Author's calculation based on IBS
Export status	1 = firm reports export activity; 0 = otherwise	Binary (0/1)	IBS (BPS)
HHI (Herfindahl-Hirschman Index)	Industry concentration index at 2-digit ISIC level, based on employment shares	Index (0–10,000)	Author's calculation based on IBS
Output	Firm's value added, deflated by the Wholesale Price Index (WPI), then log-transformed	IDR (million, constant price); log-transformed	IBS (BPS); WPI from BPS
Capital	Firm's fixed capital, deflated by WPI, then log-transformed	IDR (million, constant price); log-transformed	IBS (BPS); WPI from BPS
Labor	Number of employees in the firm, log-transformed for estimation	Persons; log of persons	IBS (BPS)

Methodology

This research employs a quantitative approach, defined as the use of numerical data in the collection, interpretation, and presentation of research findings (Arikunto, 2006). This approach is appropriate given the numerical nature of economic data and the need for comprehensive analytical methods. As previously mentioned, the study uses the IBS dataset from 2010 to 2015, which is considered relevant and reliable for assessing industrial development, particularly in the manufacturing sector. The classification of misallocation is based on the 2-digit ISIC (International Standard Industrial Classification) codes. To control for unobserved heterogeneity across firms and time, the study applies a fixed-effects regression model.

Before presenting the empirical model, it is important to provide a concise overview of the research procedure. Figure 1 illustrates the roadmap of this study, beginning with dataset preparation, followed by productivity estimation, the calculation of marginal labor elasticity and VMPL, the construction of the labor misallocation index, and finally the regression analysis.

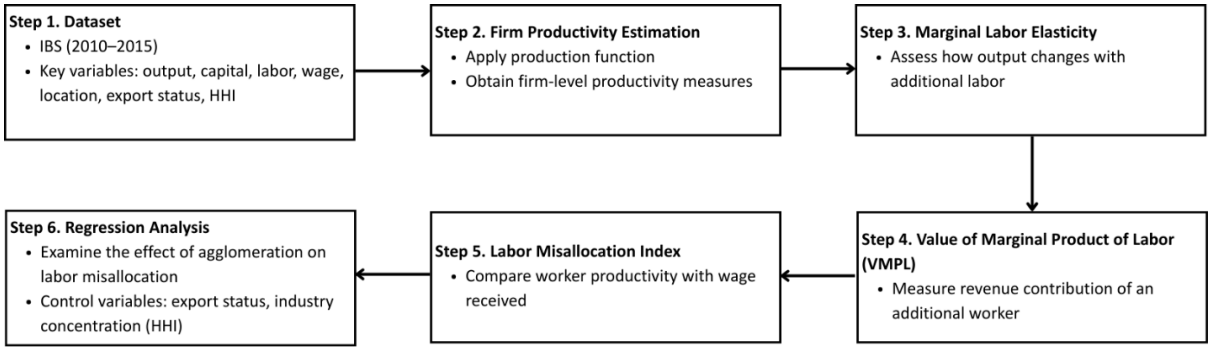

Figure 1: Empirical Procedure Flowchart

The empirical analysis begins by estimating firm-level productivity gaps using a translog production function:

$$q_{it} = \beta_l l_{it} + \beta_{ll} l_{it}^2 + \beta_k k_{it} + \beta_{kk} k_{it}^2 + \beta_{lk} l_{it} k_{it} + w_{it} + \varepsilon_{it} \quad (1)$$

Where q_{it} represents the log of value added, l_{it} is the log of the number of workers, k_{it} is the log of fixed capital, and w_{it} denotes the Hicks-neutral productivity shock. In this equation, the variables of value added and capital are deflated using the Wholesale Price Index (WPI) for the corresponding year. The inclusion of squared terms for labor and capital aims to capture a quadratic pattern in the equation, reflecting situations where increases in input do not always lead to proportional increases in output. The interaction term between labor and capital indicates the complementary relationship between the two. The coefficient w_{it} reflects productivity shocks experienced by the firm but unobserved by the researcher and ε_{it} represents an error term that is not captured by the observation. Once the coefficients from equation (1) are estimated, the next step in the model is to calculate the marginal elasticity of labor. This elasticity is then used to compute the misallocation index, which is defined as follows:

$$\phi_{it}^l = \beta_l + 2\beta_{ll} l_{it} + \beta_{lk} k_{it} \quad (2)$$

Where ϕ_{it}^l represents the marginal labor elasticity for firm *i* in year *t*. Equation (2) is used to determine how changes in the number of workers, taking into account their interaction with capital, affect a firm's output at the margin. The marginal labor elasticity, which has been previously calculated, will then be used to compute the value of VMPL (Value of Marginal Product of Labor), which indicates how changes in the number of workers influence the firm's output. The VMPL model used in this study is as follows:

$$VMP_{it}^L = \phi_{it}^l \frac{P_{it} * Q_{it}}{L_{it}} \quad (3)$$

In Equation (3), changes in a firm's output due to changes in labor input are denoted by $\frac{P_{it} * Q_{it}}{L_{it}}$. This notation illustrates how total revenue $(P_{it} * Q_{it})$ would change if there were changes in the number of workers (L_{it}). Interpreted in economic terms, it represents the additional revenue a firm would earn when it hires one more unit of labor. By multiplying this with the marginal labor elasticity (ϕ_{it}^l), the value of VMPL can be obtained.

After calculating the VMPL, the next step is to formulate an equation to assess labor misallocation. As discussed previously, misallocation refers to the use of resources in a way

that is not aligned with the company's strategies and objectives (Porter, 1991). Based on this definition, labor misallocation occurs when workers are unable to fully utilize their potential within a company. The equation used to measure labor misallocation is as follows:

$$G_{it}^{L} = VMP_{it}^{L} - w_{it} \quad (4)$$

In Equation (4), labor misallocation (G_{it}^{L}) is calculated by subtracting the VMPL from the wage paid to labor (w_{it}). A positive value of G_{it}^{L} indicates that labor contributes more value-added than the cost incurred by the firm to pay for it. Conversely, a negative value of G_{it}^{L} suggests that labor does not provide a contribution commensurate with the wages paid.

The economic intuition behind this formulation is that labor misallocation can be observed by comparing the value of marginal product of labor (VMP) with the wage (w). In a competitive labor market equilibrium, firms hire workers until VMP equals w, implying that labor resources are efficiently allocated because the additional productivity of workers is exactly matched by their compensation. This ideal condition (VMP = w) represents the benchmark of allocative efficiency, although in practice it can only be validated through empirical analysis. Deviations from this condition are common: when VMP > w, it indicates that workers generate more value than what is reflected in their wages, suggesting under-compensation and potential under-allocation of labor. Conversely, when VMP < w, it shows that labor is employed beyond its efficient level, implying over-compensation or excessive allocation. Hence, the difference between VMP and w provides a rational justification for quantifying labor misallocation in this study.

The next step is to estimate the impact of agglomeration on labor misallocation. Agglomeration is measured using two proxy variables: a dummy variable indicating whether the firm is located in an agglomerated area and the number of workers in that agglomerated area. Equation (5) is used to estimate the effect of firm location in agglomerated areas on labor misallocation, while Equation (6) estimates the influence of the number of workers in agglomerated areas on labor misallocation. Both models employ the same control variables, namely the firm's export status, agglomeration area location, and the Herfindahl-Hirschman Index (HHI) of industry concentration in relation to labor misallocation. These two models are presented as follows:

$$\ln(G_{it}^{L}) = a + Agglomeration_{it} + Exp_{it} + Comp_{st} + \varepsilon_{it} \quad (5)$$

$$\ln(G_{it}^{L}) = a + \ln(\log\_labor\_ez) + Exp_{it} + Comp_{st} + \varepsilon_{it} \quad (6)$$

Where $ln(G_{it}^{L})$ is the logarithm of absolute labor misallocation, $Agglomeration_{it}$ is a dummy variable indicating whether the firm operates in an agglomerated area or not, log_labor_ez represents the number of workers in the agglomerated area, Exp_{it} is a dummy variable for the firm's export status, and $Comp_{st}$ refers to the Herfindahl-Hirschman Index. By using the two model equations above, this study aims to obtain various insights regarding labor misallocation based on the firm's operational location, the number of workers in agglomerated areas, the firm's export status, and the level of market concentration.

The empirical models in Equations (5) and (6) were estimated using panel regression techniques. The fixed-effects estimator was selected based on the results of the F-test (which rejected pooled OLS) and the Hausman test (which rejected random effects). Classical assumption tests indicated the presence of autocorrelation (xtserial) and heteroskedasticity (hettest). To address these issues, the estimation employed Generalized Least Squares (GLS), which provides efficient and consistent estimates under heteroskedasticity and autocorrelation across panels. While potential cross-sectional dependency is recognized as a relevant econometric concern in panel data settings, this study did not explicitly conduct a Pesaran CD test. Accordingly, the results should be interpreted with this limitation in mind.

Results and Discussion

Descriptive Statistics

This section discusses the descriptive statistics of the data used in this study. According to Sugiyono (2019), descriptive analysis is a statistical method used to analyze data by describing or illustrating the data that has been collected as it is, without aiming to draw general conclusions or generalizations. This study utilizes several variables, which are used to construct equations (1) through (6). The results of the descriptive analysis for all variables used in this research are presented in the following table:

Table 2: Descriptive Statistics of Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
disic	7177	17317.353	7245.436	102	33200
export status	7177	1.863	.344	0	1
labor	7177	154.669	472.324	20	11308
output konstan	7177	30164161	2.357e+08	2237.567	9.562e+09
capital konstan	7177	2.152e+08	7.693e+09	2.907	5.976e+11
year	7177	2012.471	1.707	2010	2015
total wage	7177	3143097	11474136	2230	2.784e+08
isic code	7177	16.994	7.266	10	33
agglomeration	7177	.344	.475	0	1
loutput	7177	14.653	1.951	7.713	22.981
llabor	7177	3.976	1.136	2.996	9.333
lcapital	7177	13.779	2.196	1.067	27.116
llabor2	7177	17.097	11.218	8.974	87.11
lcapital2	7177	194.685	65.531	1.139	735.288
KL	7177	56.176	24.036	3.593	220.313
labor EZ	7177	2072.339	5071.381	0	24834
log labor EZ	7177	2.692	3.824	0	10.12
log wage	7177	13.191	1.866	7.71	19.445
gap	7177	.633	.129	-.021	.848
vmpl	7177	73054.821	248775.94	-37.849	7614318
misallocation	7177	-3070042.2	11469119	-2.784e+08	5713354.5
abs miss	7177	3087030	11464557	2.417	2.784e+08
log abs miss	7177	13.08	1.911	.883	19.444
market share	7177	.096	.75	0	34.947
HHI	7177	.571	17.526	0	1221.293

The table above presents the descriptive statistics of the variables used in this study. The descriptive statistics include the number of observations, mean, standard deviation, minimum value, and maximum value. In this table, the total number of observations is 7,177 manufacturing firms located in East Java. Descriptive statistics provide information about various aspects of the data structure used in the research. Moreover, descriptive statistics help in observing the distribution and characteristics of the data. For example, the mean value shown in Table 1 allows further analysis of how the data is distributed, supported by the standard deviation. Minimum and maximum values are also provided to determine the range of each variable. In addition, descriptive statistics reveal that the average number of workers per firm is 154 employees, but with a relatively high standard deviation of 472.324.

This indicates that in East Java, there are firms with a small number of workers, while others have a very large workforce.

Based on the previous explanation, this study measures the average labor misallocation in the manufacturing sector based on the 2-digit ISIC code. Figure 2 presents the average misallocation across industrial sectors in the Gerbangkertosusila region.

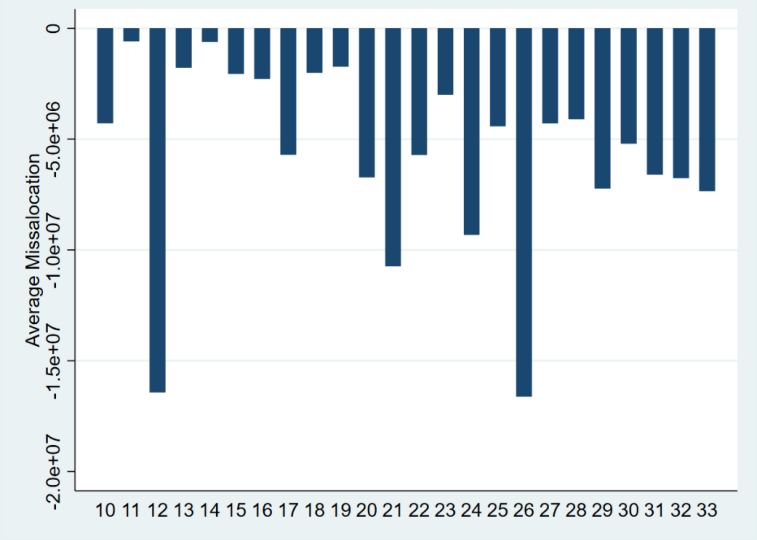

Figure 2: Average Misallocation by 2-Digit ISIC Code in Gerbangkertosusila

Figure 2 shows that the industry with ISIC code 12 (manufacture of tobacco products) experiences a high level of labor misallocation in the Gerbangkertosusila agglomeration area. Additionally, the industry with ISIC code 26 (Manufacture of computer, electronic, and optical products) also exhibits a significant level of misallocation, with an average value of approximately $ -15 million. Similar to the overall region, the average misallocation in the Gerbangkertosusila area is negative, indicating that workers' wages exceed the value added they contribute to the firm.

For comparison, Figure 3 presents the average misallocation in areas outside the Gerbangkertosusila agglomeration. This comparison highlights the differences in labor misallocation between agglomerated and non-agglomerated regions. The figure illustrates the performance of industries in non-agglomerated areas in terms of labor allocation efficiency.

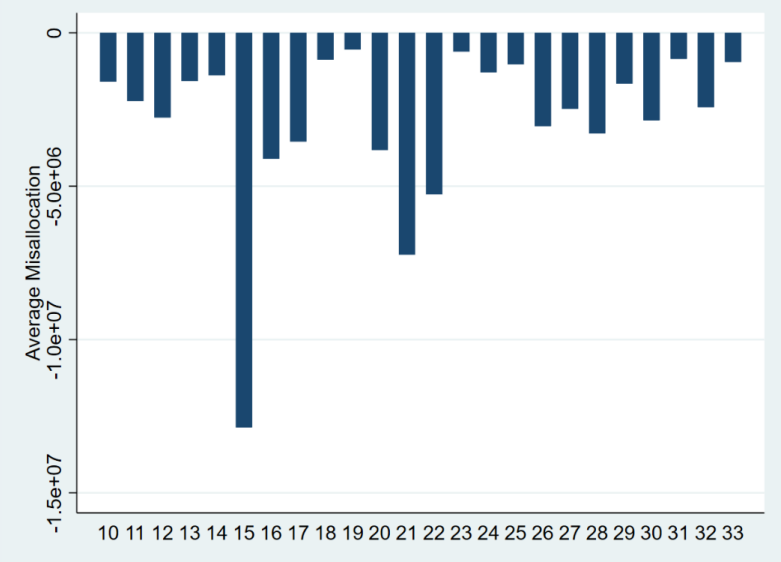

Figure 3: Average Misallocation by 2-Digit ISIC Code in Non-Agglomeration Areas

The majority of misallocation values shown in Figure 3 are below 5 million. This already indicates a significant difference in average labor misallocation between agglomerated and non-agglomerated areas, even when assessed using only descriptive statistics. One notable finding in Figure 3 is that the industrial sector with ISIC code 15 (Manufacture of leather and related products) exhibits the highest misallocation, approaching negative 15 million. By comparing these two regions, the study gains better insight into the impact of agglomeration on labor misallocation. The results help determine whether the observed conditions in the Gerbangkertosusila agglomeration are unique to that area or reflect a broader pattern across other regions. This analysis is crucial for policymakers to develop strategies aimed at addressing labor misallocation and enhancing overall productivity.

Research Findings Description

This study focuses on the agglomeration area in East Java, namely Gerbangkertosusila (Gresik, Bangkalan, Mojokerto, Surabaya, Sidoarjo, Lamongan), which is designated as a National Strategic Area (KSN) according to Government Regulation No. 26 of 2008 concerning the National Spatial Planning. More specifically, the Gerbangkertosusila agglomeration area is regulated under the Regional Regulation of East Java Province No. 4 of 1996. The mapping of the Gerbangkertosusila agglomeration area is as follows:

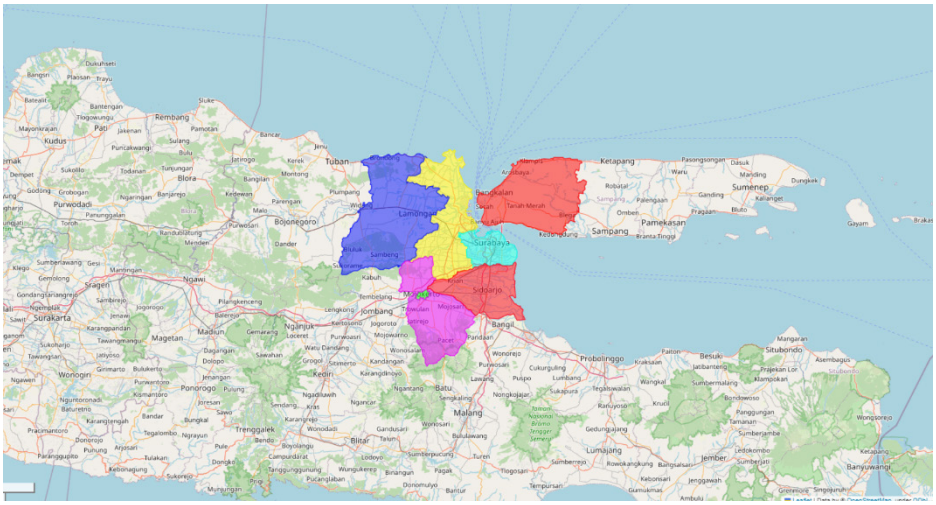

Figure 4: Gerbangkertosusila Agglomeration Area

This study aims to analyze the impact of industrial agglomeration on the degree of labor misallocation in East Java. In other words, it conducts an analysis of labor misallocation in the agglomeration region of Gerbangkertosusila compared to non-agglomerated areas. To carry out this analysis, the model equations previously discussed are employed. Specifically, equations (5) and (6) are used to analyze the effect of agglomeration on labor misallocation, particularly in terms of the operational location of firms and the number of workers. The first model equation used in this analysis is equation (5), which assesses the impact of industrial agglomeration on labor misallocation based on the geographical location of firms. The regression results from model equation (5) are presented as follows:

Table 3: Regression Results of Misallocation Based on Firm Location

log_abs_miss	Coef.	Std. Err.	t-value	p-value	[95% Conf.	Interval]	Sig.
agglomeration : base 0	0	.	.	.	.	.	
1	.925	.043	21.60	0	.841	1.009	***
export_status : ba~0	0	.	.	.	.	.	
1	-1.937	.059	-32.73	0	-2.053	-1.821	***

log_abs_miss	Coef.	Std. Err.	t-value	p-value	[95% Conf.	Interval]	Sig.
HHI	.007	.001	6.22	0	.005	.009	***
Constant	14.43	.058	249.17	0	14.317	14.544	***
Mean dependent var	13.080		SD dependent var		1.911		
Number of obs.	7177		Chi-square		1703.992		
Prob. > chi2	1.000		Akaike crit. (AIC)		28143.711		

Note: *** p<.01, ** p<.05, * p<.1

From the regression results above, it can be seen that there is a positive relationship between companies located in agglomeration areas (agglomeration = 1) and the level of labor misallocation, with a coefficient value of 0.925, assuming all other variables are held constant. This relationship is statistically significant, as indicated by the p-value of 0. The regression results can be interpreted to mean that firms operating in agglomerated areas (agglomeration = 1) have a higher degree of labor misallocation compared to firms outside agglomeration areas (agglomeration = 0). To better understand the magnitude of this difference, the regression coefficient can be exponentiated. The exponential of 0.925 is approximately 2.52. This means that companies located within agglomeration areas experience labor misallocation levels that are 2.52 times higher than those of companies outside such areas.

The next model, corresponding to Equation (6), is used to examine the impact of industrial agglomeration on labor misallocation based on the number of workers employed in the agglomeration area. The regression results are presented as follows:

Table 4: Regression Results of Misallocation Based on Number of Workers

log_abs_miss	Coef.	Std. Err.	t-value	p-value	[95% Conf.	Interval]	Sig.
log_labor_EZ	.122	.005	23.02	0	.112	.132	***
export_status : ba~0	0	.	.	.	.	.	
1	-1.926	.059	-32.66	0	-2.042	-1.811	***
HHI	.007	.001	6.25	0	.005	.009	***
Constant	14.41	.058	250.15	0	14.297	14.523	***

Mean dependent var	13.080	SD dependent var	1.911
Number of obs.	7177	Chi-square	1777.429
Prob. > chi2	1.000	Akaike crit. (AIC)	28084.608

Note: *** p<.01, ** p<.05, * p<.1

The regression results show that the coefficient of the variable log_labor_EZ which represents the number of workers in agglomeration areas, has a value of 0.122. This indicates that an increase in the number of workers employed in agglomerated areas leads to a higher degree of labor misallocation. Specifically, a 1% increase in the number of workers in agglomeration areas corresponds to a 0.122% increase in the level of labor misallocation, assuming all other variables remain constant. This result suggests a positive relationship between the number of workers and labor misallocation in agglomerated regions. In addition, the Herfindahl-Hirschman Index (HHI), which measures market concentration, also shows a positive coefficient, indicating that a 1-point increase in HHI significantly raises labor misallocation by 0.7%. The export status variable, a dummy variable, shows that exporting firms tend to have significantly higher levels of labor misallocation than non-exporting firms.

These findings differ from much of the previous literature, which generally suggests that agglomeration has a positive impact—particularly on labor working in industries located in agglomerated regions. For example, Glaeser and Gottlieb (2009) and Combes et al. (2012)

found that agglomeration improves productivity by facilitating the transfer of knowledge and technology, enhancing access to larger labor markets, and providing better infrastructure. Based on this theory, it would be expected that agglomeration reduces labor misallocation because firms can more easily find workers that meet their needs. However, this study shows that, in practice, agglomeration does not always reduce labor misallocation. On the contrary, agglomeration can increase misallocation due to several factors.

Heise & Porzio (2022) explain that one reason agglomeration may increase labor misallocation is the presence of spatial frictions, such as home bias, moving costs, and traffic congestion. Their study also highlights a tendency for firms within agglomerated regions to "shield" their workers from competition originating from other regions, which in turn lowers worker productivity and leads to aggregate productivity losses in agglomerated areas. One of their findings suggests that removing spatial frictions could improve labor productivity by approximately 5%. Brooks et al. (2021) also argue that agglomeration can increase labor misallocation. Their study explains that agglomeration may reduce inter-firm competition due to close proximity. When firms face less competitive pressure, it can negatively affect workers by lowering innovation, reducing incentives to improve skills, and causing managerial stagnation. As productivity declines, labor misallocation tends to increase.

Another study by Ji et al. (2018) also addresses a similar issue. Their journal explains that within agglomeration areas, a phenomenon known as the *crowding effect* can worsen labor misallocation. Examples of the impacts of this condition include environmental degradation, capital spillovers, and increased costs. Fan & Yu (2018) also discuss related themes. Their study explains the concepts of economic agglomeration and agglomeration diseconomies. According to this journal, companies are the primary beneficiaries of agglomeration economies, while workers are the main victims of its diseconomies. Furthermore, Grover et al. (2023) examine the impact of agglomeration in developing and developed countries. The findings indicate that both the positive and negative impacts of agglomeration are greater in developing countries than in developed ones. One of the factors contributing to high levels of labor misallocation in agglomerated areas of developing countries is that most workers live far from their workplace (often outside the city), coupled with severe traffic congestion. A deeper root cause is *premature urbanization*—urban growth occurring when per capita income levels are significantly lower than those in previously urbanized regions.

Behrens et al. (2011) explain that intercity commuting and goods transportation—exacerbated by traffic congestion and long distances between home and work—lead to decreased labor productivity in agglomerated areas. In East Java, for instance, most workers live far from their workplaces. Workers in the Gerbangkertosusila area who work in Surabaya often reside in other regions like Gresik, Sidoarjo, and Bangkalan. This situation lowers productivity due to long commutes, traffic congestion, and pollution. Furthermore, the lack of competition among firms in the same industry or area can also reduce labor productivity, which in turn increases labor misallocation (Porter, 1990). Misallocation occurs when productivity does not match its potential relative to the wages paid. The absence of competition reduces the pressure to innovate and improve efficiency, causing operational and production stagnation, which increases labor misallocation.

Moreover, urbanization—which refers to the increasing proportion of the population living in cities—leads to the expansion of urban settlements (Daldjoeni, 1998). However, *premature urbanization* occurs when urban growth outpaces the capacity of a city's infrastructure to support a growing population—both physical and non-physical infrastructure, such as roads, sanitation, education, healthcare, and employment. Premature urbanization is characterized by overcrowding, inadequate public services, high unemployment, and various environmental problems. It can drive labor misallocation due to several factors: inadequate infrastructure like roads and transport systems limits worker mobility and hinders job performance; basic services such as clean water, electricity, and sanitation fail to meet

workers' basic needs; economic growth and job opportunities lag behind urbanization rates, leading to high unemployment and growth in the informal sector. Rapid urbanization also causes severe environmental problems such as inefficient waste management, pollution, and contamination (Todaro & Smith, 2015).

The analysis also finds that as the number of workers in agglomerated areas increases, so does the degree of labor misallocation. This result indicates a positive relationship between workforce size and labor misallocation, which is consistent with the economic theory known as *The Law of Diminishing Returns*—which states that if one input is continually increased while others remain constant, it will eventually lead to a decrease in marginal output (Ricardo, 1817).

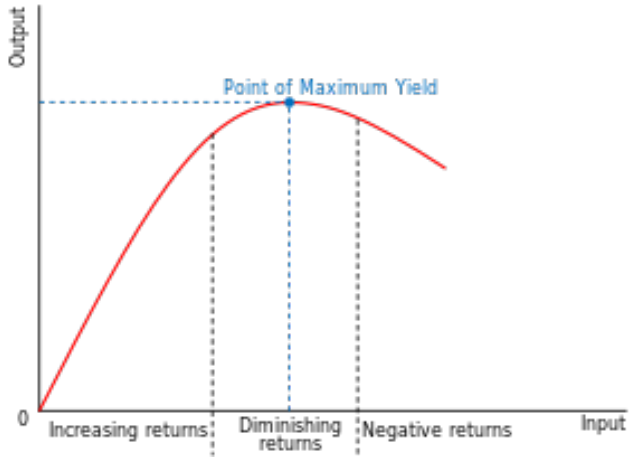

Figure 5: The Law of Diminishing Returns Curve

The curve above illustrates the Law of Diminishing Returns. The X-axis represents the input, which in this study is labor, while the Y-axis represents output. This curve consists of three stages. The first stage is the *increasing returns* phase, where additional labor results in proportionally greater output. At this stage, each new worker is highly efficient and contributes significantly to production. The second stage is the *diminishing returns* phase, where production has reached an optimal level. Here, adding more workers still increases output, but at a decreasing rate. The third stage is the *negative returns* phase, where adding more labor actually decreases total output. This is where the Law of Diminishing Returns is clearly demonstrated.

For instance, consider a bag manufacturing company. When the company employs 2 workers, they produce 20 bags per day—meaning each worker produces 10 bags per day. When the workforce increases to 7 workers, the output rises to 80 bags per day, or about 11.4 bags per worker. However, when the number of workers increases to 12, the output becomes 120 bags, and average productivity returns to 10 bags per worker. If the company hires 5 more workers (totaling 17), the output only increases to 150 bags, lowering productivity to 8.8 bags per worker. This demonstrates a decline in labor productivity as more workers are added.

In the context of agglomerated regions, increasing the number of workers can reduce overall productivity in the agglomeration area. This study calculates labor misallocation by subtracting productivity from wages. According to the Law of Diminishing Returns, continuously increasing labor input while holding other factors constant results in decreasing marginal productivity. Despite falling productivity, wage levels remain relatively constant due to the Regional Minimum Wage (UMR) policy (Lewis, 1954). This leads to increased labor misallocation in areas with high labor concentration. In such situations, firms are unable to optimize labor usage, and the marginal productivity of additional workers falls below the wage they receive. This phenomenon highlights the importance of efficient human resource management in agglomerated areas to reduce labor misallocation and improve overall efficiency (Barney, 1991).

This study also examines the effect of a company's export status on labor misallocation. The regression results show that export-oriented companies experience significantly higher labor misallocation compared to non-exporting firms. Several factors may explain why exporting firms face greater labor misallocation, most notably due to their operational scale (Melitz, 2003). Operational scale refers to the size and scope of a firm's business activities. Exporting firms often operate on a larger scale to meet both domestic and international demand, which can lead to labor misallocation due to the complexity of managing a larger workforce. Without proper management, such firms risk *overstaffing* (having excess labor) and *underutilization* (inefficient use of labor resources) (Brealey et al., 2011). Moreover, exporting firms must comply with various standards and procedures (Porter, 1986). If the firm lacks adequately trained staff to handle export standards—such as documentation and compliance—it may need to hire more employees or reassign workers from other tasks. Additional contributing factors may include inefficient employee training, shifting employee focus, and an increase in administrative tasks at the expense of production activities.

This study also examines the effect of the Herfindahl–Hirschman Index (HHI) on labor misallocation based on the 2-digit ISIC code. The regression results indicate a statistically significant relationship between the HHI variable and labor misallocation. The findings suggest that the higher the market concentration index, the greater the degree of labor misallocation. A high HHI indicates that market competition is closer to an oligopoly or even a monopoly structure. The HHI is commonly used to classify the level of market concentration into three categories:

- Below 1500 = low market concentration
- Between 1500 – 2500 = moderate concentration
- Above 2500 = highly concentrated industry

From these classifications, it can be inferred that industries with an HHI above 1500 are more prone to higher levels of labor misallocation. In addition to HHI, market concentration can also be evaluated using the Gini index. Karabaza & Shapovalova (2018) categorize market concentration based on the Gini index using the following table:

Table 5: Gini Index Based on Market Competition

Market Type	Concentration Level	Indicator Value
Monopoly	Monopolized	1.00
Rigid oligopoly with the dominant firm	Highly concentrated	0.85 – 1.00
Oligopoly with the dominant firm	Concentrated with the dominant firm	0.65 – 0.85
Oligopoly	Concentrated	0.45 – 0.65
Limited oligopoly	Low-concentration	0.25 – 0.45
Competition	Not concentrated	0 – 0.25

The table above explains how market concentration is categorized based on the Gini Index for each level of concentration. While the Gini Index is commonly used to measure inequality in income distribution, it can also be applied to other economic contexts, such as market concentration (Cowell, 2011). This study finds that higher market concentration increases labor misallocation. The greater the market concentration, the higher the level of labor misallocation. This occurs because, in highly concentrated markets, resources—including labor—are controlled by a few or even a single dominant firm. Such conditions lead to reduced competition, which can in turn diminish the incentives for firms to innovate or improve efficiency, including in labor management. Moreover, monopolistic or oligopolistic firms tend to be less responsive to market signals due to the lack of competitive pressure. This may result in companies failing to adjust their labor size according to actual market needs. Finally, with greater control over resources—including wages—dominant firms often have the

power to set wages and working conditions that do not reflect a fair or healthy market (Stigler, 1951).

Robustness Check

As an additional robustness check, the analysis was restricted to the food and beverage industry (ISIC codes 10 and 11), which represents one of the largest and most labor-intensive sectors in East Java's manufacturing. Focusing on this subsample reduces potential heterogeneity across industries while retaining sufficient variation for empirical analysis. The results remained consistent with the baseline findings, indicating that firms located in agglomerated areas continued to exhibit higher levels of labor misallocation compared to those outside agglomerated regions. This consistency suggests that the observed relationship is not driven solely by industry composition but reflects a broader pattern across East Java's industrial structure.

Table 6: Robustness Check: Regression Results of Misallocation Based on Firm Location (Food and Beverage Industry)

log_abs_miss	Coef.	Std .Err.	t-value	p-value	[95% Conf.	Interval]	Sig.
agglomeration : base 0	0	.	.	.	.	.	
1	.842	.084	10.02	0	.678	1.007	***
export_status : ba~0	0	.	.	.	.	.	
1	-1.612	.103	-15.65	0	-1.813	-1.41	***
HHI	.389	.058	6.68	0	.275	.503	***
Constant	14.015	.097	144.29	0	13.824	14.205	***

Mean dependent var	12.787	SD dependent var	1.787
Number of obs .	2407	Chi-square	383.806
Prob. > chi2	1.000	Akaike crit. (AIC)	9277.107

Note: *** p<.01, ** p<.05, * p<.1

Table 7: Robustness Check: Regression Results of Misallocation Based on Number of Workers (Food and Beverage Industry)

log_abs_miss	Coef.	Std .Err.	t-value	p-value	[95% Conf.	Interval]	Sig.
log_labor_EZ	.112	.011	10.52	0	.091	.132	***
export_status: ba~0	0	.	.	.	.	.	
1	-1.616	.103	-15.72	0	-1.817	-1.414	***
HHI	.377	.058	6.48	0	.263	.491	***
Constant	14.013	.097	144.65	0	13.824	14.203	***

Mean dependent var	12.787	SD dependent var	1.787
Number of obs .	2407	Chi-square	395.145
Prob. > chi2	1.000	Akaike crit. (AIC)	9267.348

Note: *** p<.01, ** p<.05, * p<.1

Conclusion

This study investigates the relationship between industrial agglomeration and labor misallocation in East Java, using data from the Large and Medium Industries (IBS) for the period of 2010 to 2015. The results show a significant relationship between industrial agglomeration

and labor misallocation in the region. Firms located in agglomerated areas tend to have labor misallocation levels 2.52 times higher than those located outside agglomerated zones. This is attributed to several factors such as spatial frictions, lack of competition among firms within agglomerated regions, and the crowding effect.

To strengthen the findings, this study employs several variables to test the impact of agglomeration on labor misallocation, including the logarithm of the number of workers, export status, and market competition level. The results show that a 1% increase in the number of workers in agglomerated regions potentially raises labor misallocation by 0.122%. Additionally, exporting firms were found to have significantly higher labor misallocation, by 1.926 points, compared to non-exporting firms. This may be related to the operational complexity and greater production demands faced by exporting firms. Meanwhile, an increase in the Herfindahl-Hirschman Index (HHI), indicating reduced competition, is also associated with increased labor misallocation—where each one-unit increase in HHI leads to a 0.7% increase in labor misallocation.

These findings offer critical insight: although industrial agglomeration can provide economic benefits, negative aspects such as labor misallocation must be addressed in public policy formulation and corporate strategy. Therefore, stakeholders are encouraged to adopt more integrated and coordinated approaches in developing and supporting agglomerated regions, in order to minimize the negative impact on labor efficiency.

The recommendations from this study are divided into two categories: policy recommendations and academic suggestions.

a) Enhance competition regulations: The government should enforce regulations that promote healthy competition within agglomerated areas. This may include reducing entry barriers for new firms and preventing monopolistic practices that contribute to misallocation.
b) Improved spatial policies: There is a need for better spatial planning to reduce spatial frictions. This includes improving transport and logistics infrastructure to enable more efficient mobility of labor and goods within agglomerated regions.
c) Support for SMEs: Provide greater support for small and medium enterprises (SMEs) outside agglomerated regions to balance economic growth and labor distribution across East Java.

In addition to policy recommendations, the author also provides suggestions for academics to encourage further research opportunities.

a) Further research on spatial frictions: There is a need for more in-depth studies on the factors contributing to spatial frictions and their impact on labor allocation efficiency within agglomerated regions.
b) Comparative regional studies: Conduct comparative research between industrial agglomeration areas in East Java and other provinces to understand the differing dynamics of labor misallocation across regions.
c) The impact of exports on labor misallocation: Develop more specific research on the relationship between a firm's export status and labor misallocation to provide a clearer picture of these two variables.

A potential limitation of this study is that agglomeration may be endogenous, as firms' location choices can be influenced by proximity to consumers, resources, or infrastructure. Although the use of fixed-effects estimation helps to control for unobserved time-invariant characteristics, the possibility of residual endogeneity cannot be fully ruled out. Therefore, the findings should be interpreted with this caveat in mind.

Through these suggestions, it is hoped that both policy-making and academic development related to industrial agglomeration and labor misallocation can be improved.

This research is not only important for the advancement of economic theory, but also highly relevant for the implementation of more effective and efficient public policies.

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