Economics, Business, Accounting & Society Review
Volume 4, Nomor 2, p. 184-195
ISSN 2810-0115

The Spatial Spillover of Health on Regional Economies: A Spatial Durbin Model Analysis

Novita Mukti Rinusara[1]

[1]*Department of Economics, Universitas Diponegoro, Semarang, Indonesia*
Corresponding Email: rinusaranovita@lecturer.undip.ac.id

ARTICLE INFO
Article history:
Received 30 January 2025
Revised 13 March 2025
Accepted 23 May 2025
Available Online 17 June 2025

Keywords:
Population Health, Economic Growth, Regional Development, Spatial Analysis.

Cite as:
Rinusara, N. M. (2025). The Spatial Spillover of Health on Regional Economies: A Spatial Durbin Model Analysis. Economics, Business, Accounting & Society Review, 4(2), 184–195. https://doi.org/10.55980/ebasr.v4i2.189

ABSTRACT
This study aims to examine the direct and spillover effects of population health on regional economic performance at the sub-national level in a developing country context. Using regency- and city-level data from Central Java Province, Indonesia, the study employs a Spatial Durbin Model (SDM) to capture both direct impacts within a region and indirect spillover effects across neighboring regions. The model integrates health indicators—such as life expectancy and morbidity rates—with regional economic performance measures, while controlling for socioeconomic and demographic covariates. This spatial econometric approach ensures that interdependencies across administrative boundaries are adequately addressed, offering a more comprehensive assessment than traditional regression models. The results reveal that improvements in regional health conditions significantly enhance local economic growth and produce positive spillover effects in adjacent regions. Specifically, better health outcomes increase labor productivity and expand economic capacity beyond local boundaries, suggesting that regional health is a localized asset and a shared driver of development. Moreover, the findings highlight that neglecting health disparities among neighboring regions can diminish aggregate economic performance, underlining the importance of coordinated health interventions. The study contributes to the literature by providing empirical evidence from a developing country at the sub-national level, a setting often overlooked in prior research dominated by cross-country or national analyses. The findings carry practical implications for policymakers, emphasizing that investments in regional health systems foster local prosperity and strengthen broader regional economic resilience.

1. Introduction

Health has long been considered a cornerstone of human development, yet its economic implications are far from straightforward (Djokoto, 2022). In Central Java Province, for instance, disparities between gross regional domestic product (GRDP) and life expectancy (LE) reveal paradoxical outcomes that challenge conventional wisdom (Roffia et al., 2023). Brebes Regency records one of the lowest life expectancies at only 69.39 years, yet it belongs to regions with relatively

high GRDP (Paramita et al., 2020). In contrast, Magelang City has one of the lowest GRDP levels in the province but records a high life expectancy of 76.95 years (Agita & Sailesh, 2024). These inconsistencies illustrate that health improvements do not always translate directly into local economic growth, suggesting that health benefits may diffuse beyond administrative boundaries (Bayar et al., 2024). For policymakers, this paradox complicates decision-making because investments in health may not yield the expected economic returns within the same jurisdiction (Andrew & Onoriode, 2023). Local governments often design health and economic policies in isolation, overlooking potential interregional effects (Alwago, 2022). As a result, planning becomes less effective, and the benefits of health improvements may remain underutilized without regional coordination mechanisms (Ruzima & Veerachamy, 2023).

Previous research has extensively analyzed the relation between health and economic growth, with most studies emphasizing the positive role of better health in fostering long-term development (Yang et al., 2021). Improved life expectancy enhances education, productivity, and demographic transitions, all of which contribute to economic performance (Rentería et al., 2016; Wang & Liu, 2016). However, disproportionate spending on governance weakens growth prospects, offsetting developmental gains linked to rising life expectancy and population productivity (Udoinyang et al., 2024). Fiscal independence further reinforces these outcomes by enabling efficient resource allocation, supporting sustainable growth, and accelerating poverty and unemployment reduction across regions (Amin et al., 2023). More recent studies, however, highlight that the relationship is more nuanced (Lopreite & Zhu, 2020). Health improvements may not always translate into higher income, as the impact varies across countries depending on demographic structures and stages of development (Prettner & Trimborn, 2016; Ursavas, 2022). Despite this progress, most of the literature focuses on direct effects at the national or cross-country level, employing methods such as OLS or traditional panel regressions (Bloom et al., 2024; Taguchi et al., 2021). Such approaches neglect the possibility of spatial spillovers, where improvements in health in one region may indirectly influence the economic outcomes of surrounding regions (Ruzima & Veerachamy, 2023). Consequently, while the broader link between health and growth is well documented, the spatial dimension of this relationship remains insufficiently explored in the existing literature (Vinh et al., 2021).

Empirical investigations in developing countries, particularly at the sub-national level, remain scarce, with most evidence derived from cross-country or national-level analyses (Yusuf et al., 2018). This lack of attention creates a critical gap in understanding how health outcomes shape economic performance in regions with heterogeneous development patterns, such as Indonesia's provinces (Zeren & Hizarci, 2024). Moreover, existing studies rarely employ spatial econometric techniques that can disentangle direct effects from indirect spillovers, limiting their capacity to capture the full scope of health's influence on economic growth (Gao et al., 2021). To address these gaps, this study applies a Spatial Durbin Model (SDM) to regency- and city-level data from Central Java, Indonesia, covering 2018–2022 (Yusuf et al., 2018). By explicitly accounting for interregional dependencies, the analysis evaluates whether life expectancy directly influences GRDP within a region and whether these effects extend to neighboring jurisdictions (Gao et al., 2021). The findings provide insights into direct and spillover health effects on regional economies, offering policy implications for collaborative regional development (Zeren & Hizarci, 2024).

Literature Review

Life expectancy at birth is widely recognized as a comprehensive indicator of health, and various environmental variables can be used to estimate its overall impact (Chanyalew et al., 2023; Georgescu et al., 2025; Săseanu et al., 2019). Sustained improvements in health are associated with permanent increases in income and have been shown to positively and significantly affect economic growth (Hussein et al., 2024; Zeren & Hizarci, 2024). Demographic factors also remain critical drivers of long-term growth (A A & Stover, 2023; Lee & Song, 2025), particularly in developing regions (Oliveira et al., 2024). Together, these findings highlight the pivotal role of health in shaping both immediate and long-run economic performance (Cervellati et al., 2017; de Renzis et al., 2022; Manenge, 2024). A large body of literature confirms that health positively affects

economies (Gao et al., 2021; Zeren & Hizarci, 2024), both in developed and developing countries (Pramanik & Hasnain, 2025). However, other studies suggest that the effect may vary, depending on country characteristics, or may not be significant (Lee & Song, 2025; Yusuf et al., 2018). This inconsistency calls for more nuanced approaches that account for context and possible indirect channels (Cervellati et al., 2017; A A & Stover, 2023).

Health exerts its economic influence indirectly through several key mechanisms (Alwago, 2022; Georgescu et al., 2025; Yang et al., 2021). *First*, education. Better health improves human capital formation by increasing school enrollment and learning outcomes (Agita & Sailesh, 2024; Rentería et al., 2016). Healthy students are more capable of concentration, memory use, and decision-making, all of which enhance academic achievement (Bayar et al., 2024; Wang & Liu, 2016). Thus, health and well-being are important foundations for educational development (Andrew & Onoriode, 2023; Ruzima & Veerachamy, 2023). *Second,* productivity. Building upon the human capital channel, health also directly enhances labor productivity (Cervellati et al., 2017; Lee & Song, 2025; Manenge, 2024). Healthier workers are more likely to participate fully in the labor force and perform tasks efficiently (Prettner & Trimborn, 2016; Risandini & Silvi, 2022), while chronic illnesses or unhealthy lifestyles reduce productivity and cause workplace losses (Lopreite & Zhu, 2020). From a macroeconomic perspective, productivity is a fundamental driver of economic growth, as reflected in the Cobb-Douglas production function, where output depends on capital and labor inputs and total factor productivity.

$$Y = zK^{a}(N^{d})^{1-a} \tag{1}$$

Third, fertility. Beyond productivity, health also shapes demographic dynamics by influencing fertility decisions. Improvements in women's health are associated with lower fertility rates, higher empowerment, and greater labor participation. However, reduced fertility can create long-term challenges, including population aging and increased dependency ratios. This demographic transition implies that while health-driven fertility decline may boost growth in the short term, it can constrain future labor supply and total output.

Despite extensive evidence on the role of health in fostering economic growth, most existing studies have treated the relationship as purely local, without considering potential cross-regional spillovers. Moreover, prior research predominantly employs OLS or conventional panel approaches, which cannot identify spatial dependence or disentangle direct from indirect effects. Finally, empirical investigations in developing countries, especially at the sub-national level, remain scarce, with most evidence drawn from cross-country or national-level analyses. This study applies a Spatial Durbin Model to regency- and city-level data from Central Java, Indonesia, thereby offering novel insights into health's direct and spillover effects on regional economic performance.

2. Methods

Variable Description

This study employs data collected from 29 regencies and six cities in Central Java for 2018–2022, which were obtained from the publications of the Central Bureau of Statistics of Central Java. The dependent variable is the gross regional domestic product at constant prices (GRDP), while the independent variable is life expectancy at birth (LE). Furthermore, the control variables include foreign investment (FI), domestic investment (DI), small enterprises (SE), government spending (G), and average years of schooling (AYOS), as in Table 1.

Table 1. Variables definition

Variable	Symbol	Meaning	Obs	Unit
Dependent variable	GRDP	Gross Regional Domestic Product at a constant price of 2010	175	Rupiah
Independent variable	LE	Life expectancy at birth	175	Year

Control variables	FI	Foreign investment	175	Rupiah
	DI	Domestic investment	175	Rupiah
	G	Government spending	175	Rupiah
	SE	Small Enterprises	175	Unit
	AYOS	Average year of school	175	Year

The dependent variable in this study is the gross regional domestic product at constant 2010 prices (GRDP). Among all regencies and cities in Central Java, Semarang City records the highest GRDP. A considerable disparity is observed, as only Semarang City, Cilacap Regency, and Kudus Regency demonstrate a middle-high level of GRDP. At the same time, the remaining regencies and cities fall within the middle-low category, as illustrated in Figure 1.

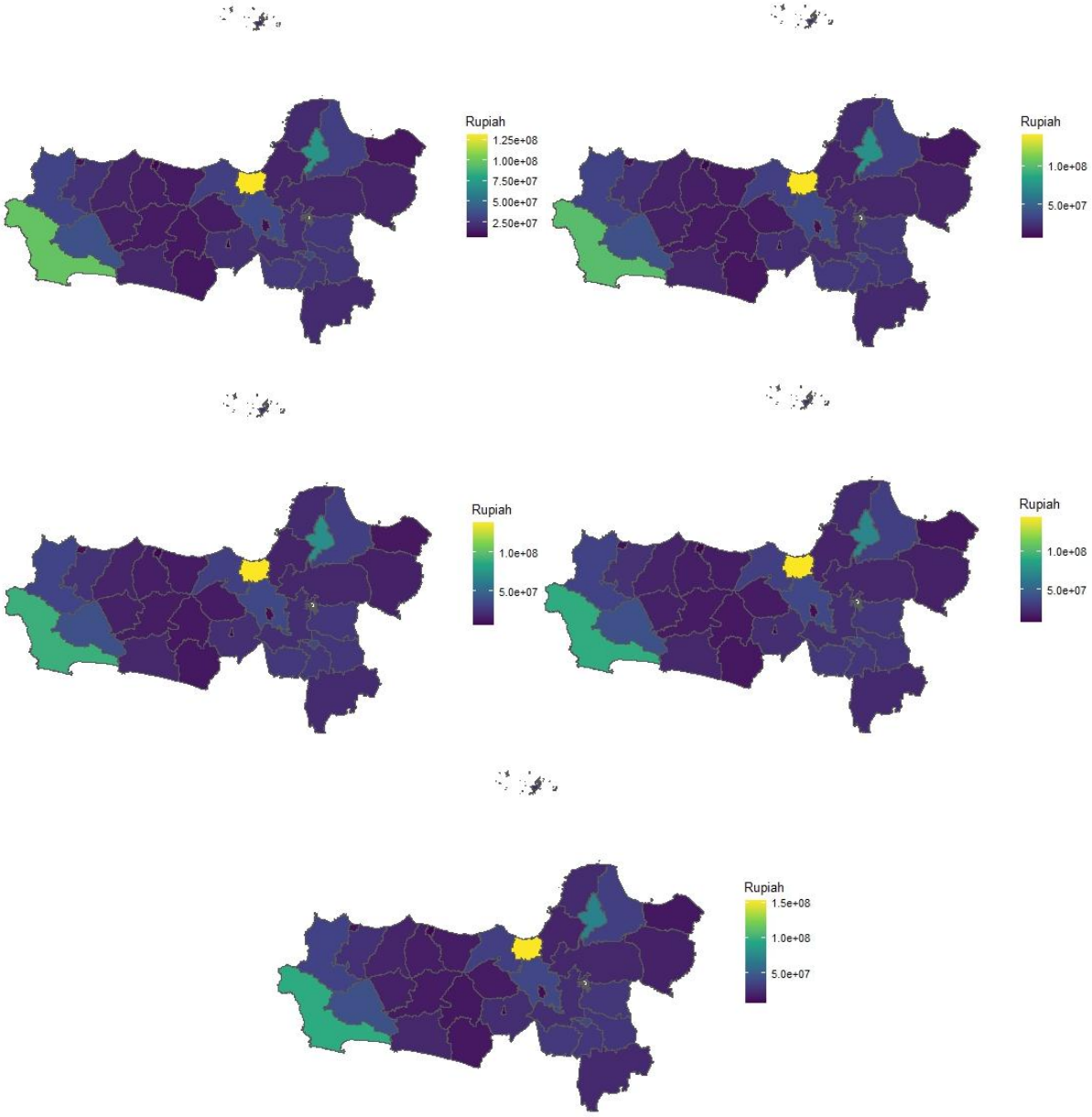

Figure 1. Gross Domestic Regional Product (GRDP) 2018-2022

Life expectancy, or life expectancy at birth (LE), is the average number of years a newborn infant is expected to live, assuming that prevailing mortality patterns at the time of birth remain constant throughout the individual's lifetime. In this study, life expectancy is treated as an independent variable. The data indicate the life expectancy of each regency and city in Central Java Province for 2018–2022. Brebes Regency records the lowest life expectancy in the province, the only region with a figure below 70 years, as presented in Figure 2.

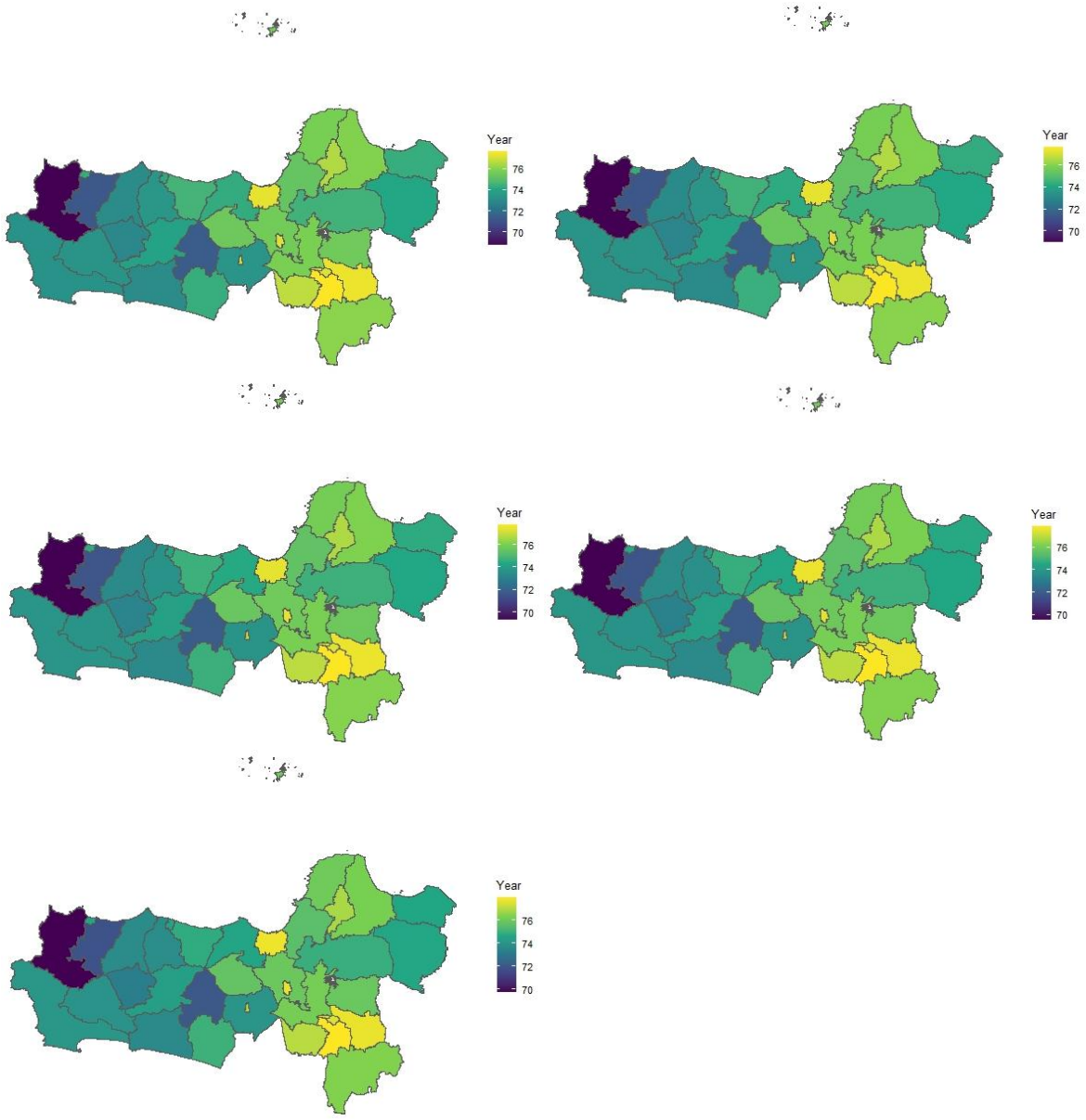

Figure 2. Life Expectancy at Birth (LE) 2018-2022

Autocorrelation

This paper used Global Moran's I to capture the spatial autocorrelation. The equation for Global Moran's I is below.

$$Moran's\ I = \frac{N}{S_0}\frac{\sum_{i=1}^{N}\sum_{j=1}^{N} w_{ij}(x_i-\overline{x})(x_j-\overline{x})}{\sum_{i=1}^{N}(x_i-\overline{x})^2} \quad (2)$$

In equation 2, N is the number of provinces; wij is the weight between regency/city i and j; xi and xj are values of the variable of interest in regency/city i and j, $\overline{and\ x}$ is the mean of the values. Moran's I value ranges from -1 to 1, with Moran's I < 0 meaning negative autocorrelation and Moran's I > 0 meaning the opposite.

Multicollinearity

This paper uses the variance inflation factor (VIF) to test the correlation between independent and control variables. The equation for VIF is below.

$$VIF(X_j) = \frac{1}{1-R_j^2} \quad (3)$$

In equation 3, R_j^2 is the R-squared value obtained by regressing predictor X_j on all predictor variables. VIF = 1 means no correlation between the predictor and other variables, 1 < VIF < 5 indicates moderate multicollinearity, and VIF ≥ 5 indicates high multicollinearity.

OLS

Besides the Spatial Durbin Model, this paper also uses Ordinary Least Squares (OLS), which will show the difference between using 'ordinary' econometrics and spatial econometrics. The equation for OLS is below.

$$lnGRDP = \beta_0 + \beta_1 lnLE + \beta_2 lnFI + \beta_3 lnDI + \beta_4 lnSE + \beta_5 lnG + \beta_6 lnAYOS + \in \quad (4)$$

In equation 4, β shows the effect of independent and control variables on GRDP: lnLE is the independent variable; lnFI, lnDI, lnSE, lnG, and lnAYOS are the control variables.

Spatial Durbin Model

There is always an interaction between one regency/city and another in Central Java Province. Everything is related to everything else, but near things are more related than distant things. That was the main reason this study chose to use Spatial Econometrics to capture those interactions, that is, the Spatial Durbin Model. This study uses distance-based weights to get more precise results and will get the direct and indirect effects. The equation for this method is below.

$$lnGRDP_{it} = \rho \sum_{i=1}^{n} W_{ij} lnGRDP_{it} + \beta_1 lnLE_{it} + \beta_2 lnFI_{it} + \beta_3 lnDI_{it} + \beta_4 lnSE_{it} + \beta_5 lnG_{it} + \beta_6 lnAYOS_{it} +$$
$$\theta_1 \sum_{i=1}^{n} W_{ij} lnLE_{it} + \theta_2 \sum_{i=1}^{n} W_{ij} lnFI_{it} + \theta_3 \sum_{i=1}^{n} W_{ij} lnDI_{it} + \theta_4 \sum_{i=1}^{n} W_{ij} lnSE_{it} + \theta_5 \sum_{i=1}^{n} W_{ij} lnG_{it} +$$
$$\theta_6 \sum_{i=1}^{n} W_{ij} lnAYOS_{it} + \mu_i + \lambda_t + \in_{it} \quad (5)$$

In equation 5, W is an n × n order geographical distance-based spatial weights matrix; i denotes the regency/city, t denotes year; ρ and θ represent spatial correlation coefficients; β shows the direct effect of independent and control variables on GRDP; lnLE is the independent variable; lnFI, lnDI, lnSE, lnG, lnAYOS, are the control variables.

3. Result

Spatial Dependency

Spatial dependency is used to see the spatial autocorrelation and understand how the spatial spillover effects of the variables are used. Using Global Moran's I, Table 2 shows the spatial Dependency of GRDP and LE from 2018 to 2022. Positive Moran's I indicates similar values are clustered, while negative Moran's I indicates dissimilar values are clustered. The GRDP 2018-2022 Moran's I is very close to 0, or there is very weak negative spatial autocorrelation, and the p-value is not significant, which means there is no significant spatial autocorrelation in GRDP.

Table 2. GRDP and LE with Global Moran's I

Year	GRDP		LE	
	Moran's I	p-value	Moran's I	p-value
2018	-0.078	0.991	0.205***	0.000
2019	-0.077	0.991	0.205***	0.000
2020	-0.076	0.990	0.205***	0.000
2021	-0.075	0.990	0.203***	0.000
2022	-0.075	0.991	0.200***	0.000

Meanwhile, the LE's Moran's I 2018-2022 shows the opposite. All of them are more than 0.2, indicating higher spatial autocorrelation. The p-value is significant, which means there is statistically significant spatial positive autocorrelation in LE data. LE values tend to cluster together, and it is very unlikely to be due to random chance.

Multicollinearity

The variance inflation factor (VIF) aims to see how independent the control variables are. Table 3 shows that the independent and control variables have a moderate level of multicollinearity since the results are 1 < VIF < 5, which means all those variables used are not too low nor too highly correlated.

Table 3. Multicollinearity Test with VIF

Variables	VIF
lnLE	2.36
lnFI	1.24
lnDI	1.39
lnSE	2.11
lnG	1.52
lnAYOS	3.23

4. Discussion

Ordinary Least Squares and Spatial Durbin Model

The results of the Ordinary Least Squares (OLS) estimation indicate that all variables, except life expectancy (LE), are statistically significant and exert positive effects on the gross regional domestic product (GRDP). Specifically, foreign investment (FI), domestic investment (DI), small enterprises (SE), government spending (G), and average years of schooling (AYOS) demonstrate significant positive contributions to the GRDP of each regency and city in Central Java. These findings align with prior studies highlighting the role of investment, education, and government expenditure in promoting regional economic performance (Agita & Sailesh, 2024; Andrew & Onoriode, 2023). By contrast, life expectancy (LE) exerts a negative yet statistically insignificant influence on GRDP, suggesting that improvements in health outcomes may not directly translate into regional economic growth in the short term. This result is consistent with evidence that the relationship between health and economic growth is complex and may vary depending on country-specific or regional characteristics (Alwago, 2022; Hussein et al., 2024). Overall, these findings provide important insights into the determinants of regional economic development in Central Java, as reported in Table 4.

The results of the Spatial Durbin Model indicate that domestic investment (DI) and foreign investment (FI) exert distinct effects on gross regional domestic product (GRDP). DI demonstrates a statistically significant and positive direct effect, alongside a statistically insignificant negative indirect effect. This suggests that an increase in DI within a regency or city enhances its GRDP, while its impact on neighboring regions' GRDP is negative yet insignificant. Conversely, FI shows a statistically insignificant adverse direct and statistically significant positive indirect effects. This

implies that higher FI within a regency or city reduces its GRDP but contributes positively to the GRDP of neighboring regions. In other words, DI primarily stimulates local economic growth without benefiting adjacent regions, whereas FI tends to generate spillover effects that favor regional neighbors rather than the host locality. Previous research has documented similar heterogeneous outcomes of investment, highlighting that both domestic and foreign capital may influence growth differently depending on context (Gao et al., 2021; Zeren & Hizarci, 2024; Oliveira et al., 2024; Lee & Song, 2025).

Small enterprises (SE) have a statistically significant positive direct effect on the gross regional domestic product (GRDP) of their respective regency or city, while at the same time exerting a significant adverse indirect effect on the GRDP of neighboring regions. An increase in small enterprises within a regency or city is associated with higher local GRDP; however, this expansion tends to reduce the GRDP of adjacent areas, suggesting the presence of competitive rather than complementary regional dynamics (Gao et al., 2021). This finding indicates that SE primarily contributes to localized economic growth without generating broader spillover effects (de Renzis et al., 2022). Previous studies have also emphasized the potential of small enterprises to stimulate growth by strengthening local employment and entrepreneurship (Agita & Sailesh, 2024). Nevertheless, other scholars have argued that small enterprises may not serve as the primary engine of job creation compared to larger firms, thereby limiting their aggregate impact on regional or national economic growth (Andrew & Onoriode, 2023).

Table 4. OLS and Spatial Durbin Model

Variable	**OLS**		**Spatial Durbin Model**	
	Coefficient	**p-value**	**Coefficient**	**p-value**
lnLE	-2.524	0.180	-5.471*	0.013
lnFI	0.018*	0.031	-0.012	0.078
lnDI	0.136***	0.000	0.113***	0.000
lnSE	0.156**	0.004	0.262***	0.000
lnG	0.835***	0.000	0.541***	0.000
lnAYOS	1.417***	0.000	2.223***	0.000
W × lnLE			26.023*	0.027
W × lnFI			0.420*	0.010
W × lnDI			-0.470	0.464
W × lnSE			-7.530***	0.000
W × lnG			5.493*	0.038
W×lnAYOS			-42.79***	0.000
R^2	**0.5915**	**0.000**		
LM error	1.0944	0.295		
LM Lag	13.6385	0.000		
Robust LM error	14.3030	0.000		
Robust LM lag	26.8472	0.000		
Rho			**-3.4404**	
LR test value			**6.9541**	**0.008**

Government spending (G) is the only variable that exerts a statistically significant and positive effect on the gross regional domestic product (GRDP) of a regency or city and its neighbors. This finding implies that higher government spending enhances local economic growth and generates spillover benefits for surrounding regions (Andrew & Onoriode, 2023; Gao et al., 2021). Accordingly, G contributes to regional economic expansion by strengthening direct and indirect growth channels (Oliveira et al., 2024). However, prior evidence has suggested that government expenditure does not always guarantee sustainable economic growth, reflecting the importance of institutional quality and contextual factors (Ruzima & Veerachamy, 2023; Manenge, 2024).

Average years of schooling (AYOS), similar to small enterprises (SE), exerts a statistically significant positive direct and adverse indirect effect on GRDP. This finding indicates that higher AYOS is associated with an increase in the GRDP of a regency or city, but simultaneously with a decrease in the GRDP of its neighboring regions (Agita & Sailesh, 2024). In other words, education contributes to economic growth at the local level but does not necessarily generate spillover benefits for adjacent areas. Previous studies have consistently shown that education positively influences economic growth; however, some evidence suggests that the contribution may be negligible or even negative when education quality is low (Bayar et al., 2024; Ruzima & Veerachamy, 2023).

The effect of life expectancy (LE) on GRDP appears more complex. In both OLS and Spatial Durbin Model estimates, LE negatively influences local economic growth while positively affecting neighboring economies (Alwago, 2022). Although much of the literature agrees that health generally enhances economic performance, several studies argue that its impact depends heavily on contextual and demographic characteristics (Cervellati et al., 2017). The effect of life expectancy on economic growth tends to be positive in economies where life expectancy remains relatively low, yet it may turn negative in more advanced economies (Alwago, 2022). Cross-country evidence further demonstrates that the impact of life expectancy varies according to demographic structure, particularly the degree of population aging (Lee & Song, 2025). In younger countries, higher life expectancy enhances savings behavior and fosters human capital accumulation, thereby supporting economic growth (Cervellati et al., 2017). However, in middle- and older-country groups, such positive effects are either weakened or absent, reflecting structural demographic constraints (A A & Stover, 2023).

The regencies and cities with high Gross Regional Domestic Product (GRDP) do not necessarily correspond to high life expectancy (LE). Central Java Province recorded LE values of 74.18, 74.23, 74.37, 74.47, and 74.57 years from 2018 to 2022, averaging 74.36 years. Among the seven regencies and cities with the highest GRDP—Semarang City, Cilacap Regency, Kudus Regency, Banyumas Regency, Surakarta City, Demak Regency, and Brebes Regency—not all demonstrate high LE. For example, Cilacap Regency, despite ranking second in GRDP, achieved an LE of only 73.81 years, while Banyumas Regency, ranked fourth in GRDP, recorded 73.73 years. Most notably, Brebes Regency, which placed seventh in GRDP, exhibited the lowest LE in Central Java at 69.39 years (Figures 1 and 2). Meanwhile, the seven regencies and cities with the lowest GRDP in Central Java—Magelang City, Pekalongan City, Salatiga City, Tegal City, Purworejo Regency, Rembang Regency, and Wonosobo Regency—do not necessarily have low LE. Despite having the lowest GRDP, Magelang City has a relatively high LE of 76.95 years. Similarly, Salatiga City, with the third lowest GRDP, records an even higher LE of 77.46 years. In contrast, Pekalongan City (second lowest GRDP), Tegal City (fourth), Purworejo Regency (fifth), and Rembang Regency (sixth) show life expectancies ranging between 74.39 and 74.77 years. It confirms the negative effect of LE on some regencies/cities' GRDP.

The five regencies/cities with the highest life expectancy (LE) in Central Java are Sukoharjo Regency, Karanganyar Regency, Semarang City, Salatiga City, and Magelang City. The Sukoharjo Regency is bordered by Klaten Regency and Surakarta City, which record a higher Gross Regional Domestic Product (GRDP). In a similar pattern, Karanganyar Regency is adjacent to Sukoharjo Regency, Surakarta City, and Sragen Regency, all reporting higher GRDP. Semarang City, which demonstrates the highest GRDP in Central Java, is naturally surrounded by neighboring regions with comparatively lower GRDP. Furthermore, Salatiga City shares borders with Semarang City, Temanggung Regency, Magelang Regency, and Boyolali Regency, all exhibiting higher GRDP. Likewise, Magelang City is bordered by Magelang Regency, Temanggung Regency, Wonosobo Regency, and Boyolali Regency, each having a higher GRDP.

Conversely, the five regencies/cities with the lowest LE in Central Java—Brebes Regency, Tegal Regency, Wonosobo Regency, Kebumen Regency, and Pemalang Regency—are largely bordered by regions with lower GRDP. Brebes Regency shares boundaries with Tegal City and Tegal

Regency, which register lower GRDP. Tegal Regency, in turn, is adjacent to Tegal City and Pemalang Regency, which also report lower GRDP. Wonosobo Regency is surrounded by Temanggung Regency, Banjarnegara Regency, Purworejo Regency, and Batang Regency, all showing lower GRDP. Similarly, Kebumen Regency borders Purworejo Regency and Banjarnegara Regency, which possess lower GRDP. Finally, Pemalang Regency is adjacent to Pekalongan Regency and Purbalingga Regency, which also record lower GRDP.

The findings indicate that, in most regencies and cities, higher life expectancy (LE) is associated with lower gross regional domestic product (GRDP) within the same region but corresponds to higher GRDP in neighboring regions. This spatial pattern reflects the outcomes of the Spatial Durbin Model, which shows that LE exerts a negative direct effect yet a positive indirect effect on GRDP (Alwago, 2022; Agita & Sailesh, 2024). Nevertheless, the underlying mechanisms driving this contrasting spatial relationship remain unclear. Further investigation is necessary to understand these dynamics, particularly in the context of demographic and structural factors (Cervellati et al., 2017; Lee & Song, 2025).

5. Conclusion

This study investigated the relationship between life expectancy (LE) and regional economic growth in Central Java Province, using both Ordinary Least Squares (OLS) and the Spatial Durbin Model (SDM). The results revealed a paradoxical pattern: while foreign investment (FI), domestic investment (DI), small enterprises (SE), government spending (G), and average years of schooling (AYOS) consistently exert significant positive effects on gross regional domestic product (GRDP), the role of LE is more complex. Specifically, LE has a negative direct effect on GRDP within a region but a positive indirect effect on neighboring regions. This finding suggests that the economic benefits of improved health may not remain confined within local administrative boundaries but instead diffuse spatially, producing spillover effects that benefit surrounding areas.

This study's key contribution lies in its application of spatial econometric techniques to subnational data, thereby advancing the understanding of how health interacts with regional economies beyond local boundaries. By highlighting the indirect positive effects of LE, this research underscores the importance of coordinated regional policies. Investments in health may not yield immediate local returns but can generate broader benefits when neighboring jurisdictions act collaboratively. This insight strongly supports regional planning approaches integrating health and economic policies across administrative units.

Nonetheless, the study has limitations. The analysis relies on a relatively short period (2018–2022) and focuses only on one province, which restricts the generalizability of the findings. Future research should extend the temporal and geographical scope, incorporate quality-of-health indicators, and compare interprovincial patterns. Such efforts will refine the understanding of the spatial dynamics between health and growth and strengthen evidence for policy coordination in developing economies.

6. References

A A, J., & Stover, J. (2023). Drivers of future population growth in six most populous countries: Effect of demographic components on the population growth using decomposition analysis. *Gates Open Research*, *7*, 118. https://doi.org/10.12688/gatesopenres.14741.1

Agita, V., & Sailesh, S. (2024). The Geography of Human Capital : Insights from the Subnational Human Capital Index in Indonesia. *Social Indicators Research*, *172*(2), 673–702. https://doi.org/10.1007/s11205-024-03322-x

Alwago, W. O. (2022). The nexus between health expenditure , life expectancy , and economic growth : ARDL model analysis for Kenya. *Regional Science Policy and Practice*, *15*(5), 1064–1086. https://doi.org/10.1111/rsp3.12588

Amin, A., Bambang Juanda, & Wiwiek Rindayati. (2023). Effect of Fiscal Independence and Economic Growth on Reducing Poverty and Unemployment in Indonesia. *Economics,*

Business, Accounting & Society Review, *2*(2), 97–109. https://doi.org/10.55980/ebasr.v2i2.62

Andrew, A., & Onoriode, B. (2023). Government sectoral spending and human development in Nigeria : Is there a link ? *Heliyon*, *9*(7), e17545. https://doi.org/10.1016/j.heliyon.2023.e17545

Bayar, Y., Danilina, M., & Babitsch, B. (2024). *Impact of education and income inequalities on life expectancy : insights from the new EU members*. *August*. https://doi.org/10.3389/fpubh.2024.1397585

Bloom, D. E., Kuhn, M., & Prettner, K. (2024). Fertility in High-Income Countries: Trends, Patterns, Determinants, and Consequences. *Annual Review of Economics*, *16*(1), 159–184. https://doi.org/10.1146/annurev-economics-081523-013750

Cervellati, M., Sunde, U., & Zimmermann, K. F. (2017). Demographic dynamics and long-run development: insights for the secular stagnation debate. *Journal of Population Economics*, *30*(2), 401–432. https://doi.org/10.1007/s00148-016-0626-8

Chanyalew, M. A., Yitayal, M., Atnafu, A., & Tilahun, B. (2023). Assessment of Data Demand for Informed-Decisions Among Health Facility and Department Heads in Public Health Facilities of Amhara Region, Northwest Ethiopia. *Health Research Policy and Systems*, *21*(1). https://doi.org/10.1186/s12961-023-01006-5

de Renzis, A., Faggian, A., & Urso, G. (2022). Distant but Vibrant Places. Local Determinants of Adaptability to Peripherality. *Tijdschrift Voor Economische En Sociale Geografie*, *113*(5), 483–501. https://doi.org/10.1111/tesg.12535

Gao, J., Jun, B., Pentland, A. 'Sandy,' Zhou, T., & Hidalgo, C. A. (2021). Spillovers across industries and regions in China's regional economic diversification. *Regional Studies*, *55*(7), 1311–1326. https://doi.org/10.1080/00343404.2021.1883191

Georgescu, I. A., Bâra, A., & Oprea, S.-V. (2025). Life Expectancy and Its Determinants in Selected European Union (EU) and Non-EU Countries in the Mediterranean Region. *Sustainability*, *17*(11), 5103. https://doi.org/10.3390/su17115103

Hussein, H. A., Warsame, A. A., Ahmed, M. Y., & Abdullahi, A. M. (2024). Fostering economic growth in Somalia: the role of life expectancy and environmental degradation. *Discover Sustainability*, *5*(1), 342. https://doi.org/10.1007/s43621-024-00512-y

Lee, J. W., & Song, E. (2025). Demographic change and long-term economic growth path in Asia. *Economic Modelling*, *147*(October 2023), 107043. https://doi.org/10.1016/j.econmod.2025.107043

Lopreite, M., & Zhu, Z. (2020). The effects of ageing population on health expenditure and economic growth in China: A Bayesian-VAR approach. *Social Science & Medicine*, *265*, 113513. https://doi.org/10.1016/j.socscimed.2020.113513

Manenge, R. (2024). Health Expenditures and Economic Growth in Zimbabwe. *International Journal of Economics and Financial Issues*, *15*(1), 256–264. https://doi.org/10.32479/ijefi.17397

Oliveira, H., Ferreira, V., & Afonso, O. (2024). Exploring the Relationship Between Technological Progress , Human Capital , Political Uncertain , Energy Consumption , and Economic Growth : Evidence from a Panel Data Analysis. In *Journal of the Knowledge Economy* (Issue 0123456789). Springer US. https://doi.org/10.1007/s13132-024-02431-9

Paramita, S. A., Yamazaki, C., & Koyama, H. (2020). *Determinants of life expectancy and clustering of provinces to improve life expectancy : an ecological study in Indonesia*. 1–8.

Pramanik, M. N. H., & Hasnain, M. N. (2025). Exploring the nexus between environmental degradation and living standard in Bangladesh: Evidence from ARDL and ECM technique. *PLOS Climate*, *4*(5), e0000421. https://doi.org/10.1371/journal.pclm.0000421

Prettner, K., & Trimborn, T. (2016). Demographic Change and R&D-based Economic Growth. *Economica*, *84*(336), 667–681. https://doi.org/10.1111/ecca.12195

Rentería, E., Souto, G., Mejía-Guevara, I., & Patxot, C. (2016). The Effect of Education on the Demographic Dividend. *Population and Development Review*, *42*(4), 651–671.

https://doi.org/10.1111/padr.12017

Risandini, F., & Silvi, R. (2022). Potencies and Threats of the Demographic Bonus on the Quality of Human Resources and Economy in Indonesia 2019. *Proceedings of the International Conference on Data Science and Official Statistics*, *2021*(1), 856–867. https://doi.org/10.34123/icdsos.v2021i1.154

Roffia, P., Bucciol, A., & Hashlamoun, S. (2023). Determinants of life expectancy at birth : a longitudinal study on OECD countries. *International Journal of Health Economics and Management*, *23*(2), 189–212. https://doi.org/10.1007/s10754-022-09338-5

Ruzima, M., & Veerachamy, P. (2023). The impact of public spending in education and health on human development in India. *Journal of the Asia Pacific Economy*, *28*(2), 390–403. https://doi.org/10.1080/13547860.2021.1952920

Săseanu, A. S., Gogonea, R.-M., Ghiță, S., & Zaharia, R. Ş. (2019). The Impact of Education and Residential Environment on Long-Term Waste Management Behavior in the Context of Sustainability. *Sustainability*, *11*(14), 3775. https://doi.org/10.3390/su11143775

Taguchi, H., Lar, N., & Ky, S. (2021). Revisiting the effects of demographic dynamics on economic growth in Asia: a panel vector-autoregressive approach with a saving channel. *Asian-Pacific Economic Literature*, *35*(2), 77–94. https://doi.org/10.1111/apel.12328

Udoinyang, N., Daniel, R., Ifeoma, G. E., Eduviere, V. O., Nkemdilim, E. R., & David, A. E. (2024). Massive Governance, Miserable Populace: Cost Of Governance As Economic Growth Decelerator In Nigeria. *Economics, Business, Accounting & Society Review*, *3*(2), 92–102. https://doi.org/10.55980/ebasr.v3i2.141

Ursavas, U. (2022). Growth Acceleration and Demographic Structure: The Case of ECOWAS Countries. *Fiscaoeconomia*, *6*(3), 1059–1070. https://doi.org/10.25295/fsecon1077283

Vinh, X., Shahbaz, M., Song, M., Ahmad, S., & Vinh Vo, X. (2021). Munich Personal RePEc Archive Does Economic Growth Stimulate Energy Consumption? The Role of Human Capital and RD Expenditures in China Does Economic Growth Stimulate Energy Consumption? The Role of Human Capital and R&D Expenditures in China. *MPRA: Munich Personal RePEc Archive*, *110352*.

Wang, Y., & Liu, S. (2016). Education, Human Capital and Economic Growth: Empirical Research on 55 Countries and Regions (1960-2009). *Theoretical Economics Letters*, *06*(02), 347–355. https://doi.org/10.4236/tel.2016.62039

Yang, Y., Zheng, R., & Zhao, L. (2021). Population Aging, Health Investment and Economic Growth: Based on a Cross-Country Panel Data Analysis. *International Journal of Environmental Research and Public Health*, *18*(4), 1801. https://doi.org/10.3390/ijerph18041801

Yusuf, A. A., Roos, L., & Horridge, M. (2018). Indonesia's Moratorium on Palm Oil Expansion From Natural Forests: Economy-Wide Impacts and the Role of International Transfers. *Asian Development Review*, *35*(2), 85–112. https://doi.org/10.1162/adev_a_00115

Zeren, F., & Hizarci, A. E. (2024). Hydropower Energy Consumption, Financial Development, Foreign Direct Investment, and Economic Growth: Further Evidence from Newly Industrialized Countries. *Journal of the Knowledge Economy*, *15*(1), 1535–1555. https://doi.org/10.1007/s13132-023-01135-w