How Does Dynamic Ordinary Least Squares Uncover Spillover Effects in Economic Growth and Sustainability Development Goals (SDGs)?

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Abstract. The Barlingmascakeb region consists of Banjarnegara Regency, Purbalingga Regency, Banyumas Regency, Cilacap Regency, and Kebumen Regency. The economic disparity among these regencies indicates that economic growth in the region is uneven. This condition is also supported by the high poverty rates in the area. This study aims to examine the influence of population size, the Human Development Index (HDI), minimum wage, and spill-over effect on economic growth in the Barlingmascakeb development region from 2010 to 2022. The method used in this study is the Panel Dynamic Ordinary Least Square (DOLS). The results of this study show that the variables of population size and spillover effect have a positive and significant impact on economic growth. The Human Development Index variable has a negative and insignificant impact on economic growth. The minimum wage variable has a negative and insignificant impact on economic growth. These findings are directly relevant to several Sustainable Development Goals (SDGs), including SDG 1 (No Poverty), SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 4 (Quality Education). By addressing these SDGs, the study underscores the importance of integrated policies that promote inclusive and sustainable development, reduce poverty, and ensure decent work and economic growth in the Barlingmascakeb region.

Keywords: Spillover Effect, HDI, Wages, Population, Economic growth

1 Introduction

The goal of economic development in a region is viewed as efforts to increase the productivity of the community, which in turn affects income growth (1). Economic development in a region is expected to bring positive effects on economic growth (2). Regional or area economic growth is a fundamental aspect of the continuity of economic sector development in a region (3). Economic growth in a region is influenced by both external and internal factors. One external factor influencing the economy and development in a region is the spillover effects between regions within a development area. The spatial interconnection between these regions creates a relationship in fulfilling the needs of the community within them (4).

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In the framework of the Sustainable Development Goals (SDGs), promoting economic growth and development in regions aligns with several critical goals. SDG 1 (No Poverty) highlights the need to alleviate poverty through economic progress, ensuring that increased productivity and income growth benefit all members of society. SDG 8 (Decent Work and Economic Growth) aims to foster sustained, inclusive, and sustainable economic growth, along with full, productive employment and decent work for everyone, which regional economic development initiatives can drive. SDG 10 (Reduced Inequalities) focuses on reducing inequalities both within and among regions, addressing disparities through spatial interconnections and spillover effects. SDG 11 (Sustainable Cities and Communities) emphasizes the need for inclusive, safe, resilient, and sustainable cities and settlements, which are supported by regional economic development. Lastly, SDG 4 (Quality Education) underscores the role of education in developing human capital, essential for long-term economic growth. By incorporating these SDGs into regional development strategies, regions can achieve sustainable and inclusive economic progress that benefits all community members (4–6)

The Regional Regulation of Central Java Province Number 16 of 2019 amends the Regional Regulation of Central Java Province Number 6 of 2010 concerning the Spatial Plan of Central Java Province for 2009-2029. Article 17 explains that there are 8 development areas in Central Java, which include the development areas of Barlingmascakeb, Purwomanggung, Subosukowonosraten, Banglor, Wanarakuti, Kedungsepur, Petanglong, and Bregasmalang The purpose of establishing these development areas is to foster cooperation to enhance economic growth and income distribution.

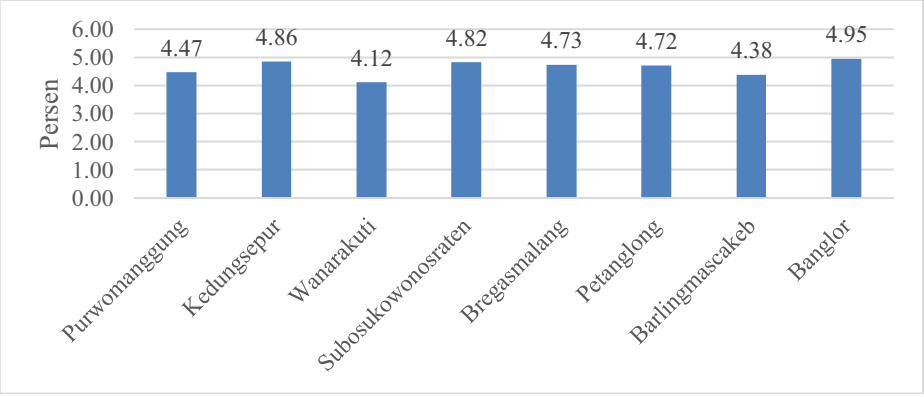

Fig. 1. Average GRDP Growth Rate of 8 Development Areas in Central Java Province for 2010-2022 (Percent) Source: Central Java Province BPS, 2024 (processed data)

Based on Fig. 1, data obtained from the Central Java Province Statistics Agency shows the average GRDP growth rate at constant prices for the 8 development areas in Central Java Province from 2010-2022. The average GRDP growth rate for the Barlingmascakeb development area is 4.38 percent. This is the second lowest position after the Wanarakuti development area, which is 4.12 percent. The data also shows that the Banglor development area has the highest average growth rate at 4.95 percent, followed by the Kedungsepur area at 4.86 percent. Over the 13-year period from 2010

to 2022, the Barlingmascakeb area remains in the lowest position, although the difference is only 0.26 points from the Wanarakuti area.

Slow economic growth can be attributed to the persistent and complex issue of poverty (7). To maintain economic stability in each region, it is necessary to measure the level of community welfare (8). The welfare of a community depends on the poverty level in an area, which can be indicated by the high or low number of poor residents in that area.

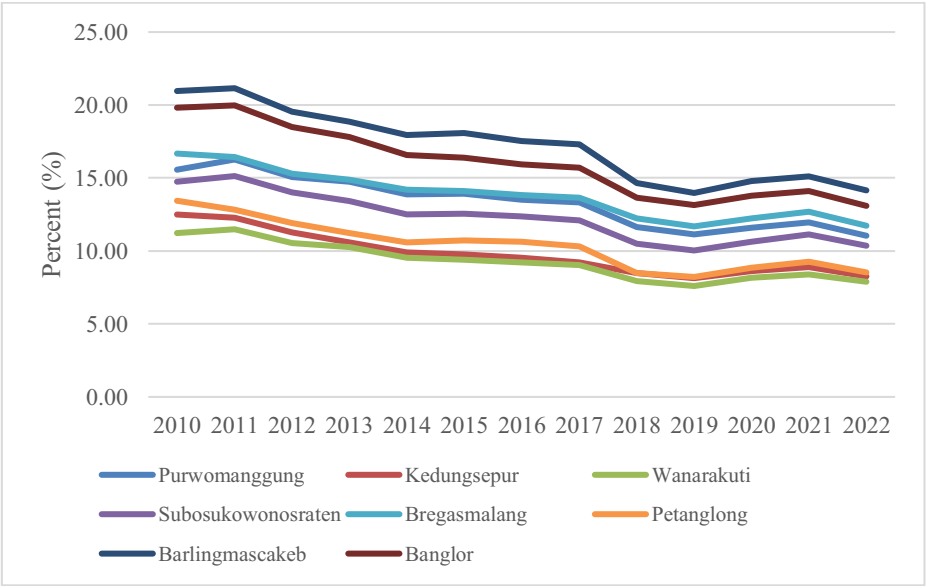

Fig. 2. Average Percentage of Poor Population in 8 Development Areas of Central Java Province for 2010-2022 Source: Central Java Province BPS, 2024 (processed data)

The data above shows the average percentage of the poor population in the 8 development areas of Central Java Province from 2010 to 2022. The Wanarakuti area has the lowest poverty percentage over the 10-year period, with a value of 9.29 percent. However, upon further examination, the highest poverty percentage is in the Barlingmascakeb area, with a value of 17.24 percent. This indicates a significant disparity between the two development areas, Wanarakuti and Barlingmascakeb. The high poverty rate suggests differences in interaction and economic activity among the districts/cities in the Barlingmascakeb development area.

The Barlingmascakeb development area consists of Banjarnegara Regency, Purbalingga Regency, Banyumas Regency, Cilacap Regency, and Kebumen Regency, with Banyumas Regency considered the growth pole. The Barlingmascakeb development area still has a high level of inequality among its districts. This regional inequality can be seen from the economic growth rates of each district. Differences in economic growth between regions in a development area tend to cause disparities between regions (4).

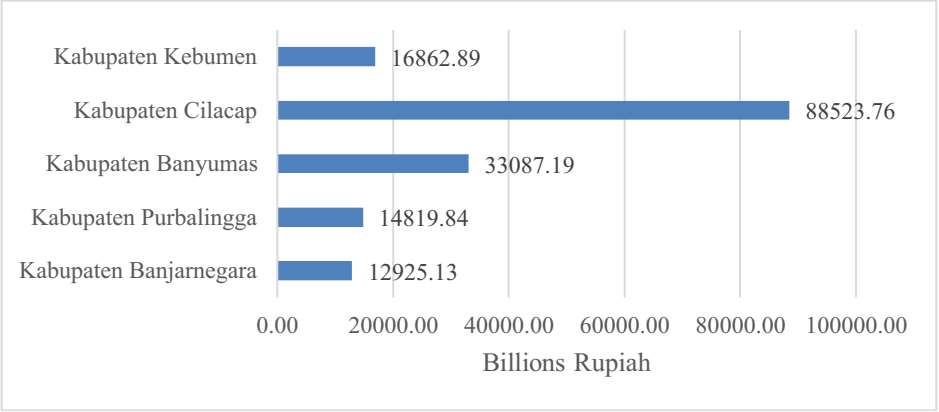

Fig. 3. Average GDP ADHK by Expenditure in the Barlingmascakeb Development Region of Central Java Province, 2010-2022 (Billion) Source: Central Java Provincial BPS, 2024 (processed data)

The data above illustrates significant growth disparities among districts in the Barlingmascakeb region. Cilacap District shows the highest consistent growth over a period of 13 years, contrasting with Banjarnegara District, which remains the area with the lowest economic growth over the same period. This disparity contributes to the uneven development levels within the Barlingmascakeb development region. However, over a 10-year period, economic growth in these five districts has shown consistent improvement each year.

The economic growth of a region is closely tied to its population development. Population growth influences the success or decline of development efforts (9). Population increase is essential in creating a skilled workforce that contributes to technological advancements and economic development (10,11)

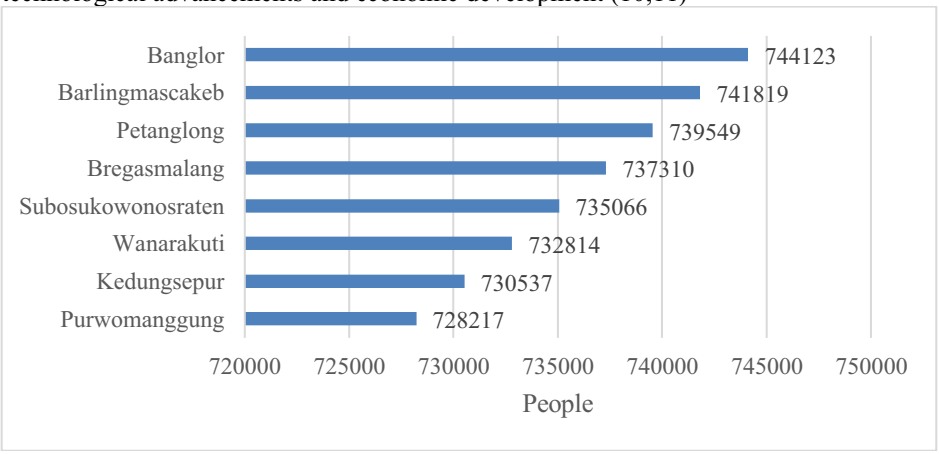

Fig. 4. Average Population in the 8 Development Regions of Central Java Province, 2010-2022 (Population) Source: Central Java Provincial BPS, 2024 (processed data)

Based on Fig. 4, the Barlingmascakeb region has the second highest average population, at 741,819 inhabitants, compared to other development regions in Central Java Province from 2010-2022. However, on the flip side, its economic growth rate ranks second lowest among the development regions, which is attributed to the lower human capital quality in that area. There is a significant impact of population increase on economic progress in a region.

In addition to population growth, the development of human capital is a crucial component for economic success in any region. Human capital can be gauged through the Human Development Index. Improvements in human quality can enhance productivity and thereby impact economic growth (12).

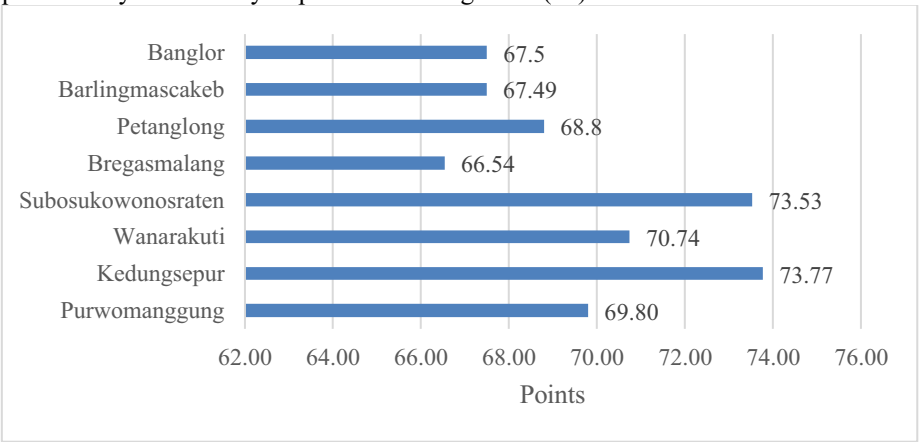

Fig. 5. Average HDI in the 8 Development Regions of Central Java Province, 2010-2022 (Population) Source: Central Java Provincial BPS, 2024 (processed data)

Based on Fig. 5, the Human Development Index (HDI) of the Barlingmascakeb area ranks as the second lowest, at 67.49 points, compared to other development areas. The low human quality in this area is due to low economic growth, which can lead to limitations in job creation, infrastructure, and public services. This can negatively impact the quality of life of the community. Previous research shows that human quality has a significant impact on economic growth in a region (13).

The development of human productivity is in line with the increase in wages received when entering the workforce. Wage levels indicate the quality of life and consumption of the community in a region (14). The higher the wages provided by companies, the higher the productivity of the workforce, and the greater the purchasing power in supporting economic growth.

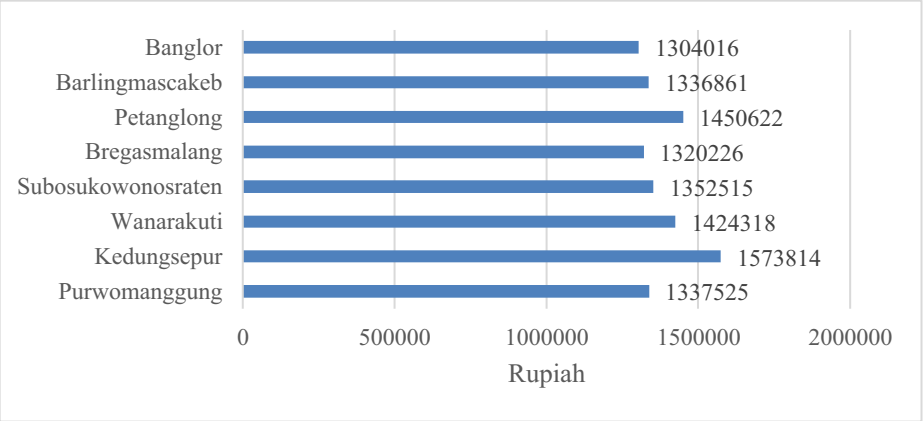

Fig. 6. Average Wages in the 8 Development Regions of Central Java Province, 2010-2022 (Population) Source: Central Java Provincial BPS, 2024 (processed data)

Based on the data above, Cilacap Regency has the highest average minimum wage from 2010-2022, which is Rp 1,458,378. Meanwhile, Banjarnegara Regency has the lowest average minimum wage, which is Rp 1,252,731. The wage differences in each region of the development area indicate that the socio-economic conditions of each region are very different. The minimum wage policy will positively impact productivity, thereby boosting economic growth in a region.

In addition to the above factors, there are other factors in stimulating economic growth in a region or development area. The spillover effect is an impact that arises due to interdependence between regions, which can influence the regional economy (14). The spillover effect has a positive impact, or spread effect, on the economic growth in other regions (15).

2 Research Methods

This study uses a quantitative approach with secondary data. The quantitative approach is an investigation of various problems by testing a theory consisting of multiple variables, measured with numbers and analyzed with statistical procedures to determine whether the predictive generalization of the theory is true. The data used in this study includes GDP at constant prices, population size, Human Development Index, minimum wage, and spillover effect calculation. The study period covers the years 2010-2022, utilizing the Panel Dynamic Ordinary Least Squares (DOLS) analysis technique with the assistance of Eviews 12 software. The general model equation for the Panel DOLS analysis is:

$$Y = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + e_{it}$$

Therefore, the general equation above can be transformed into:

$$LogPDRB_{it} = \beta_0 + \beta 1 logJP_{it} + \beta 2 IPM_{it} + \beta 3 logUM_{it} + \beta 4 logPSE_{it} + e_{it}$$

where LogPDRB is the logarithm of Gross Regional Domestic Product, LogJP is the logarithm of Population Size, IPM is the Human Development Index, LogUM is the

logarithm of the Minimum Wage, and LogPSE is the logarithm of the Spillover Effect calculation.

3 Results and Discussion

3.1 Panel Dynamic Ordinary Least Square test

Table 1. Stationary test

Variable	*level*	*1st difference*
Logpdrb	0.0004	0.0000
Logjp	0.9853	0.0000
IPM	0.0000	0.0000
Logum	0.0005	0.0420
Logpse	0.0021	0.0000

Source: EViews output, 2024

Based on Levin Lin Cu's Unit Root Test. Stationarity testing can be concluded that the variables are economic growth, Human Development Index, population, minimum wage level and spillover effect. in this research it can be used and can proceed to the next stage, namely the cointegration test because it passes at the level level or at the first difference level.

Table 2. Cointegration test

Kao Residual Cointegration Test				
Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob.*
RESID(-1)	-0.41915	0.145121	-2.888273	0.0056

Source: EViews output, 2024

Based on Table 2, it shows that the model estimation results are below 5% alpha, namely 0.0056 < 0.05, which means that the variables in this study are cointegrated with each other or it can be said that there is a long-term relationship.

Table 3. DOLS Panel Regression results

Variable	***Coefficient***	***Std. Error***	***t-statistic***	***Prob***
LOGJP	0.459880	0.185629	2.477417	0.0189
IPM	-0.010977	0.014230	-0.771380	0.4463
LOGUM	-0.393200	0.081317	-4.835374	0.0000
LOGPSE	1.049907	0.118955	8.826123	0.0000
R-Squared		0.999466		

Source: EViews output, 2024

The variable population size (LOGJP) and spillover effect (LOGPSE) have a positive and significant influence on economic growth. The Human Development Index (HDI) variable has a negative and insignificant influence on economic growth. The

minimum wage (LOGUM) variable has a negative and insignificant effect on economic growth.

3.2 Coefficient of Determinations (R^2)

The coefficient of determination value shows the number 0.999466, which means that 99% of the independent variables, namely population, Human Development Index (HDI), minimum wage and spillover effect are able to provide a strong influence simultaneously in explaining the dependent variable, namely economic growth in Barlingmascakeb. The remaining 1% can be explained by other variables outside the research.

Table 4. Wald test

Test Statistic	*Value*	*df*	*Probability*
F-statistic	366.1784	-4.31	0.0000
Chi-Square	1464.714	4	0.0000

Source: EViews output, 2024

The Chi Square probability shows the number 0.0000, which means it is below alpha 0.05, so it can be concluded that in the Wald test, the variables in this research, namely the independent variables, have a significant influence on the dependent variable partially.

3.3 Normality test

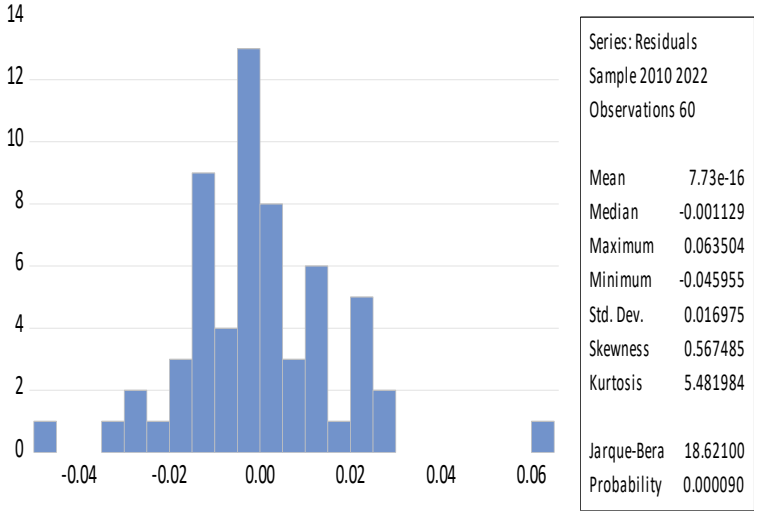

Fig. 7. Normality test Source: EViews output, 2024

The Jarque Berra Probability value shows 0.000090, so the model is not normally distributed because it is less than 5% alpha. With these results which are not normally

distributed, the Central Limit Theorem can be used, which is a phenomenon that explains if the data is more than 30 or n > 30 then it can be concluded that the data is normally distributed. The occurrence of violations or failure to pass the normality test should not be a complex problem so that the normality test in this research can be ignored.

Table 5. Multicollinearity test

LOGJP	IPM	LOGUM	LOGPSE
1	0.611420753451 3758	0.237064255029 8552	0.785900622398 6898
0.611420753451 3758	1	0.804234119822 4315	0.802848821908 3229
0.237064255029 8552	0.804234119822 4315	1	0.633398868779 0412
0.785900622398 6898	0.802848821908 3229	0.633398868779 0412	1

Source: EViews output, 2024

The tolerance values in the multicollinearity test for the independent variables are all below 0.90, so it can be concluded that there is no high correlation or relationship between the independent variables, so it can be concluded that this research is free from the multicollinearity test or has passed the multicollinearity test.

Table 6. Heteroskedastic test

Variable	*Coefficient*	*Std. Error*	*t-statistic*	*Prob*
LN_JP	0.101330	0.052569	1.927559	0.0631
IPM	-0.002324	0.004030	-0.576800	0.5682
LN_UM	-0.016075	0.023029	-0.698039	0.4904
LN_PSE	0.016329	0.033687	0.484733	0.6313

Source: EViews output, 2024

Based on Table 6, the output of the estimation results using EViews 12 shows that the probability of the independent variables showing a statistical value above alpha 5%, which means that in this test no symptoms of heteroscedasticity were found, meaning the model is free from heteroscedasticity.

3.4 The Impact of Population Size on Economic Growth

Based on the estimation model conducted using the DOLS panel, the results indicate that population positively and significantly influences economic growth in the Barlingmascakeb development area. This finding aligns with previous studies that suggest population growth generates a larger pool of scientists, researchers, and experts across various fields, thereby fostering technological progress and innovation, which in turn drive economic growth (16). Consistently, this research corroborates earlier work demonstrating that population growth has a positive and significant impact on economic development (17).

3.5 The Impact of HDI on Economic Growth

Based on the results of the estimation model that has been carried out using the DOLS panel, it shows that the Human Development Index has a negative and insignificant influence on economic growth in the Barlingmascakeb development area. This is because human development achievements are increasing, but the unemployment rate in Barlingmascakeb is experiencing an upward trend throughout 2010-2022, giving rise to the level of educated unemployment in the region. This can be shown in Figure 8 below.

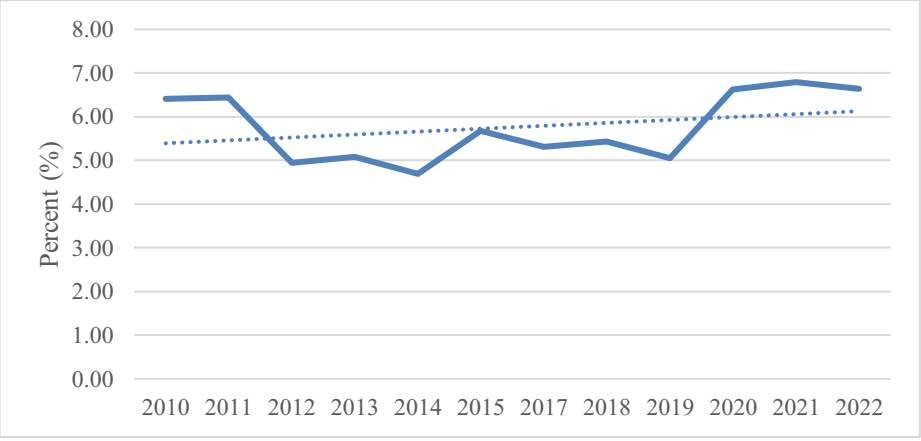

Fig. 8. Average Open Unemployment Rate in Barlingmascakeb Development Area 2010-2022 (Percent) Source: Central Java Province BPS, 2024 (processed data)

This result contradicts Romer's theory, which posits that knowledge, human capital, and innovation drive economic growth. According to Romer, as knowledge increases, individuals become more skilled and capable of creating or utilizing renewable technologies, leading to higher production of goods and services, which in turn positively impacts the economy. This research is not in line with previous research that the Human Development Index has a positive and significant effect on economic growth (7).

3.6 The Impact of Wages on Economic Growth

Based on the results of the estimation model that has been carried out using the DOLS panel, it shows that the minimum wage has a negative and significant influence on economic growth in the Barlingmascakeb development area. The results of this research are not in line with the wage theory according to (18) which explains that workers who receive a high level of wages will fulfill their living needs and be able to purchase or consume goods and services, thus having an impact on the economy. This is because high wages, if not balanced with labor force participation or an increase in the labor force, will have an impact on the economic sector in the Barlingmascakeb area.

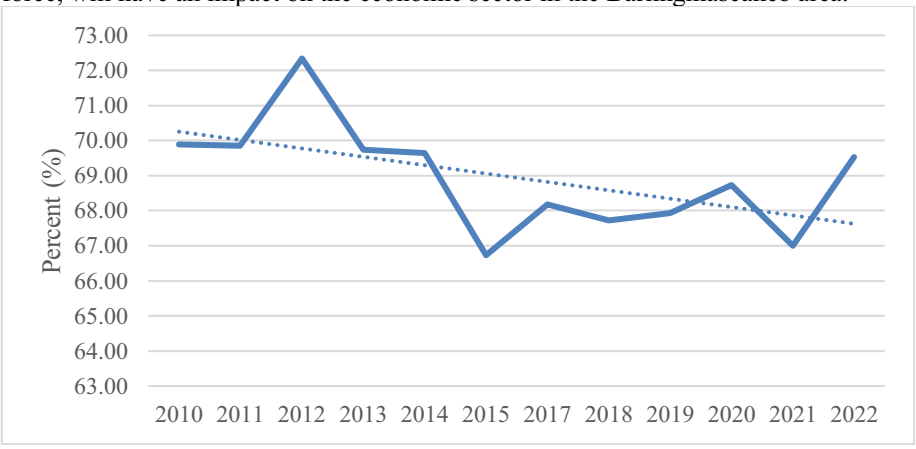

Fig. 9. Average Labor Force Participation Level in the Barlingmascakeb Development Area 2010-2022 (Percent) Source: Central Java Province BPS, 2024 (processed data)

The Labor Force Participation Rate (TPAK) from 2010-2022 in Barlingmascakeb has decreased, meaning that labor force participation is decreasing, which has an impact on economic conditions. On the other hand, an increase in wages causes the supply of labor to increase so that the demand for labor decreases or there will be a surplus of labor which results in unemployment. The results of this research are not in line with research which explains that wage levels have a positive and significant effect on economic growth (19). This is different from the research which explains that increasing wages has a significant but negative impact on economic growth conditions (20).

3.7 The Impact of Spillover Effect on Economic Growth

The estimation model results, using the DOLS panel, indicate that the spillover effect variable has a positive and significant influence on economic growth in the Barlingmascakeb development area. These findings align with Roberto Capello's theory, which suggests that the spillover effect from economic growth in one region can positively impact other regions. Additionally, Francois Perroux's theory supports this, asserting that spatial linkages can benefit surrounding areas. Specifically, when a developed region shares spatial connections with an underdeveloped area, the latter can

benefit from the former's advanced development, thereby boosting its own economic growth. This research is in line with research (21) and (22) that the spillover impact is able to create a positive influence on economic growth in a region with a spread effect.

3.8 The Impact of Spillover Effect on Sustainability Development Goals (SDGs)

The study's findings that the spillover effect has a positive and significant influence on economic growth in the Barlingmascakeb development area are closely related to several Sustainable Development Goals (SDGs). The positive impact of spillover effects helps reduce poverty (SDG 1: No Poverty) by promoting economic activities and creating better employment opportunities in underdeveloped areas, leading to job creation and increased incomes. This aligns with SDG 8 (Decent Work and Economic Growth) as the spillover effects contribute to sustained, inclusive, and sustainable economic growth by creating new business opportunities, increasing productivity, and improving labor market conditions (23)

Additionally, the spatial linkages between advanced and underdeveloped areas can reduce regional inequalities (SDG 10: Reduced Inequalities). Underdeveloped regions benefit from the economic advancements of neighboring developed areas, improving their infrastructure, access to resources, and overall economic conditions, thus narrowing the inequality gap. This also contributes to the development of more sustainable cities and communities (SDG 11: Sustainable Cities and Communities), as enhanced economic activities lead to better urban planning, improved public services, and greater community resilience, making cities and human settlements more inclusive, safe, and sustainable (24)

Moreover, while the direct impact of spillover effects on education is not the primary focus, the resulting economic growth can lead to increased investments in education and training, aligning with SDG 4 (Quality Education) (24). This fosters a more educated workforce that can contribute to sustained economic growth and innovation. In summary, the study highlights how the positive and significant impact of spillover effects on economic growth in the Barlingmascakeb development area supports multiple SDGs by promoting inclusive and sustainable economic development, reducing poverty and inequalities, and fostering resilient and sustainable communities.

4 Conclusion

Based on the research results, it can be concluded that there is a spillover effect between districts in the Barlingmascakeb development area. Additionally, the findings indicate that both the population variable and the spillover effect variable have a positive and significant impact on economic growth. Conversely, the Human Development Index variable has a negative and insignificant effect, while the minimum wage variable has a negative but significant impact on economic growth. These results underscore the need to address several Sustainable Development Goals (SDGs), including SDG 1 (No

Poverty), by focusing on poverty reduction through targeted economic policies; SDG 8 (Decent Work and Economic Growth), by ensuring decent wages and employment opportunities to support sustainable economic growth; SDG 10 (Reduced Inequalities), by implementing policies that reduce economic disparities within the region; SDG 11 (Sustainable Cities and Communities), by improving urban and regional planning for economic resilience and sustainability; and SDG 4 (Quality Education), by investing in education and healthcare to enhance human capital and drive long-term economic growth.

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