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# ECONOMIC GROWTH IN CENTRAL JAVA: DOES MANUFACTURING INDUSTRY AGGLOMERATION MATTER?

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## ABSTRACT

The manufacturing industry agglomeration in Central Java has experienced growth and has played an important role in increasing production efficiency. However, Central Java's contribution to Indonesia's GDP (GRDP) has declined, indicating early signs of deindustrialization. This study aims to identify manufacturing industry agglomeration and its effect on economic growth in Central Java. The data sample consists of 490 observations from 35 districts/cities during the period 2010-2023, analyzed using panel data regression with a fixed effects model. This study presents a novelty in the form of independent variables representing distribution and consumption aspects, as well as a more recent and extended observation period. The study found that medium-level manufacturing industry agglomeration occurs only in Jepara, while low-level manufacturing industry agglomeration occurs in Kudus, Pekalongan, Pekalongan City, Purbalingga, Sukoharjo, Semarang, Klaten, Batang, Kebumen, Karanganyar, Salatiga City, Surakarta City, Semarang City, Temanggung, and Boyolali. Manufacturing industry agglomeration has a non-significant positive effect on economic growth, while gross fixed capital formation (GFCF), labor force, average years of schooling, capital expenditure, and minimum wage have a significant positive effect on economic growth. Policymakers are encouraged to promote further manufacturing industry agglomeration and provide public goods that support both manufacturing industry agglomerations and economic growth.

Keywords: *Economic Growth, Industrial Agglomeration, and Manufacturing*.

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## INTRODUCTION

Economic agglomeration occurs through the spatial concentration of manufacturing firms. Economic agglomeration can provide positive externalities such as the availability of skilled labor, specialized firms, and spillover effects from technology adoption, which can contribute to increased output (Edwards, 2007) and economic growth.

GRDP in Central Java has been steadily increasing, but its contribution to GDP in Indonesia has been decreasing. Based on Figure 1, Central Java's GRDP contributed 9.08% to GDP in 2010, but this contribution has been steadily decreasing to 8.86% in 2023. Decreased Central Java's GRDP contribution indicates that its economic growth has been relatively lower compared to other provinces in Indonesia.

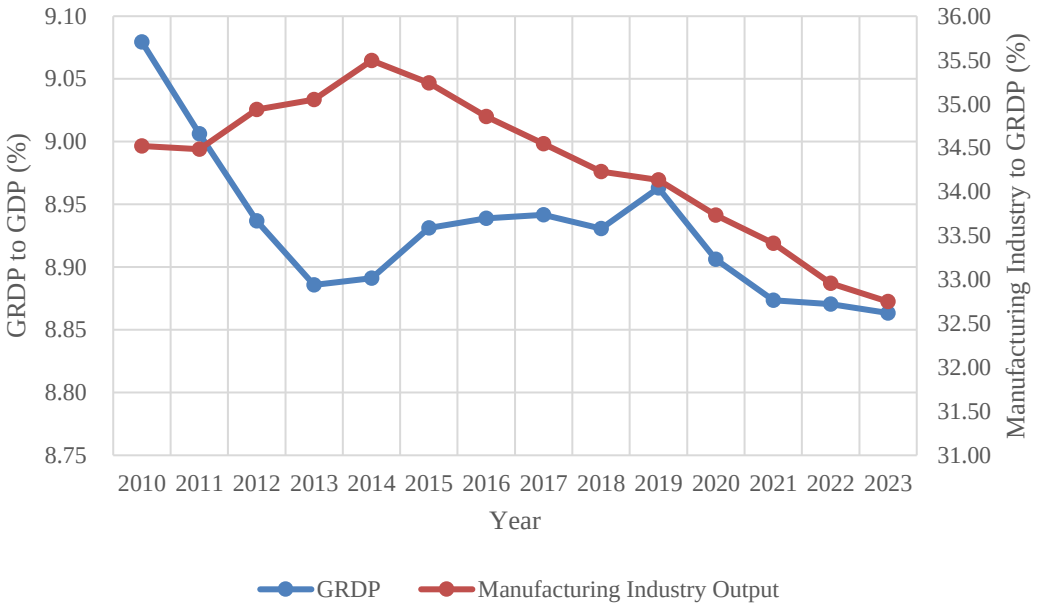


Figure 1. Contribution of GRDP and Manufacturing Industry Output in Central Java
Source: Statistics Indonesia Central Java (2024)

Declined Central Java's contribution to GDP can be attributed to the declined contribution of the manufacturing industry to Central Java's GRDP. Based on Figure 1, the contribution of manufacturing industry output to Central Java's GRDP has decreased from 34.52% in 2010 to 32.75% in 2023. Kaldor asserts that the manufacturing industry is the engine of economic growth (Dasgupta & Singh, 2007). Declined manufacturing industry output will hinder economic growth and economic transformation due to its highest value added and employment absorption compared to other sectors. In addition, declined manufacturing output is also an indication of early deindustrialization (Araujo et al., 2021).

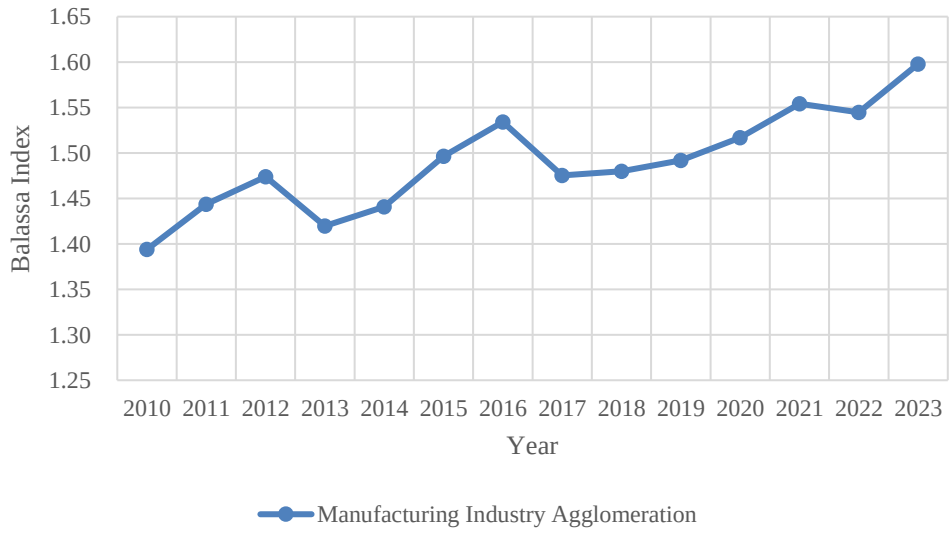


Figure 2. Manufacturing Industry Agglomeration in Central Java
Source: Statistics Indonesia Central Java (2024)

On the other hand, manufacturing industry agglomeration in Central Java, as measured by the Balassa index, has actually experienced a relative increase compared to other provinces in Indonesia. Based on Figure 2, the Balassa index for Central Java has increased from 1.39 in 2010 to 1.60 in 2023. Increased Balassa index indicates that several districts/cities have formed spatial clusters in the manufacturing industry. This manufacturing agglomeration is expected to provide production efficiency through positive externalities such as the availability of abundant skilled labor, production specialization, and adoption of advanced technology, which should contribute to economic growth.

Several studies have identified manufacturing industry agglomeration's effect on economic growth in Central Java. Susetyo and Hayati (2011), Wibowo et al. (2013), and Putra and Arif (2018) found that manufacturing industry agglomeration has a significant positive effect on economic growth. Meanwhile, Matitaputty and Mudakir (2010), Rezkinosa et al. (2014), Hasanah and Mustofa (2016), Yulianto and Hasmarini (2017), Windasari et al. (2021), and Purwoko and Hartarto (2023) found that manufacturing industry agglomeration has a non-significant effect on economic growth. On the other hand, Agustin et al. (2021) and Nadilla et al. (2021) found that manufacturing industry agglomeration has a significant negative effect on economic growth.

This study is based on the phenomenon gap, namely the decreased contribution of GRDP and manufacturing industry output in Central Java during increased manufacturing industry agglomeration. Meanwhile, several previous studies with different results are used as research gaps.

The novelty of this study compared to the previous one is the use of capital expenditure and minimum wage as independent variables representing distributional and consumption aspects, as well as a more recent observation period with a longer duration.

The problem statement is that increased manufacturing industry agglomeration in Central Java, as measured by the Balassa index, has not yet represented manufacturing industry agglomeration at the district/city level. In addition, the effect of manufacturing industry agglomeration in Central Java on economic growth has not been conclusively determined. Therefore, this study is important to identify the role of manufacturing industry agglomeration in economic growth and to develop strategies to accelerate economic growth.

This study aims to identify manufacturing industry agglomeration and its effect on economic growth in Central Java. This study can contribute to the literature by providing empirical evidence on the manufacturing industry agglomeration effect on economic growth. In addition, policymakers can use this study as a consideration to promote more manufacturing industry agglomeration and provide public goods that support manufacturing industry agglomeration and economic growth.

## LITERATURE REVIEW

Agglomeration economies occur when firms are spatially clustered in a particular region. Agglomeration economies encourage other firms to join a cluster, creating a centripetal force. When the cluster becomes too large, diseconomies of agglomeration occur, causing firms within the cluster to leave, creating a centrifugal force (Edwards, 2007).

Firms located close to each other will have agglomeration economies namely localization economies and urbanization economies. Localization economies refer to reduction in production costs for each firm in the same industry within the agglomeration location, while urbanization economies related to reduction in production costs for each firm in the same city, even if they belong to different industries. Firms in agglomeration economies benefit from improved accessibility and communication, creating positive externalities. Agglomeration economies provide positive externalities through labor supply, specialized resources, and technology spillovers. Therefore, agglomeration economies reduce production costs and increase creativity for each firm (Edwards, 2007).

Localization economies and urbanization economies will generate several positive externalities. First, specialized labor, which leads to higher productivity, will push up wages and thus increase the supply of skilled labor. Meanwhile, increased skilled labor supply can lower production costs. Second, specialized firms tend to locate close to each other to reduce transportation costs, both in terms of proximity to raw materials (backward linkages) and markets (forward linkages). The availability of basic infrastructure can also reduce transport and production costs. Third, technological spillovers involve the adoption of cutting-edge technology to increase productivity through communication and the poaching of skilled labor from other firms (Edwards, 2007).

Diseconomies of agglomeration occur when the number of firms within an agglomeration becomes too large. An agglomeration that is too large will result in increased transportation costs, land costs, crime, and pollution, thereby reducing the cost savings in production within the agglomeration economy. This will encourage firms within the agglomeration to disperse and relocate to other areas in order to reduce production costs (Edwards, 2007).

However, the cumulative causality hypothesis suggests that agglomeration economies will continue to persist due to factors that have shaped and strengthened agglomeration economies effect, even if some key firms have left the agglomeration area (Robinson & Myrdal, 1939). Factors that contribute to the persistence of agglomeration economies include reduced production costs and improved access to markets. Conversely, key firms that have left the agglomeration may not be able to return to their original location, despite reversal actions that have been conducted.

Several studies have been conducted to identify agglomeration economies' effect on economic growth in Central Java. Susetyo and Hayati (2011) found that manufacturing industry agglomeration had a significant positive effect on economic growth during the period 2004-2007. Meanwhile, Wibowo et al. (2013) also found that manufacturing industry agglomeration had a significant positive effect on economic growth during the period 2005-2010 due to cost savings in input materials, promotion, and other support facilities when firms are located in clustered areas. Similarly, Putra and Arif (2018) found that manufacturing industry agglomeration had a significant positive effect on economic growth during the period 2013-2016.

Furthermore, several studies have been conducted to identify agglomeration economies' effect on economic growth in Indonesia. Widodo et al. (2015) found that agglomeration economies would increase specialization, which would promote technical efficiency for manufacturing firms in Indonesia. The level of competition among similar firms would promote technical efficiency, leading to higher output. Aritenang (2021) found that the diffusion effect of agglomeration economies and the

use of advanced technology in the manufacturing industry would drive economic growth in Indonesia. Nurlestari and Oktavilia (2023) also found that manufacturing industry agglomeration tends to occur on Java island. Manufacturing industry agglomeration will contribute to economic growth in Indonesia as firms benefit from reduced transportation costs and labor migration.

This study uses the neoclassical economic growth model of Solow (1956) with factors of production consisting of physical capital, labor, and knowledge to identify the effect of manufacturing industry agglomeration on economic growth. Therefore, independent variables used consist of GFCF, labor force, average years of schooling, and manufacturing industry agglomeration. In addition, this study also considers distributional and consumption aspects by using capital expenditure and minimum wage as independent variables.

This study has several hypotheses which can be explained as follows:

H1 : GFCF has a significant positive effect on economic growth
H2 : The labor force has a significant positive effect on economic growth
H3 : Average years of schooling has a significant positive effect on economic growth
H4 : Manufacturing industry agglomeration has a significant positive effect on economic growth
H5 : Capital expenditure has a significant positive effect on economic growth
H6 : Minimum wage has a significant positive effect on economic growth

## RESEARCH METHODS

This study used quantitative methods with secondary data, which can be detailed according to Table 1 data sample using a panel dataset with 490 observations from 35 districts/cities during the period 2010-2023.

Table 1. Data Variable

| Variable | Description | Unit | Source |
|---|---|---|---|
| Gross Regional Domestic Product (GRDP) | Gross regional domestic product at constant prices | Billion (IDR) | Statistics Indonesia |
| Gross Fixed Capital Formation (GFCF) | Gross fixed capital formation at constant prices | Billion (IDR) | Statistics Indonesia |
| Labor Force (Labor) | Population aged 15 and over, employed or unemployed | Thousand (People) | Statistics Indonesia |
| Average Years of Schooling (School) | Average years of formal education for the population aged 25 and over | Year | Statistics Indonesia |
| Manufacturing Industry Agglomeration (Agglomeration) | Agglomeration economies index in the manufacturing industry | Index | Statistics Indonesia |
| Capital Expenditure (CapExp) | Government expenditure from APBD for capital goods | Billion (IDR) | Ministry of Finance |
| Minimum Wage (Wage) | Minimum wage received by labor from their main job | Thousand (IDR) | Statistics Indonesia |

The data sample used consists of data from all districts/cities in Central Java to provide a more comprehensive analysis. Data sample at the district/city level is also used because all data variables in this study are not available at the sub-district level.

Data sample also covers the period 2010-2023 to capture the events of declining GRDP contribution and increasing manufacturing industry agglomeration in Central Java.

This study uses the Balassa index, which was also used by Sbergami (2002), to identify agglomeration economies. Manufacturing industry agglomeration in Central Java is measured by ratio of manufacturing industry employment to total employment at the district/city level compared to the provincial level as in equation 1. In addition, panel data regression as in equation 2 is used to identify manufacturing industry agglomeration effect on economic growth, similar to the study conducted by Matitaputty and Mudakir (2010), Rezkinosa et al. (2014), Hasanah and Mustofa (2016), Yulianto and Hasmarini (2017), Windasari et al. (2021), and Purwoko and Hartarto (2023). All data variable are transformed into natural logarithm form to simplify further analysis and to avoid multicollinearity (Ekananda, 2019). The model equations for the Balassa index and panel data regression can be written as follows.

$$\text{Balassa Index: } \left(\frac{E_{ij}}{\sum_j E_{ij}}\right) / \left(\frac{\sum_i E_{ij}}{\sum_i \sum_j E_{ij}}\right) \quad (1)$$

where, *E* is employment, *i* is manufacturing industry, *j* and districts/cities in Central Java.

$$\ln GRDP_{it} = \alpha_0 + \beta_1 \ln GFCF_{it} + \beta_2 \ln Labor_{it} + \beta_3 \ln School_{it} + \beta_4 \ln Agglomeration_{it} + \beta_5 \ln CapExp_{it} + \beta_6 \ln Wage_{it} + \varepsilon_{it} \quad (2)$$

where $\alpha_0$is intercept, $\beta_{1,2,3,4,5,6}$ are coefficient, *i* is districts/cities, *t* is year, and $\varepsilon$ is error term.

Panel data regression can be conducted using Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM) based on model selection result using Chow, Lagrange multiplier, and Hausman test. Model equation must also satisfy the Gauss-Markov assumptions to ensure that model equation is the best linear unbiased estimator as determined by normality, multicollinearity, heteroskedasticity, and autocorrelation test (Gujarati & Porter, 2009). However, estimation results that exhibit heteroskedasticity and autocorrelation must be corrected with robust standard error in order to be used for further analysis (Gujarati & Porter, 2009).

## RESULTS AND DISCUSSION

Descriptive statistics that provide brief information about dependent and independent variables can be detailed in Table 2.

Table 2. Descriptive Statistics

| Variable | Obs. | Mean | Std. Dev | Min. | Max. |
|---|---|---|---|---|---|
| GRDP | 490 | 24,596.16 | 23,325.70 | 4,010.71 | 161,849.1 |
| GFCF | 490 | 7,188.41 | 12,695.58 | 1,191.20 | 91,911.16 |
| Labor | 490 | 519.09 | 211.58 | 61.06 | 1,075.82 |
| School | 490 | 7.49 | 1.32 | 4.94 | 11.24 |
| Agglomeration | 490 | 1.01 | 0.45 | 0.17 | 2.63 |
| CapExp | 490 | 282.96 | 171.02 | 25.47 | 1,275.35 |
| Wage | 490 | 1451.32 | 527.46 | 662 | 3,060.34 |

Based on Table 2, manufacturing industry agglomeration has a relatively large standard deviation. It indicates that there is a relatively high disparity in manufacturing industry agglomeration among districts/cities in Central Java. GRDP also has a relatively large standard deviation, indicating a high disparity in economic growth among districts/cities in Central Java. This GRDP disparity is caused by relatively high disparities in the ownership of production factors including physical capital, labor force, and capital expenditure. However, average years of schooling and minimum wage are not significantly different among districts/cities in Central Java.

Table 3. Manufacturing Industry Agglomeration in Central Java

| Balassa Index | Category | Region |
|---|---|---|
| > 4 | High | - |
| 2-4 | Medium | Jepara |
| 1-2 | Low | Kudus, Pekalongan, Pekalongan City, Purbalingga, Sukoharjo, Semarang, Klaten, Batang, Kebumen, Karanganyar, Salatiga City, Surakarta City, Semarang City, Temanggung, Boyolali |
| < 1 | No | Banyumas, Kendal, Tegal, Cilacap, Demak, Sragen, Magelang, Magelang City, Pemalang, Pati, Tegal City, Purworejo, Banjarnegara, Wonosobo, Rembang, Wonogiri, Grobogan, Brebes, Blora |

Based on Table 3, manufacturing industry agglomeration measured by the Balassa index shows that only one (2.85%) region has a medium level of agglomeration, 15 (42.85%) regions have a low level of agglomeration, and 19 (54.28%) regions have no manufacturing industry agglomeration in Central Java during the period 2010-2023. Jepara stands out as a region in Central Java with specialization and comparative advantage in the manufacturing industry, especially in furniture, compared to other regions. In addition, the number of regions with medium manufacturing industry agglomeration in Central Java has decreased from three (8.57%) in 2010 to one (2.85%) in 2023. It indicates the occurrence of agglomeration diseconomies, where some firms leave the agglomeration area due to increasing production costs and relocate to other regions.

Table 4. Panel Data Regression Model

| Model Selection | P-value | Decision |
|---|---|---|
| Chow Test | 0.0000 | FEM |
| Lagrange Multiplier Test | 0.0000 | REM |
| Hausman Test | 0.0000 | FEM |

Based on Table 4, panel data regression was conducted with a fixed effect model. The fixed effect model takes into account the heterogeneity of independent variables in each district/city and remains constant throughout the observation period. The fixed effect model also assumes that the influence of the error term is constant during the observation period (Ekananda, 2019).

The normality test conducted using the skewness kurtosis test has a significant p-value, rejecting the initial hypothesis. It indicates that residuals are not normally distributed. This condition occurs due to the high disparity between regions in terms of several variables used in this study. Some districts/cities have high production factors while others do not. However, it is not necessary to adjust for this non-normally

distributed data when using a large sample (more than 100) because the F-stat and t-stat values are derived based on the assumption that residual follows a normal distribution (Gujarati & Porter, 2009).

The multicollinearity test is conducted using a correlation matrix to identify partial correlations among independent variables used in the model equation. Correlation matrix results show that all independent variables have correlation matrix values below 0.75, indicating that there is no multicollinearity.

The heteroskedasticity test conducted using the Wald test shows a significant p-value, rejecting the initial hypothesis and indicating that residuals exhibit heteroskedasticity. Meanwhile, the Wooldridge test for serial correlation also shows a significant p-value, rejecting the initial hypothesis and indicating that residuals have autocorrelation. Despite these problems, the estimation results of the model equation remain unbiased and consistent, but inefficient due to non-minimum variance. As a result, the F-stat and t-stat values become smaller and insignificant. Therefore, dealing with heteroskedasticity and autocorrelation using robust standard errors is necessary for further analysis (Gujarati & Porter, 2009).

Table 5. Panel Data Regression Results

| Independent Variable | Dependent Variable: lnGRDP | | |
|---|---|---|---|
| | Coefficient | Robust Std. Error | P-value |
| lnGFCF | 0.1278* | 0.0643 | 0.0550 |
| lnLabor | 0.1634*** | 0.0400 | 0.0000 |
| lnSchool | 0.3900** | 0.1525 | 0.0150 |
| lnAgglomeration | 0.0241 | 0.0207 | 0.2520 |
| lnCapExp | 0.0184*** | 0.0054 | 0.0020 |
| lnWage | 0.3096*** | 0.0487 | 0.0000 |
| Observation | 490 | | |
| Prob>F | 0.0000 | | |
| R-squared | 0.9621 | | |

Note: significance * p<0.10; ** p<0.05; *** p<0.01
Source: Data Processed (2024)

Table 5 shows panel data regression results to identify the manufacturing industry agglomeration effect on economic growth in Central Java. Based on the P>|t| values, GFCF, labor force, average years of schooling, capital expenditure, and minimum wage all have a significant positive effect on economic growth. However, manufacturing industry agglomeration has a positive but non-significant effect on economic growth.

Based on the Prob>F value, GFCF, labor force, average years of schooling, manufacturing industry agglomeration, capital expenditure, and minimum wage simultaneously have a significant positive effect on economic growth. Based on the R-squared value, the dependent variable is influenced by independent variables by 96.21% during the observation period, while the remaining portion is determined by the error term or other independent variables outside the model equation.

GFCF has a significant positive effect on economic growth. Increased GFCF by 1% will increase economic growth by 0.1278%, ceteris paribus. Increased GFCF or foreign and domestic investment will add physical capital to increase production capacity. Solow (1956) stated that increased physical capital must exceed depreciation to achieve sustainable economic growth. These findings are consistent with a study

conducted by Topcu et al. (2020), which found that GFCF will drive economic growth in developed countries. Zaman et al. (2021) also found that GFCF will promote economic growth in BRI countries. Meanwhile, Shi and Xu (2023) found that capital accumulation in physical investment and human capital will drive sustainable development. Increased GFCF will promote economic growth through increased production capacity, innovation, and job creation.

The labor force has a significant positive effect on economic growth. Increased labor force by 1% will increase economic growth by 0.1634%, ceteris paribus. The increased labor force will also encourage the labor supply, potentially lowering labor wages and production costs. In addition, labor absorption by firms will increase per capita income. Skilled labor will become more productive, thereby increasing output. These findings are consistent with a study conducted by Immurana et al. (2024), which found that labor productivity can improve both short and long-run economic growth in Africa. Jian et al. (2024) found that skilled labor agglomeration will enhance economic growth in China. Skilled labor contributes to knowledge sharing and technological innovation, thereby increasing productivity. Zhao et al. (2024) also found that the use of robots in production can improve labor productivity in China.

Average years of schooling have a significant positive effect on economic growth. Increased average years of schooling by 1% will increase economic growth by 0.3900%, ceteris paribus. Increased average years of schooling contribute to labor force knowledge, enabling them to better operate advanced technology and improve productivity. These findings are consistent with a study conducted by Sugiharti et al. (2021), which found that average years of schooling promote economic growth in Indonesia. However, labor productivity in Indonesia is more influenced by work experience than formal education. Sultana et al. (2022) found that formal education improves human capital quality, which promotes economic growth in both developed and developing countries. Danuza and Farah (2023) found that average years of schooling and work experience will increase economic growth in Indonesia. The government needs to support access to education for males, rural residents, and laborers in the agricultural and mining sectors who have lower incomes than others. Meanwhile, Jin and Kim (2024) found that higher education can boost economic growth through innovation, which benefits industries in terms of production efficiency.

Manufacturing industry agglomeration has a positive but insignificant effect on economic growth. It occurs due to the limited number of districts/cities with significant manufacturing industry agglomeration in Central Java. Central Java has only one (2.85%) medium-level manufacturing industry agglomeration region, which is Jepara. In addition, the number of manufacturing industry agglomeration regions at the district/city level in Central Java has decreased from three regions (Jepara, Kudus, Pekalongan City) in 2010 to only one region (Jepara) in 2023. Declined agglomeration economies indicate that districts/cities in Central Java are experiencing diseconomies of agglomeration, which has led some firms to spread out from the manufacturing industrial agglomeration region to reduce production costs.

These findings differ from a study conducted by Stojčić et al. (2019), which found that manufacturing industry agglomeration would increase firm productivity, sales, firm growth, and export performance, and provide higher wages for workers in the European Union. Zeng et al. (2023) found that manufacturing industry agglomeration would promote economic growth in China through competitiveness

level in urban clusters derived from population and resources. Liu et al. (2024) found that urbanization has a spillover effect in promoting manufacturing industry agglomeration and economic growth in China. However, urbanization's effect on economic growth is also determined by geographical conditions, resource availability, and regional economic conditions. Meanwhile, Maket et al. (2024) found that urban agglomeration can promote economic growth in both developed and developing countries that have adequate basic infrastructure and a large number of skilled labor.

Capital expenditure has a significant positive effect on economic growth. Increased capital expenditure by 1% will increase economic growth by 0.0184%, ceteris paribus. Capital expenditure is used to provide public goods with a useful life of more than one year for basic infrastructure such as roads, bridges, irrigation, sanitation, airports, ports, and terminals that can provide positive externalities to firms by reducing transportation and production costs. These findings are consistent with a study conducted by Arvin et al. (2021), which found that government expenditure contributes to economic growth in low-income and lower-middle-income countries. Cheng et al. (2022) also found that government expenditure increases the provision of public goods and stimulates private-sector investment, thereby promoting economic growth in China. Fedajev et al. (2023) found that the provision of electricity from renewable energy sources through government expenditure increases the industrial value added and economic growth in Central and Eastern Europe. Zhiqi et al. (2023) found that transportation infrastructure provided by government expenditure will promote long-run economic growth in the United Kingdom. In addition, the government should expand the transportation network and integrate it with the economic and geographical needs of each region to reduce production costs and increase private sector profits. Meanwhile, Meka'a et al. (2024) found that government expenditure on basic public infrastructure including transportation, telecommunications, water, and energy will promote economic growth in Cameroon.

The minimum wage has a significant positive effect on economic growth. Increased minimum wage by 1% will increase economic growth by 0.3096%, ceteris paribus. Increased minimum wage will also increase per capita income, thereby stimulating household consumption and economic growth. These findings are consistent with a study conducted by Lv et al. (2023), which found that increased minimum wage improves household revenue for low-income groups, improves household health, and increases emergency savings, thereby reducing household economic vulnerability in China. Wei et al. (2023) also found that increased minimum wage stimulates R&D in firms, especially in labor-intensive firms, private firms, and smaller financially capable firms in China. This is because an increased minimum wage will drive substitution and competition effects to create innovation for more efficient production. Ma et al. (2024) found that increased minimum wage will encourage job seekers to migrate to other cities in China that offer higher wages. Meanwhile, Otterby et al. (2024) found that an increased minimum wage will increase labor supply, but it will also increase unemployment in rural areas, regions with decreasing populations, and regions with low average wages in the United States.

## CONCLUSION

This study aims to identify manufacturing industry agglomeration and its effect on economic growth in Central Java. The data sample is derived from secondary data with

490 observations. It covers 35 districts/cities during the period 2010-2023 which was analyzed using panel data regression with fixed effect model. This study found that medium manufacturing industry agglomeration only occurs in Jepara, while low manufacturing industry agglomeration occurs in Kudus, Pekalongan, Pekalongan City, Purbalingga, Sukoharjo, Semarang, Klaten, Batang, Kebumen, Karanganyar, Salatiga city, Surakarta city, Semarang city, Temanggung, and Boyolali. Manufacturing industry agglomeration has a non-significant positive effect on economic growth. This is due to the very low number of medium manufacturing industry agglomerations (2.85%), as well as diseconomies of agglomeration indicated by a decreased number of medium manufacturing industry agglomerations from three (8.57%) in 2010 to one (2.85%) in 2023. Meanwhile, GFCF, labor force, average years of schooling, capital expenditure, and minimum wage have a significant positive effect on economic growth.

Manufacturing industry agglomeration in Central Java needs to be improved to support economic growth. This study's results are expected to be considered by policymakers to promote more manufacturing industry agglomeration and provide public goods that can support manufacturing industry agglomeration and economic growth.

This study has limitations because it only uses one independent variable related to agglomeration economies in the model equation, thus not fully representing the concept of manufacturing industry agglomeration in detail. In addition, this study has not yet measured the spillover effect of manufacturing industry agglomeration from surrounding regions. Therefore, further research can be conducted to identify the manufacturing industry agglomeration effect on economic growth through more independent variables that better represent the conditions of manufacturing industry agglomeration in Central Java. In addition, manufacturing industry agglomeration determinants and spillover effects of manufacturing industry agglomeration in Central Java need to be identified.

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