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Exploring Local Labor Markets and Knowledge Spillover from a Spatial Perspective

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ABSTRACT

Relevance. Cities serve as vital hubs for socioeconomic activities, fostering convergence in local labor markets characterized by high productivity, premium wages, and knowledge spillover. Jakarta Metropolitan, as Indonesia's economic center, embodies these advantages, prompting the need for a spatial investigation of their regional association.

Research Objective. This study examines the unique attributes of the labor market in the Jakarta Metropolitan Area. The analysis encompasses anomalies such as the impact of premium wages on local labor productivity and the influence of education levels, as a proxy for knowledge spillover, on urban labor productivity.

Data and Methods. Utilizing microdata from Sakernas and macrodata from BPS for 2017-2019, this study offers a comprehensive analysis of the Jakarta Metropolitan Area. By synthesizing cross-level data, the intricate interplay between productivity, wages, and area size becomes evident, particularly the tendency for skilled individuals to gravitate toward larger urban centers. Employing spatial regression, the analysis takes into account local characteristics in regions.

Results. Density and education have a positive correlation, while the number of holders of bachelor's degrees has a surprisingly negative impact on productivity. Notably, higher aggregate education levels enhance regional productivity throughout the Jakarta Metropolitan Area, except for highly educated individuals. The level of education influences the minimum wage in a region, driven by spatial disparities in the educational infrastructure and quality. The number of educated people also influences wages in and across regions, prompting migration to regions with higher salaries.

Conclusions. By integrating microdata and macrodata and employing spatial regression techniques, this study shows the connection between education, productivity, and regional dynamics, particularly in the Jakarta Metropolitan Area. These findings challenge the assumption that possessing a high level of education guarantees higher productivity and remuneration, demonstrating the need for education reforms that align with labor market demands and bolster the economy.

KEYWORDS
local labor market; knowledge spillover; urban area; wage premium; productivity; Indonesia

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Анализ локальных рынков труда и эффекта перетока знаний: пространственный аспект

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АННОТАЦИЯ

Актуальность. Города служат жизненно важными центрами социально-экономической активности, способствуя конвергенции локальных рынков труда, характеризующихся высокой производительностью, премиальной заработной платой и наличием эффекта перетока знаний. Столичный регион Джакарта, как экономический центр Индонезии, воплощает в себе эти преимущества, что вызывает необходимость исследования специфики их пространственного проявления.

КЛЮЧЕВЫЕ СЛОВА
локальный рынок труда; эффект перетока знаний; городская территория; надбавка к заработной плате; производительность; Индонезия

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Цель исследования. В исследовании рассматриваются уникальные особенности рынка труда в столичном регионе Джакарта. Анализ охватывает такие явления, как влияние премиальной заработной платы на производительность труда на локальном уровне и влияние уровня образования, как показателя распространения знаний, на производительность труда в городах.
Данные и методы. На основе микроданных Национального обследования рабочей силы (Sakernas) и макроданных Государственной службы статистики Индонезии (BPS) за 2017-2019 годы, в исследовании выполнен всесторонний анализ рынка труда столичного региона Джакарта. При обобщении перекрестных данных становится очевидной сложная взаимосвязь между производительностью, заработной платой и размером территории, а также тенденция к тому, что квалифицированные специалисты тяготеют к более крупным городским центрам. Использование пространственной регрессии позволяет учесть локальные особенности исследуемых регионов.
Результаты. Плотность населения и образование имеют положительную корреляцию, в то время как количество обладателей степеней бакалавра оказывает, как ни парадоксально, негативное влияние на производительность труда. Примечательно, что более высокий совокупный уровень образования повышает региональную производительность во всем столичном регионе Джакарты, за исключением высокообразованных людей. Уровень образования влияет на минимальную заработную плату в регионе, что обусловлено пространственными различиями в инфраструктуре и качестве образования. Количество образованных людей также влияет на ситуацию внутри региона и характер взаимовлияния регионов, стимулируя миграцию в регионы с более высокими зарплатами.
Выводы. Интегрируя микроданные и макроданные и используя методы пространственной регрессии, это исследование показывает связь между образованием, производительностью и региональной динамикой, фокусируясь на примере столичного региона Джакарта. Эти результаты ставят под сомнение предположение о том, что обладание высоким уровнем образования гарантирует более высокую производительность и оплату труда; демонстрируют необходимость реформ образования, которые обеспечили бы соответствие образования требованиям рынка труда и укрепили бы экономику.

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地方劳动力市场和知识溢出效应分析：空间视角

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摘要
现实性：城市是社会和经济活动的重要中心，促进了高生产率、高工资和知识溢出为特征的当地劳动力市场的融合。雅加达首都地区作为印度尼西亚的经济中心，体现了这些优势，因此有必要研究其空间表现的具体情况。
研究目标：该研究探讨了雅加达首都地区劳动力市场的独特特征。分析涵盖了工资溢价对地方劳动生产率的影响，以及作为知识传播指标的教育水平对城市劳动生产率的影响等现象。
数据与方法：该研究基于2017-2019年国家劳动力调查（Sakernas）的微观数据和印度尼西亚国家统计局（BPS）的宏观数据，并对雅加达首都地区的劳动力市场进行了全面分析。当汇总横截面数据时，生产力、工资和地区规模之间的复杂关系变得显而易见，技术专业人员倾向于向较大的城市中心倾斜。而空间回归的使用使我们能够考虑到所研究地区的地方特点。
研究结果：人口密度和教育程度呈正相关，而矛盾的是，拥有学士学位的人数却对劳动生产率产生负面影响。值得注意的是，在整个雅加达首都地区，除了受过高等教育的人之外，总体教育水平越高，地区生产率就越高。由于基础设施和教育质量的空间差异，教育水平会影响地区最低工资。受教育人口的数量也会影响区域内的情况和区域间的性质，鼓励人口向工资较高的区域迁移。
结论：通过整合微观和宏观数据并使用空间回归技术，本研究以雅加达首都地区为例，展示了教育、生产力和地区动态之间的关系。这些结果挑战了“高水平的教育可以保证更高的生产率和工资”的假设。表明有必要进行教育改革，使教育与劳动力市场需求相一致，并加强经济发展。

关键词
当地劳动力市场、知识溢出效应、城市、工资溢价、生产率、印度尼西亚

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Introduction

The city is renowned as a hub for the exchange of information and the transaction of goods and services, serving as a focal point for socio-economic activities. Given its grandeur, the city naturally demands high productivity, competitive wages, top-tier education, and quality healthcare services, among others. However, the array of conveniences provided by urban environments contributes to congestion and density, leading to concentrated labor forces and subsequently, elevated living costs.

The primary incentive for individuals to relocate to urban areas is the allure of higher wages. Gould (2007), Glaeser and Maré (2001), for instance, found that the basic urban wage premium for smaller cities surpasses 21%, while for moderately-sized cities with over a million residents, the wage premium exceeds 30% compared to areas outside this territory. Similar evidence was presented by Combes et al. (2007) for France, and Díaz-Dapena et al. (2017) for Spain.

The urban wage premium prevalent in cosmopolitan areas can stem from either heightened labor productivity in downtown regions or the inclination of workers to pursue more promising careers and live in a metropolitan environment. Consequently, the premium salary aligns with higher levels of education; without a doubt, cities boast an ample supply of skilled and well-educated labor. This phenomenon is observable in Indonesia as well, where education correlates with higher earnings (as illustrated in Figure 1). Figure 1 demonstrates that obtaining a university degree correlates with higher wages. In contrast, the earnings of those with only an elementary school education are approximately half the salary of university graduates. Theoretically, education levels show a positive correlation with income. Indonesia's system of compulsory education comprises primary school (Sekolah Dasar – SD) (6 years), junior high school (Sekolah Menegah Pertama – SMP) (3 years), and high school divided in senior high school (Sekolah Menengah Atas – SMA) and vocational high school (Sekolah Menegah Kejuruan – SMK) (3 years). After completing compulsory education, students can enter an institution of higher education, which can be roughly divided into institutions of higher vocational education (Diploma 1 (D1), Diploma 2 (D2), Diploma 3 (D3), Diploma 4 (D4)) and those of academic education (bachelor, master, and doctoral degrees). However, after 2021, the salaries of high school graduates (SMA/SMK) have shown a slight decline, while those of people with primary school education (SD) and junior high school (SMP) levels have remained relatively stable. This shift has contributed to the evolution of Indonesia's labor market dynamics.

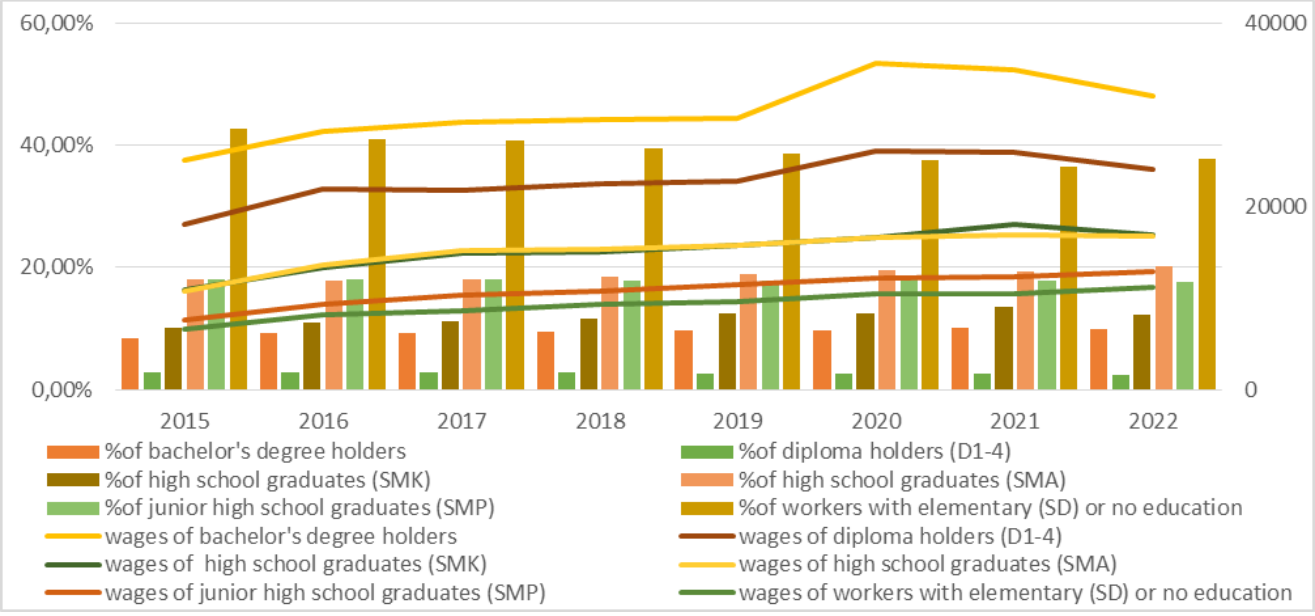

Figure 1. *Average wage per hour (Rupiah/Hour) and workers with different levels of education (%) in Indonesia*
Source: Compiled by the authors based on the data from the labor section of Badan Pusat Statistik Indonesia. Retrieved from: https://www.bps.go.id/indicator/19/1175/1/upah-rata---rata-per-jam-pekerja-menurut-tingkat-pendidikan.html;https://www.bps.go.id/statictable/2016/04/05/1909/penduduk-berumur-15-tahun-ke-atas-menurut-pendidikan-tertinggi-yang-di-tamatkan-dan-jenis-kegiatan-selama-seminggu-yang-lalu-2008-2022.html (Date of access: 16 June 2023)

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Furthermore, delving into Indonesia's labor market structure based on education levels, it becomes apparent that the labor force predominantly consists of individuals with elementary education, constituting 37.88%. These workers received less than 15,000 rupiahs per hour in 2022 (Figure 1). In 2022, the average wage for Indonesian laborers hovered around 18,973 rupiahs per hour, and a significant 87.88% of those with education ranging from primary school (SD) to high school diploma (SMA/SMK) earn an average wage of less than 15,000 rupiahs per hour.

Additionally, the labor segmentation in Indonesia's cosmopolitan centers also attracts those with lower levels of education. Allen et al. (2016) showed that unskilled laborers earning lower wages are predominantly concentrated in urban areas, likely due to the fact that 50% of the labor force resides in cities. Consequently, this attraction can both stimulate urban productivity and economic growth, while also generating challenges such as poverty and the emergence of slum areas.

The high level of productivity and attractive wages naturally lead to a substantial influx of highly skilled labor. Urban environments offer exceptional amenities that encourage swift interactions among individuals possessing top-tier education and advanced skills. Consequently, metropolises become hubs attracting individuals with excellent education and sought-after skills. This convergence of educated individuals, along with their ability to adapt to new challenges, fuels Indonesia's sustainable economic growth, especially in urban zones such as the Jakarta Metropolitan Area.

However, there is a certain disparity in the distribution of education in Jakarta (Muhaimin et al., 2022), which generates varying productivity levels across different locations within the Jakarta Metropolitan Area. Imagine a scenario where all individuals in urban areas have access to proper education to confront the challenges of the new industrial revolution; as a result, other areas could also influence the enhancement of urban regions. This phenomenon of knowledge dissemination in cities is termed knowledge spillover, a mechanism that amplifies city productivity and fosters sustainable economic growth.

The above-described situation in Jakarta has determined the purpose of this study, which aims to gain an understanding of the interconnection of productivity, wages, knowledge spillover, and labor market conditions in Indonesia's metropolises, with a particular focus on the Jakarta Metropolitan Area.

Furthermore, the Jakarta Metropolitan Area, encompassing 13 municipalities/cities, exhibits distinct characteristics. Consequently, a spatial model framework proves to be an invaluable tool for dissecting these unique attributes and interactions. By integrating spatial elements, such as geographic proximity, into the analysis, a deeper understanding of the impacts of agglomeration and knowledge spillover on labor market outcomes can be gained. The prime focus of this paper is on the anomalies in the local labor market of urban areas, particularly the Jakarta Metropolitan Area, which is Indonesia's capital city and a sprawling metropolis. These anomalies include the impact of wages on the productivity of the local labor market and the influence of different education levels in the local labor market, which act as proxies for knowledge spillover, on urban labor productivity. Achieving these objectives could confirm that dense urban areas foster knowledge spillover, which in turn boosts productivity and contributes to the enhancement of the national economy through higher salaries in cities.

Theoretical framework

Urban Labor Market and Productivity

The city is an area with a high concentration of diverse professionals. Unquestionably, this pool of people creates a city that becomes a tremendously big labor market. Combes et al. (2012) remarked that agglomeration economies in larger cities encourage interchanges that enhance productivity, conceivably strengthened by localized natural benefits. In other words, urban agglomeration means that the local labor market's size can yield productivity gains (Ciccone, 2002; de la Roca & Puga, 2017; Glaeser &Resseger, 2010; Groot & de Groot, 2020; Lee et al., 2017; Prasertsoong&Puttanapong, 2022; Venhorst, 2017). The higher productivity observed in a dense labor market could be influenced by preferences that arise due to increased competition in that market (Ciccone, 2002; Di Giacinto et al., 2020; Gould, 2007; Henderson & Turner, 2020; Moretti, 2010; Shi et al., 2022; Sveikauskas, 1975; Tadjoeddin& Mercer-Blackman, 2018). Moretti (2010) contends that the size of the labor market is correlated with reduced unemployment risk for employees and the presence of job vacancies for companies, both of which reflect wage differences.

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The urban environment's external effects on productivity are associated with the fact that the more prominent and denser accommodations imply a robust positive relationship between urbanization and economic development (Di Giacinto et al., 2020; Henderson & Turner, 2020; Moretti, 2010; Sveikauskas, 1975; Tadjoeddin& Mercer-Blackman, 2018). Prasertsoong and Puttanapong (2022) proved that a higher population thickness in Thailand increases labor productivity due to a high agglomeration pressure yielded by density. According to Tadjoeddin and Mercer-Blackman(2018), urban economies produced by agglomeration economies have better worker productivity, as the case of the Jakarta Metropolitan Area illustrates. Moreover, Di Giacinto et al. (2020) stated that density plays a significant role in metropolitan productivity; for instance, doubling density increases productivity by 2-4%. Kuswardana et al. (2021) conducted a primary investigation of the relationship between job density and productivity. They found that as an agglomeration increases in size, the impact on productivity remains consistently around 2-6%. This result is in line with previous studies, such as Ciccone (2002).

Furthermore, Lee et al. (2017) showed the significance of population density driven by localization and urbanization economies. Similarly, de la Roca and Puga (2017) discuss the fundamental queries of urban economics: evaluating the productive advantages of metropolises and understanding their essence. The advantages of urban areas' productivity are exemplified by the increased productivity of firms operating in them (de la Roca & Puga, 2017; Glaeser & Xiong, 2017; Henderson & Turner, 2020; Lee et al., 2017), highlighting the crucial role cities play in national economic development.

The assertion that cities are labor markets is fundamentally accurate. The undeniable allure of metropolitan amenities must also be acknowledged (Glaeser & Xiong, 2017; Gould, 2007; Henderson & Turner, 2020). Thus, at its core, the overarching dynamic centers on cities assuming the role of hubs wherein companies actively recruit employees while individuals seek to secure employment opportunities. Chen et al. (2020) noted that workers in large firms tend to be more productive due to heightened labor competition. A parallel logic applies to employees in large cities, where higher effectiveness and productivity are observed (Henrekson, 2020). The convergence of firms and workers in a single location enhances productivity (Combes et al., 2012), thereby stimulating the city's development.

Previous studies confirm strong and positive connections between productivity, agglomeration, and premium earnings in urban areas (Combes et al., 2007; Díaz-Dapena et al., 2017; Glaeser & Maré, 2001; Gould, 2007; Lee et al., 2017; Moretti, 2010; Prasertsoong & Puttanapong, 2022; Tadjoeddin & Mercer-Blackman, 2018). The interplay between regional size, productivity, and wage offerings per sector in cities influences residential choices (de la Roca & Puga, 2017; Glaeser & Resseger, 2010; Gould, 2007; Lee et al., 2017; Venhorst, 2017). Li et al. (2021) concluded that high wages determine the quality of the workforce, reinforcing the idea that cities are zones of productivity with substantial paychecks and progressive technology.

As for education, both public and private, it tends to be higher in urban areas. Moreover, human capital accumulation is accelerated in metropolises through in-person interactions (Glaeser & Maré, 2001; Glaeser & Resseger, 2010). Concerning firms' spatial sorting, the concept suggests that as businesses grow, labor market competition intensifies, allowing only the most productive firms to thrive. This dynamic enables firms to attract higher-quality workers, contributing to their expansion or enhanced productivity (Glaeser & Resseger, 2010; Lee et al., 2017).

Multiple studies investigating the correlation between premium pay and urbanization imply that higher productivity in a metropolitan area positively affects individual incomes, even when considering different timeframes and datasets (de la Roca & Puga, 2017). Furthermore, it's accurate to state that cities fundamentally operate as labor markets. Certainly, we cannot disregard the attractiveness of urban amenities. Di Giacinto (2020) demonstrated a strong correlation between the labor productivity component of urban productivity and demographic factors, serving as a proxy for labor market density. Notably, productivity increases alongside density (Glaeser & Resseger, 2010; Glaeser & Xiong, 2017; Tadjoeddin & Mercer-Blackman, 2018).

Moreover, there is a tendency for uneven growth in productivity across different sectors (Manning & Pratomo, 2018; Sugiyarto et al., 2006). To a certain extent, the shift from agriculture to manufacturing and services is a response to low productivity in the agricultural sector. However, despite this broader economic adjustment, a significant portion of the population remains engaged in low-productivity industries. This phenomenon isn't exclusive to agriculture but also prevails in urban areas where

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industries exhibit a low rate of labor absorption, particularly during the industrial revolution era. Consequently, local urban labor is required to possess high skills and productivity. The compensation for their heightened efficiency and productivity is the high wages offered by urban areas.

Local Labor Market, Wages, and Knowledge Spillover

Higher earnings consistently lead workers to contemplate moving, especially to cities. According to the widely accepted view, agglomeration economies come into play as productivity increases alongside higher population density, resulting in larger rewards for local workers (Di Giacinto et al., 2020; Henderson & Turner, 2020; Tadjoeddin & Mercer-Blackman, 2018). Glaeser & Maré (2001) cite Max Weber, who reported a 50% wage disparity between rural and urban areas in Germany. This gap proved significant for taxing purposes and roughly equivalent to the daily earnings of unskilled urban labor (Halfdanarson et al., 2008). Acar (2003) showed that in developing countries, agricultural wages were approximately 41% lower than the nominal urban wages for full-time unskilled labor. In the 1830s, England witnessed a more pronounced wage gap of around 73%, while the USA experienced a 50% gap in the mid-1890s (Acar, 2003).

Gould (2007) and Glaeser and Maré (2001) showed that locations with over 1 million residents exhibit an average wage approximately 30% higher than smaller areas, the latter enjoying a basic urban wage premium of about 21%. Glaeser and Resseger (2010) concluded that real wages rise in tandem with city population. Similar findings were reported by Combes et al. (2007) for France and Diaz-Dapena et al. (2017) for Spain. In Thailand, higher population density translates to increased labor productivity: Prasertsoong and Puttanapong (2022) demonstrate a concentrated high wage pattern in Bangkok and its environs, a result of strong agglomeration forces due to higher population density. Thus, it may be concluded that the higher wages offered by cities are the main factor that attracts labor to these areas.

According to Zgarrick et al. (2020), the wage premium serves as a critical tool for assessing the labor market, essential for maintaining and supporting the labor force. Furthermore, Li et al. (2021) emphasize that wages fundamentally reflect the economic standing of workers and serve as a critical gauge of the quality of their employment.

Glaeser and Xiong (2017) show the key role of the relationship between productivity, earnings per worker, and the size of the area in urban economics. They hypothesize that this connection reflects the preference of more skilled professionals to establish themselves in non-rural areas, driven by urban prominence as a market access point that attracts educated labor with higher earnings (de la Roca & Puga, 2017; Di Giacinto et al., 2020; Glaeser & Maré, 2001; Glaeser & Xiong, 2017; Groot & de Groot, 2020; Henderson & Turner, 2020; Lee et al., 2017; Moretti, 2010; Prasertsoong & Puttanapong, 2022; Shi et al., 2022; Tadjoeddin & Mercer-Blackman, 2018; Venhorst, 2017). This convergence of educated labor in urban areas is highlighted by Duranton & Puga (2020), Glaeser & Maré (2001), Lamorgese et al. (2019), Lu (2022), Moretti (2010), Shi et al. (2022), and Tadjoeddin & Mercer-Blackman (2018). Consequently, urban spillovers encompass both premium wages and knowledge sharing.

Gould (2007) contends that higher productivity, which leads to an increased presence of skilled workers in cities and ideal conditions for human capital development, drives higher earnings in urban areas. Additionally, Di Giacinto et al. (2020) find that the availability of local human capital is closely tied to the benefits of increased urban productivity due to the depth of the labor market and recognized indicators of agglomeration economies. Prasertsoong and Puttanapong (2022) assert that labor skill is compounded by localized productivity and wages. Tadjoeddin and Mercer-Blackman (2018) highlight that cities foster efficiency through proximity, facilitating the exchange of ideas, knowledge dissemination, and creativity. Glaeser and Xiong (2017) add that higher firm density in specific locations fosters the exchange of ideas and job matching, reducing search costs and promoting flexibility. Since well-educated individuals tend to live in highly productive urban areas, this solidifies the recognition of cities as productive hubs, offering competitive wages and advanced technology.

The research literature predominantly focuses on the positive effects of urban labor markets and knowledge spillover in developed countries while the implications for developing countries remain a question, particularly the effectiveness of local knowledge spillovers. Kesidou and Romjin (2008) and Kesidou and Szirmai (2008) conducted research among software firms in Uruguay and found that local knowledge spillovers enhance firm performance. Their findings are further sup-

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plemented by Chen et al. (2020), who utilized a probit model to explore knowledge distribution across urban areas in various developing Asian countries, including Indonesia. Chen et al. (2020) argue that larger city populations correlate with a higher propensity for innovation. However, their study covered Jakarta as a province rather than a specific metropolitan area.

Taniguchi et al. (2018) noted that Indonesia's labor productivity still has room for improvement, and educational investments should be aligned with market demands. Consequently, delving into the Jakarta Metropolitan Area, a pivotal hub in Indonesia, could yield us valuable insights into this issue. Jakarta serves as both the cornerstone of Java's economic corridor and the capital city of Indonesia. Setyawan et al. (2020) showed Jakarta's significance in offering ample job opportunities for individuals with higher education levels, leading to commuter activities that influence economic development in their respective regions. This effect reverberates in terms of economic activities and the regional minimum wage (Setyawan et al., 2020). As far as education is concerned, Muhaimin et al. (2022) showed that achieving educational equity through the school zoning system in Jakarta hinges on the existence of spatial justice. Concurrently, Kuswardana et al. (2021) discovered that in Indonesia, inter-sectoral knowledge spillover has a positive impact on productivity, especially in capital-intensive industries. This underscores the need for comprehensive research on the intricate interplay between urban economies, labor markets, and knowledge diffusion within the spatial confines of the Jakarta Metropolitan Area. Such studies hold the potential to enrich analyses related to this matter, especially within the context of developing countries.

Method and data

Numerous empirical studies on agglomeration have centered around using urban and industrial size as indicators of productivity, with premium wages often serving as a motivating factor for agglomeration economies. Additionally, the concept of knowledge spillovers is highlighted as a benefit stemming from agglomeration. Furthermore, considering the inevitable interaction between regions, this can be reflected through a spatial weight matrix with a weight structure expressed mathematically as follows:

$$\begin{bmatrix} w_{11} & \cdots & w_{1N} \\ \vdots & \ddots & \vdots \\ w_{N1} & \cdots & w_{NN} \end{bmatrix}, \quad (1)$$

A spatial weights matrix (W) is an N by N positive and symmetric matrix that identifies, for each observation (row), the positions (columns) with non-zero elements, determined by their neighborhood relationships (Anselin & Bera, 1998). Specifically, wij= 1 when i and j are neighbors, and wij = 0 otherwise. The diagonal elements of the weight matrix are set to zero, and the sum of each row is equal to one. This results in components of the row-standardized weights matrix being uniform. In the context of geography, the construction of W is based on either adjacency connections or the closest k neighbors, determined through Euclidean distance measurements.

Indonesia employs a five-tiered geographic system consisting of national, provincial, district/municipality (*kabupaten*) and city (*kota*), sub-district (*kecamatan*), and village (*desa*) levels. In this study, the focus is on the kabupaten/kota level, which represents the third tier in this system. The study specifically centers on the Jakarta Metropolitan Area, encompassing the following areas: Central Jakarta, East Jakarta, West Jakarta, North Jakarta, South Jakarta, Bekasi City, Bekasi Municipality, Depok City, Bogor City, Bogor Municipality, Tangerang City, Tangerang Municipality, and Kepulauan Seribu. It's worth noting that the areas with water boundaries may lack neighboring areas. The data used in this research is sourced from the National Labor Force Survey (Sakernas) and Statistics Indonesia (BPS). BPS offers open-access data, collected annually up to the third-tier level. As a result, data on various variables such as productivity, wages, population, density, localization economy, human development index, and education rate are gathered. On the other hand, Sakernas provides detailed household-level microdata, though access is limited. Data regarding educated individuals, specifically those holding bachelor's degrees, is sourced from Sakernas. Therefore, this study employs aggregated data from Sakernas and BPS for 2017-2019, covering 13 kabupaten/kota in the Jakarta Metropolitan Area.

The spatial lag or spatial autoregressive model (SAR) is applicable to assess the existence and strength of spatial interaction. The SAR model is formalized as follows (Anselin& Bera, 1998; Elhorst, 2014b):

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$$Y_{nt} = \rho_0 WY_{nt} + X_{nt}\beta_0 + U_{nt} \quad (2)$$

where Y_{nt} represents the dependent variable, ρ stands for the coefficient of spatial autoregression, and ε represents a vector of error terms. WY_{nt} signifies the spatial lag for y at i. Another approach is the spatial error model (SEM), which arises when error terms are correlated across observations, meaning that an observation's error affects the errors of its neighbors, hence defined as:

$$\begin{aligned} Y_{nt} &= X_{nt}\beta_0 + U_{nt} \\ U_{nt} &= \lambda W_u + \varepsilon \end{aligned} \quad (3)$$

where W_u is the spatial lag in errors and ε is a vector of error terms. Further, the Spatial Durbin Model (SDM) is a model that can support both spatially lagged dependent and independent variables (Elhorst, 2014b; LeSage& Pace, 2009a). Anselin and Bera (1998) stated that SDM solves the similarity between spatial lag and error models and imposes a spillover effect for different explanatory variables. The SDM equation is as follows (Elhorst, 2014a):

$$\begin{aligned} Y_{nt} &= \rho_0 WY_{nt} + X_{nt}\beta_0 + WX\theta_{nt} + U_{nt} \\ U_{nt} &= \lambda W_u + \varepsilon \end{aligned} \quad (4)$$

where WY_{nt} is the spatial lag of dependent variable, WX is the spatial lag of independent variables, and W_u is the spatial lag error term.

Moreover, incorporating the region into the spatial model introduces a distinct interpretation of the effects of changing variables. In a spatial context, spillovers are often described as changes in one location influencing changes in other regions. If we look at the SDM from equation (4), it can be rewritten in vector form as:

$$Y_i = (I - \rho W)^{-1}\alpha I_n + (I - \rho W)^{-1}(X_t\beta + WX_t\theta) + (I - \rho W)^{-1}\varepsilon_t \quad (5)$$

$$Y_i = \sum_{k=1}^{n} S_k(W)X_k + V(W)\alpha + V(W)\varepsilon, \quad (6)$$

where $V(W)=(I-\rho W)^{-1}$ degenerates to the identity matrix, αI_n is a vector constant parameter where vector y does not have mean value of zero (Golgher& Voss, 2016; LeSage& Pace, 2009b). Moreover, $S_k(W)=(I-\rho W)^{-1}[I_N\beta_k+W\theta_k]$ presents as a "multiplier" which transforms X_k into a matrix with higher-order adjacent relations (LeSage& Pace, 2009b). Let's expand the expected value to illustrate the function of $S_k(W)$ for a single dependent variable. This will lead to the following equation (6) (Elhorst, 2014b; LeSage& Pace, 2009b):

$$Y_i = \sum_{k=1}^{n}[S_k(W)_{i1}X_{1k} + \cdots + S_k(W)_{in}X_{nk}] + V(W)\alpha + V(W)\varepsilon \quad (7)$$

Moreover, the derivative $\partial y_i/\partial x_j$ can be used to represent the idea of spillover mathematically (Golgher& Voss, 2016). The dependent variable in area $j \neq i$ is affected by changes to the explanatory factors in region i. Lesage and Pace (LeSage& Pace, 2009b) clarified the complexity of the derivative of y_i with respect to X_{ik} in models with spatial lags of a dependent variable, where i and j stand for two different observations. Therefore, the impact of the expected value of area i, given a change in a particular variable for the same region or called direct effect (Golgher& Voss, 2016; LeSage& Pace, 2009b), is determined by:

$$\frac{\partial y_i}{\partial x_{ik}} = S_k(W)_{ii}, \quad (8)$$

where $S_k(W)_{ii}$ represents the i element of the matrix $S_k(W)$. The expected value of the dependent variable in i will change in response to a change in x_{ik} and then pass via neighbors of i before returning to the origin area (Golgher& Voss, 2016; LeSage& Pace, 2009b). Meanwhile, the indirect effect is the impact of a unit increase in xj in a region on y in all other areas collectively. Considering equation (8) and modifying the explanatory variable x_k in location j, the effect on the anticipated value of location i is:

$$\frac{\partial y_i}{\partial x_{ik}} = S_k(W)_{ij} \quad (9)$$

where $S_k(W)_{ij}$ represents the i and j element of the matrix $S_k(W)$.

In theory, Sveikauskas (1975) proposed that the potential labor productivity gains in larger areas could be analyzed through regressions between value-added divided by labor in the city ($(V/L)_c$) and the city's population (Pop_c). However, as the quality of laborers tends to increase along with the urbanization rate, the equation examined by Sveikauskas is as follows:

$$\log(V/L)_c = \alpha + \beta_1 \log Pop_c + \beta_1 \log Edu_c + \varepsilon_{ct} \quad (10)$$

Following Sveikauskas' model and using the sector's industrial concentration or market share as a proxy for localization economies (Díaz-Dapena et al., 2017), we introduce an additional variable, referred to as Localization Economy (LE), into equation (10). As stated by Glaeser and Maré (2001), knowledge spillover or human externality could be approximated using the human development index and the proportion of bachelor's degree holders in the population. Extending this notion to comprehend productivity and education in the urban context, our variables for the initial model are as follows:

$$prod_c = f(D, HI, LE, BA, Pop) \quad (11)$$

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Here, c represents the specific region, and the dependent variable, 'prod,' pertains to the productivity of that region, calculated as the ratio of GDP to the labor force. The independent variables include density (D), the population size in the region (Pop), the human development index (HI), the education index (Edu) which signifies the literacy rate in the region, and localization economic (LE) which proxies the proportion of industrial sector share in the region's GDP. These data are sourced from BPS at the kabupaten/kota level within the Jakarta Metropolitan Area. Meanwhile, the percentage of holders of bachelor's degrees in the population (BA) is derived from the Sakernas microdata. This model aims to uncover how the influence of educated individuals, represented by the share of bachelor's degrees (BA), impacts the enhancement of urban productivity.

Therefore, the next step involves showing the existence of premium salaries and knowledge spillover, employing a composite framework built upon the work of Combes et al. (2007) and Lee et al. (2017). In this context, the minimum wage (w_c) will serve as the dependent variable and will be regressed against independent variables, similar to the previous equation. Additionally, productivity will be introduced as another independent variable (Díaz-Dapena et al., 2017). Thus, the formulation of the second model is as follows:

$$w_c = f(prod, D, HI, LE, BA, Pop) \quad (12)$$

Furthermore, while regional productivity and wages have garnered significant attention, it's essential to acknowledge that local attributes also play a pivotal role in shaping employment choices and corporate placements. It could be supposed that the correlation between productivity and urban scale signifies a preference of highly skilled individuals for larger metropolitan areas. Therefore, this approach aims to reveal the interplay between urban agglomeration, labor motivation (represented by wages), and knowledge spillover, while taking into account the nuances of local characteristics.

Results

The structure of Indonesia's labor market features a substantial workforce supply, particularly owing to favorable demographic conditions, with the majority of the population concentrated in urban areas. These factors present an important opportunity for Indonesia's economy. However, as illustrated in Figure 1, the current state of the labor market structure is unsatisfactory primarily due to the fact that nearly 45% of the labor force has limited education (no education or primary school), and middle-level education (junior and senior high school). In contrast, the proportion of individuals with higher education (diploma of institutions of higher vocational education and academic degrees) is only around 10%. As a result, Indonesia's labor market faces a paradoxical situation, often linked to uneducated or low-skilled labor migration (Wijayanti & Turgel, 2021). This situation, combined with the benefits of the demographic dividend and rapid technological advancement, could potentially place Indonesia in a precarious position. This concern is particularly relevant in densely populated areas, such as urban centers, which play a crucial role in a country's economy. Hence, megacities such as Jakarta could be disproportionately affected by these challenges.

Jakarta, as Indonesia's capital city, has transformed into a metropolitan region known as Jabodetabek (Jakarta, Bogor, Depok, Tangerang, and Bekasi) due to agglomeration effects. Jakarta comprises distinct areas: Central Jakarta, East Jakarta, West Jakarta, North Jakarta, South Jakarta, and KepulauanSeribu. The cluster map shows that these areas can be grouped into four spatial clusters based on productivity and wages—high-high, low-low, high-low, and low-high (refer to Figure 2). This classification signifies that Central Jakarta and its surroundings exhibit both high productivity and wages, denoting its status as the core of Jakarta metropolitan (indicated by the red color in Figure 2). Central Jakarta functions as the administrative hub and has a high number of trading and service enterprises.

On the contrary, West Jakarta demonstrates high productivity but is encircled by areas with lower wage levels (indicated by the purple color in Figure 2). This phenomenon is explained by the influence of agglomeration, which boosts West Jakarta's productivity due to its proximity to key centers like Soekarno-Hatta International Airport. On the other hand, Bekasi City showcases high productivity within a region surrounded by lower wage areas. This can be attributed to East Jakarta's reputation as a less economically active area, resulting in similar low minimum wage levels for Bekasi Regency. Moreover, the concentration of factories in Bekasi City contributes to its higher productivity compared to East Jakarta and Bekasi Regency.

In contrast, Bogor Regency (indicated by the blue color in Figure 2) exhibits lower productiv-

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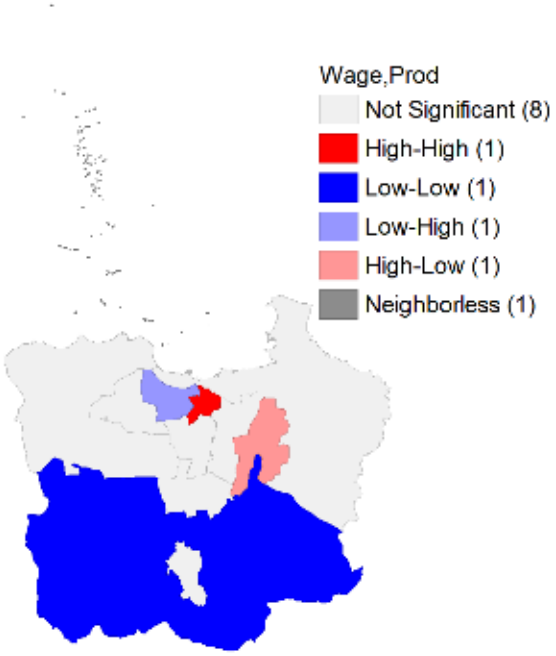

Figure 2. *Cluster map of Jakarta Metropolitan*
Source: compiled by the author

Table 1

AIC value for SAR, SEM, and SDM

	Model	SAR	SEM	SDM
Model 1	AIC	320.7514	317.3909	318.678
Model 2	AIC	725.17	718.4942	717.6291

Source: calculated by the author

ity and wages compared to its neighboring areas. This disparity arises from its distant location from the economic core, reduced consumption and investment levels, and a lower human capital base, particularly in terms of education, compared to other regions.

Firstly, we employ the Akaike Information Criterion (AIC) test to assess the goodness of fit for these spatial models. The AIC test is commonly employed as an information criterion for comparing different model specifications (Darmofal, 2015). Table 1 indicates that the SEM exhibits the lowest AIC value for the first model, while the SDM has the lowest AIC value for the second model.

Moving forward, the Glaeser and Mare's equation yields intriguing results. This equation seeks to show how the presence of highly educated individuals with bachelor's degrees (BA) influences cities' productivity through minimum wage policies. Notably, the connection between the number of holders of bachelor's degrees and productivity exhibits a negative correlation. At the ASEAN level, hiring young workers with higher education is seen as more productive than hiring older workers (Wijayanti, 2018). Nevertheless, as can be seen from Table 2 and 4, a higher number of bachelor's degrees negatively affects productivity and wages. In essence, higher education, as a proxy for knowledge spillover in Jakarta, does not guarantee higher salaries and productivity. Recently, the perception of higher education in Indonesia has taken a negative turn, exacerbated by the pandemic. In the present scenario, many individuals are exploring alternative avenues, such as investment and programming courses offered by informal institutions.

However, in terms of spatial influence, the education rate in Jakarta has a positive impact on both productivity and wages (see Table 2 and Table 4). If we look at the direct effect on productivity, the education level in similar regions has a positive influence (Table 3). Meanwhile, the direct effect on wages indicates that the education level in a specific region affects the minimum wage level in that same region rather than neighboring ones (Table 5). This pattern is attributed to the concentration of education in Central and South Jakarta and the unequal distribution of schools across the Jakarta Metropolitan Area, as highlighted by Muhaimin et al. (2022).

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Table 2

Primary analysis of productivity and knowledge spillover in the Jakarta Metropolitan Area

Prod	D	HI	LE	BA	Edu	Pop
OLS	0.0064568	19.57861	-3.064477	-0.0011996	-2.424324	3.26e-06
	(0.0129569)	(20.41899)	(2.516236)	(0.0005642)	(8.582651)	(0.0000503)
SAR	0.0350725***	-6.782217	2.952632*	-0.0010612***	-3.144468	7.34e-07
	(0.0071625)	(11.20958)	(1.546813)	(0.0002734)	(28.97395)	(0.0000318)
SEM	0.0323243***	-8.986515	1.689443	-.0009656***	85.39174**	-.0000179
	(0.0062846)	(9.506901)	(1.507335)	(0.0002315)	(38.94964)	(0.0000262)
SDM	0.0278014***	-5.181213	0.6277514	-0.0009916***	96.69396**	-0.0000138
	(0.0076685)	(8.726163)	(2.05945)	(0.000234)	(43.15497)	(0.0000327)

*Note: ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively.*

Source: calculated by the author

Table 3

Impact of the local labor market and educated workforce on the productivity of the Jakarta Metropolitan Area

Prod		D	HI	LE	BA	Edu	Pop
SAR	DE	0.0371396***	-7.181951	3.126656*	-0.0011237***	-3.329798	7.77e-07
		(0.0080486)	(12.02442)	(1.674515)	(0.0002805)	(30.59125)	(0.0000336)
	IE	0.0384286	-7.431205	3.235169	-0.0011627	-3.445361	8.04e-07
		(0.0313655)	(15.25365)	(3.220884)	(0.0008779)	(30.62066)	(0.0000345)
	TE	0.0755682**	-14.61316	6.361824	-0.0022864**	-6.775159	1.58e-06
		(0.0365192)	(26.91345)	(4.572995)	(0.0010024)	(61.1722)	(0.0000681)
SEM	DE	0.0279518***	-5.57644	0.6206622	-0.0009874***	97.14964**	-0.0000144
		(0.0087529)	(10.91545)	(2.037261)	(0.0002381)	(42.41329)	(0.0000306)
	IE	-0.0490447	128.8298	2.310806	-0.0013667	-148.536**	0.0002068***
		(0.0549612)	(102.6092)	(7.468917)	(0.0018078)	(64.62192)	(0.0000599)
	TE	-.0210929	123.2534	2.931468	-0.0023541	-51.38634	0.0001924***
		(0.0613009)	(106.7022)	(7.691653)	(0.0018648)	(50.93131)	(0.0000528)
SDM	DE	0.0327375***	-9.101392	1.711039	-0.0009779***	86.48333**	-0.0000181
		(0.0058899)	(9.565377)	(1.495487)	(0.0002337)	(39.51695)	(0.0000264)
	IE	-0.0089122	2.477705	-.4658024	0.0002662	-23.54367	4.93e-06
		(0.0105611)	(3.658785)	(0.5260764)	(0.0003359)	(31.40571)	(8.37e-06)
	TE	0.0238252	-6.623687	1.245237	-0.0007117	62.93966	-0.0000132
		(0.0128391)	(8.039688)	(1.443478)	(0.0003587)	(39.43096)	(0.0000213)

*Note: ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively*

Source: calculated by the author

Table 3 presents the outcomes of the analysis regarding the impact of the local labor market and educated workforce on the productivity of the Jakarta Metropolitan Area. As indicated in Table 3, results from SAR, SEM, and SDM demonstrate that density and the education index exhibit a significant positive correlation, while the number of holders of bachelor's degrees displays a significant negative association with productivity. The direct effect size of 0.0327375 for density implies that a 1% increase in productivity corresponds to a 0.0327% enhancement in density. The influence of density on productivity suggests that regions with higher population density are more likely to attract individuals, contributing to increased density in those areas. This connection between denser living environments and heightened economic activity, competitiveness, and productivity aligns with various studies on the correlation between density and productivity (Di Giacinto et al., 2020; Gould, 2007; Henderson & Turner, 2020; Moretti, 2010; Prasertsoong & Puttanapong, 2022; Sveikauskas, 1975; Tadjoeddin & Mercer-Blackman, 2018).

Meanwhile, high population concentration has a negative impact on productivity in both approaches. Evidently, in Jakarta, this creates vari-

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ous challenges such as crime, poverty, and underdeveloped zones. Additionally, Jakarta's role as a hub for economic activity and migration contributes to the clustering of both people and businesses in the region. Nonetheless, Jakarta's localization economy, represented by the proxy of the manufacturing sector, shows no relevance to productivity. This outcome contradicts the findings of Combes et al. and several other studies that emphasize higher firm productivity in larger areas (P. Combes et al., 2012; de la Roca & Puga, 2017; Di Giacinto et al., 2020; Glaeser & Resseger, 2010; Groot & de Groot, 2020; Lee et al., 2017; Moretti, 2010; Prasertsoong & Puttanapong, 2022; Tadjoeddin & Mercer-Blackman, 2018; Venhorst, 2017). This outcome might be attributed to the proxy used for the localization economy, which primarily represents industrial sectors. Another possible interpretation is that it signifies a shift in the economic structure of Jakarta towards other sectors. Consequently, among the three variables analyzed, the education level of the region emerges as a key determinant of Jakarta's metropolitan productivity within a spatial context.

To explore the presence of productivity and human capital externalities, we examine the impact of the human development index on productivity in the Jakarta Metropolitan Area. The human development index is a composite measure of health, education, and living standards, serving as an indicator of regional welfare levels. Despite Jakarta's substantial population concentration, the dense and productive environment does not ensure uniformly high life expectancy, education, and per capita income. Consequently, the human development index exhibits a spatially negative relationship with productivity, registering a value of -9.101392. While cities offer numerous benefits, they also carry disadvantages, particularly in terms of managing a sizable population (de la Roca & Puga, 2017; Duranton & Puga, 2020).

The direct impacts of the number of holders of bachelor's degrees and the education index in a district are -0.0009779 and 86.4833, respectively (see Table 3). This result showcases the negative correlation between higher education and productivity, juxtaposed with the positive correlation between education levels and productivity in the Jakarta Metropolitan Area. Plausibly, higher education quality contributes to higher productivity in similar regions. However, the number of highly educated individuals has a negative impact on productivity, albeit relatively small. Hypothetically, such individuals may not contribute significantly to their region, potentially migrating to other areas or countries. Consequently, while aggregate-level education can drive productivity in each region of the Jakarta Metropolitan Area, the impact of highly educated individuals is different. This result disagrees with a number of studies that emphasize the value of high human capital in densely populated areas or cities (de la Roca & Puga, 2017; Di Giacinto et al., 2020; Duranton & Puga, 2020; Glaeser & Maré, 2001; Glaeser & Resseger, 2010; Glaeser & Xiong, 2017; Groot & de Groot, 2020; Halfdanarson et al., 2008; Henrekson, 2020; Kijek & Kijek, 2019; Lamorgese et al., 2019; Lee et al., 2017; Lu, 2022; Moretti, 2010; Shi et al., 2022; Tadjoeddin & Mercer-Blackman, 2018; Venhorst, 2017; Yin et al., 2022; Zgarrick et al., 2020). Presumably, this outcome stems from various factors, including: 1) the limited share of highly educated individuals in the labor market; 2) a mismatch between tertiary education curricula and labor market demands; 3) Indonesia's status as a developing country rather than a developed one; 4) disparities in school distribution in the Jakarta metropolitan area; and 5) the migration of highly educated individuals to other regions or countries. Consequently, the high level of education in the Jakarta Metropolitan Area does not necessarily align with the skill demands of the local labor market.

Meanwhile, the presence of educated individuals seems to decrease productivity in their respective regions, while also impacting the minimum wage in those regions and neighboring areas (see Table 5). This suggests that higher wages in certain regions attract educated individuals, prompting them to migrate, as noted by Setyawan et al. (2020). It's likely that firms or labor demand prefer locations with high education rates as an incentive for offering higher salaries. It could be supposed that while a high urban education rate could generally elevate wages, in the specific case of holders of bachelor's degrees, there seems to be no significant effect on productivity and wage. This phenomenon could be caused by such factors as limited job opportunities, a majority of the labor market being composed of lower-educated workers, or even the migration patterns of educated individuals.

More specifically, the components of the minimum wage structure do not seem to account for education, despite the high competitiveness in the metropolitan area; consequently, possessing

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Table 4

Primary analysis of wages, productivity, and knowledge spillover in the Jakarta Metropolitan Area

Wage	Prod	D	HI	LE	BA	Edu	Pop
OLS	433.0241	12.04379	45123.39	6629.431	-1.31036	-4820.967	.1096157
	(276.5905)	(20.35137)	(32403.9)	(4027.191)	(0.943041)	(13445.42)	(0.0787449)
SAR	1913.316***	0.8693918	66204.27**	7119.918**	-0.0915953	108875.3*	0.1971435**
	(458.0517)	(22.79237)	(28437.6)	(3728.719)	(0.8016353)	(62736.03)	(0.0775362)
SEM	2068.811***	-3.873147	101215.3***	5534.871***	-0.6434435**	112599.1***	0.3352907***
	(353.3042)	(18.06969)	(22287.3)	(2881.077)	(0.6439398)	(35049.16)	(0.0700849)
SDM	1916.646***	-28.71461	123768.3***	7409.1*	-1.61645***	425104.9 ***	0.1630168**
	(365.9361)	(18.8779)	(16922.35)	(4160.121)	(0.5893733)	(121861)	(0.0766741)

*Note: ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively*

Source: calculated by the author

Table 5

Impact of productivity and knowledge spillover on the wage level in the Jakarta Metropolitan Area

Wage		Prod	D	HI	LE	BA	Edu	Pop
SAR	DE	1915.216***	0.8702551	66270.01**	7126.988**	-0.0916863	108983.4*	0.1973393**
		(454.2106)	(22.81633)	(28308.93)	(3734.476)	(0.8024122)	(62832.07)	(0.0771738)
	IE	185.1628	0.0841361	6406.975	689.0362	-0.0088642	10536.5	0.0190787
		(460.7156)	(2.283548)	(15440.7)	(1840.739)	(0.0799508)	(28319.03)	(0.0464522)
	TE	2100.378**	0.9543912	72676.99***	7816.025**	-0.1005505	119519.9	0.216418***
		(511.6332)	(25.09137)	(27259.51)	(4569.461)	(0.8793101)	(75796.98)	(0.07631)
SDM	DE	1790.399***	-13.51877	102279.1**	5830.467	-1.338017*	415680.7***	0.1786886**
		(430.5677)	(31.43816)	(39863.84)	(5022.434)	(0.7355338)	(120822.5)	(0.0773673)
	IE	3424.399	-412.1823*	582886.6**	42819.91**	-7.552426*	255630.7	-0.4250934
		(2854.48)	(239.4008)	(262832.7)	(19081.64)	(4.138607)	(385494.6)	(0.4470071)
	TE	5214.799*	-425.701	685165.7**	48650.38**	-8.890443**	671311.4	-.2464048
		(2957.687)	(262.2839)	(291206.2)	(20989.87)	(4.348735)	(417253)	0.4916601
SEM	DE	2069.657***	-3.87473	101256.6***	5537.133**	-.6437065	112645.2***	.3354277***
		(355.5597)	(18.07829)	(22396.52)	(2881.029)	(.6443458)	(35104.41)	(.0704838)
	IE	-117.6631	.2202842	-5756.594	-314.7944	.0365957	-6404.048	-.0190696
		(255.1772)	(1.195992)	(12645.54)	(649.6527)	(.0880414)	(13772.98)	.0420043
	TE	1951.994***	-3.654445	95500.06***	5222.339*	-0.6071108	106241.1***	0.3163581***
		(275.1301)	(16.97492)	(17369.09)	(2871.795)	(0.6027197)	(32959.17)	0.0514384

*Note: ***, **, and * represent significance at the 1%, 5% and 10% levels, respectively*

Source: calculated by the author

a bachelor's degree doesn't guarantee higher salaries and increased productivity. It's likely that the education system in Indonesia falls short of meeting the skill demands of the labor market. This contrasts with the findings of Glaeser and Maré (2001), who argue that cities accumulate human capital, leading to increased productivity and higher salaries in urban areas. Therefore, the government should prioritize further investment in the education sector.

Based on Table 5 and the results of SDM, the most influential factors affecting salary in Jakarta are the education index in the region, the human development index (HI), productivity (Prod), and population. The direct positive impacts of Edu, HI, productivity, and population are 415680.7, 102279.1, 1790.399, and 0.1786886, respectively, while the number of holders of bachelor's degrees has a negative effect. HI stands as a significant factor contributing to higher salaries in the region, particularly in Jakarta. The combined direct and indirect effects, spanning both the region itself and its neighbors, emphasize the importance of the human development index in the Jakarta Metropolitan Area. It has a substantial and positive impact on the minimum wage, surpassing the

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impact of other variables (as shown in Table 5). Given that the HI is closely linked to the dimensions of education, health, and living standards, it plays a pivotal role in determining the workforce's capabilities. The abundant facilities offered by cities contribute to a decent quality of life for their inhabitants (Glaeser & Xiong, 2017; Gould, 2007; Halfdanarson et al., 2008; Henderson & Turner, 2020), ultimately affecting the quality of the future workforce. This includes the birth of skilled and educated workers with longer life expectancies, subsequently leading to higher wages and better compensation for workers.

In the Jakarta Metropolitan Area, density has a negative indirect effect on the salary rate. This implies that densely populated neighborhoods contribute to a decrease in the minimum wage in certain regions. In contrast, the localization economy, represented by the share of industrial activity, has a positive effect on neighboring regions by increasing the minimum wage. The varying industry structures across regions can account for some of the differences in regional salary levels. For instance, the densest area in the Jakarta Metropolitan Area is Central Jakarta, while the highest minimum wage is found in Bekasi City. Therefore, discrepancies in salary between regions can be attributed to differences in the local industry structure (Chen et al., 2020; Sveikauskas, 1975).

Based on the outcomes of these models' indirect effects (Table 3 and 5), it can be speculated that when considering spatial dependence in the region itself, a significant spatial spillover effect is observed in comparison to other regions within the Jakarta Metropolitan Area, particularly with regard to salaries. This finding indicates that the process of agglomeration is already underway, and the economic interactions in each region are crucial for harnessing the benefits of localization. However, it's imperative to address the state of education in densely populated areas in Indonesia. This is essential to mitigate the risk of significant unemployment arising from the new era of technology and the burgeoning working-age population in Indonesia.

In response, the Ministry of Education, Culture, Research, and Technology has initiated a comprehensive strategy named "Kampus Merdeka" (Independent Campus). This strategic plan aims to foster integration between universities and the professional field, enabling graduating students to acquire not only theoretical knowledge but also practical skills. This program helps students gain a diverse range of experiences, including professional internships, international study opportunities, laboratory involvement, and cross-university collaboration both in Indonesia and abroad. This initiative holds the potential to mark a significant step toward producing high-quality graduates with bachelor's degrees who can effectively contribute to productivity. These outcomes align with findings from various studies, including those by Glaeser and Maré (2001), Glaeser and Resseger (2010), Duranton and Puga (2020), and others in the field.

Conclusion

The novelty of this study lies in the fact that it amalgamates microdata from the Sakernas survey and macrodata from BPS within the timeframe of 2017-2019, focusing on the Jakarta Metropolitan Area. By seamlessly integrating individual-level data on highly educated individuals from Sakernas with regional-level data from BPS, the study achieves a holistic comprehension of the distinctive attributes prevalent across different regions. This harmonization of data across varying levels empowers a more intricate analysis of the correlation between productivity and area dimensions, offering insights into the trend of skilled individuals gravitating toward larger urban centers. This spatial exploration adds depth and complexity to the investigation, showing how the presence of skilled individuals in one area influences the neighboring regions. This spatial lens adds a layer of intricacy and authenticity to the study's findings.

Regarding productivity, it becomes evident that Jakarta's productivity is affected by its density. Additionally, localization economy, the human development index, and population size exhibit a positive yet statistically insignificant influence on productivity. Intriguingly, a negative association is observed between high education and productivity, contrasting the common assumption that education drives productivity. On a broader scale, the education rate at the aggregate level demonstrates the potential to increase productivity in its respective region. As such, it becomes apparent that density has a more pronounced impact on productivity than the sheer number of individuals in a region. The quality of education is also under scrutiny for its alignment with and contribution to Jakarta's productivity. This highlights a nuanced knowledge spillover scenario in Jakarta, deviating slightly from the common theoretical expectations and the notion of brain drain.

With respect to wages, the study reveals that productivity, the human development index, education rate, localization economy, and population

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collectively exert a positive influence on salary increments. Conversely, the population density of a region appears to have a dampening effect on wages, which might be explained by the presence of both prosperous and struggling areas in denser regions. Furthermore, the concentration of highly educated individuals in specific regional clusters seems to reduce minimum wages. This finding raises questions and suggests potential limitations in the study's scope. Basically, the study demonstrates that possessing a high level of education does not guarantee higher productivity and remuneration in Jakarta. Consequently, the need for reforming the education system emerges as a crucial priority in urban areas.

These findings suggest that relying solely on increased productivity as a measure of a nation's economic performance or progress could lead to inaccurate interpretations. Short-term development strategies that exhaust finite resources, such as natural reserves, may yield short-lived growth while undermining long-term progress. It is therefore imperative for Indonesia to focus on investing in human capital for sustained growth and prosperity. Despite the study's limitations—such as time frame constraints, the utilization of education rate and bachelor's degrees as proxies for knowledge spillover, and the localization proxy via industrial share in GDP—future research avenues are clear. These could encompass comparative analyses of multiple Indonesian metropolitan areas, a more nuanced exploration of knowledge spillover involving work experience as a proxy, or a focus on IT graduates as a driving force in Indonesia's evolving landscape. Additionally, studying variations in localization economies could enrich our understanding of local labor markets. Moreover, a more comprehensive assessment of human development factors is required to obtain a more accurate picture of urban well-being. Therefore, it's important for future studies to investigate well-being metrics, as they play a vital role in incorporating human and social capital values into sustainable development initiatives, particularly in densely populated areas such as urban environments.

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