

# Strategies for Sustainable Development: Leveraging Demographic Factors in Indonesia's Regions

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## Abstract

*This study investigates the impact of demographic factors on the demographic bonus and regional development in Indonesia, using a sample of 30 provinces from 2011 to 2019. Population growth positively influences both the demographic bonus and regional development. In contrast, life expectancy and contraceptive prevalence rate have negative effects on the demographic bonus. The school-age population positively impacts both the demographic bonus and regional development. The demographic bonus negatively affects regional development and fails to mediate the relationship between population growth and regional development. However, it mediates the effects of life expectancy and the school-age population on regional development. The analysis employs descriptive analysis and structural equation modelling (SEM) using Smart-PLS. The findings recommend effective management of population growth, enhanced healthcare to improve life expectancy, and balanced birth control programs. Increased investment in education and inclusive development strategies are vital. Policies should facilitate the active participation of the working-age population, supported by continuous research and development to ensure responsive policy formulation. These recommendations aim to maximize the potential of the demographic bonus and support sustainable regional development in Indonesia.*

**Keywords:** *Demographic Bonus; Regional Development; Structural Equation Modelling; Smart-PLS; Indonesia.*

## Introduction

Understanding and leveraging demographic factors are crucial for the sustainable development of Indonesia's regions. The study aims to address how demographic transitions impact economic growth and regional development. This research is particularly significant as it explores the potential economic benefits arising from changes in the age structure of the population, known as the demographic bonus, which can lead to enhanced productivity and growth if managed effectively.

Several studies have highlighted the importance of demographic factors in regional development. For instance, Bloom, Canning, and Sevilla (2003) emphasized the potential of the demographic bonus in boosting economic growth through increased labor supply, savings, and human capital investments (OOSGA) (Population Trends Asia Pacific). The United Nations (2023) reported that countries with effective family planning and health initiatives, such as Thailand and South Korea, have successfully harnessed their demographic bonuss to reduce dependency ratios and stimulate economic growth (Population Trends Asia Pacific).

In Indonesia, studies by McDonald (2014) and Ananta et al. (2016) noted that while population growth positively impacts economic activities, the challenges posed by high dependency ratios due to increased life expectancy and varying contraceptive prevalence rates need targeted policy interventions. Moreover, the role of education in enhancing the demographic bonus has been well-documented, with a positive correlation between educational investments and regional economic performance (Jones, 2013; UNICEF, 2020) (Population Trends Asia Pacific).

Despite extensive research on demographic bonuss and regional development, there is a lack of comprehensive studies that integrate the impacts of population growth, life expectancy, contraceptive prevalence rate, and education on regional development in Indonesia. This study aims to fill this gap by providing a nuanced understanding of how these demographic factors interact and influence regional development outcomes.

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Indonesia, with its diverse and rapidly growing population, presents a unique case for studying the impact of demographic factors on regional development. The period from 2011 to 2019 saw significant demographic shifts across the country's 30 provinces, affecting economic activities and development policies. Population growth continues to drive economic opportunities, while increased life expectancy and contraceptive prevalence rates pose challenges that require effective health and social policies (Population Trends Asia Pacific).

The school-age population, representing a substantial segment of the population, plays a crucial role in shaping the future workforce. However, regional disparities in education and employment opportunities highlight the need for inclusive development strategies that ensure all regions benefit from the demographic bonus. The government's focus on improving educational infrastructure and healthcare services aims to address these disparities and leverage demographic factors for sustainable development (OOSGA) (Population Trends Asia Pacific).

The study holds significant value as it aims to inform policymakers and stakeholders about the strategic importance of demographic factors in regional development. By understanding the complex interactions between population growth, life expectancy, contraceptive prevalence rates, and education, the study provides actionable insights for formulating policies that maximize the demographic bonus. Implementing these strategies can lead to more equitable and sustainable regional development, ensuring that all regions in Indonesia benefit from demographic transitions. Additionally, the findings can serve as a reference for other developing countries facing similar demographic challenges, contributing to the broader discourse on sustainable development and demographic management.

## Literature Review

The concept of the demographic bonus, also known as the demographic dividend, refers to the economic growth potential that arises from changes in a country's age structure, primarily when the working-age population is larger than the non-working-age share of the population. This demographic transition provides a unique opportunity for accelerated economic growth if leveraged effectively.

Bloom, Canning, and Sevilla (2003) describe the demographic dividend as arising from a period during which the proportion of working-age individuals in the population increases due to declining fertility rates. This shift can lead to higher economic productivity, given that a larger share of the population is engaged in income-generating activities. Furthermore, Lee and Mason (2006) emphasize the importance of complementary policies, including those related to health, education, and employment, to fully realize the benefits of a demographic bonus.

Recent empirical studies have investigated the impact of the demographic bonus on regional development. For instance, Bloom, Kuhn, and Prettnner (2020) found that countries with higher proportions of working-age populations experience faster economic growth, provided that they implement supportive economic policies. Their research underscores the significance of investing in human capital, improving labor market conditions, and ensuring macroeconomic stability to harness the benefits of a demographic bonus.

Another study by Mason and Lee (2018) examined the demographic dividend in East Asian countries, noting that these nations' rapid economic growth during the late 20th century can be partially attributed to favorable demographic conditions. They highlighted those countries like South Korea and Singapore effectively leveraged their demographic bonus through strategic investments in education and robust economic reforms.

However, the relationship between the demographic bonus and regional development is not automatic. The potential economic benefits can be undermined by high unemployment rates, inadequate education systems, and poor health infrastructure. According to Lee and Mason (2017), without appropriate policies, a growing working-age population can lead to increased unemployment and social unrest, negating the potential benefits of the demographic dividend.

Kim and Kim (2019) emphasize the need for comprehensive policy frameworks that include improving education systems, fostering job creation, and enhancing healthcare services. They argue that governments should also focus on policies that encourage female labor force participation and provide support for families to balance work and child-rearing responsibilities.

Several case studies provide insights into how different regions have managed their demographic transitions. In sub-Saharan Africa, Canning, Raja, and Yazbeck (2015) discuss how high fertility rates and

slow demographic transitions have impeded economic development. They argue for the necessity of policies that reduce fertility rates through improved access to family planning services and education.

In contrast, Latin American countries such as Brazil and Mexico have shown mixed results in harnessing their demographic dividends. According to Gribble and Bremner (2018), while these countries have seen improvements in education and healthcare, challenges like income inequality and informal labor markets have limited their ability to fully capitalize on their demographic transitions.

## Research Method

### *Scope of the Study*

This study examines the determinants influencing the demographic bonus and its impact on regional development in Indonesia. The determinants considered are population growth, life expectancy, contraceptive prevalence rate, and school-age population. Regional development is observed through changes in regional income measured by Gross Regional Domestic Product (GRDP), Labour Force Participation Rate (LFPR), unemployment rate, and poverty rate. The analysis period spans from 2011 to 2019. The population under study includes Indonesia's provinces, with 30 out of 34 provinces sampled due to data unavailability in Kepulauan Riau, Kalimantan Utara, Sulawesi Barat, and Papua Barat.

### *Data Sources and Types*

This research utilizes panel data, combining time series and cross-sectional data from 2011 to 2019. The data include demographic bonus indicators (population growth, life expectancy, contraceptive prevalence rate, and school-age population) and regional development indicators (GRDP, LFPR, unemployment rate, and poverty rate). Secondary data sources include the Indonesian Central Bureau of Statistics (BPS), National Development Planning Agency (BAPPENAS), National Population and Family Planning Board (BKKBN), and other relevant institutions.

### *Analytical Model*

The analytical model employs descriptive analysis and Structural Equation Modelling (SEM) with Partial Least Squares (PLS) analysis. Descriptive analysis utilizes tables and graphs to provide an overview of socio-economic variables. SEM with PLS analysis determines the determinants influencing the demographic bonus and its impact on regional development, considering both direct and indirect effects. PLS is particularly suitable due to the relatively small dataset over nine years, making it preferable for data analysis.

### *Hypothesis Testing*

Hypothesis testing employs SEM with PLS, a variance-based approach. PLS is a powerful method applicable to all data scales, requiring fewer assumptions and not necessitating large sample sizes. It can confirm theories and analyse constructs with reflective and formative indicators. Reflective indicators, based on classical test theory, assume variation in construct scores is a function of true score plus error. Key characteristics include causal relationships from construct to indicators and internal consistency reliability. Formative indicators, based on operational definitions, assume indicators determine latent variables, with causal relationships from indicators to constructs. Hypotheses are evaluated using t-statistics and R-square values, with a t-table value of 1.986 at a 0.05 significance level as the cut-off for acceptance or rejection.

### *Evaluating the Model*

#### a. Outer Model Evaluation:

Reflective Indicators: Assessed using Convergent Validity, Discriminant Validity, and Composite Reliability. Convergent Validity is evaluated based on item score correlations with constructs, with high validity indicated by correlations over 0.70. Discriminant Validity is assessed by comparing the Average Variance Extracted (AVE) values with inter-construct correlations.

Formative Indicators: Evaluated based on substantive content and statistical significance of weight estimates. Significant weights indicate indicator contributions to construct formation.

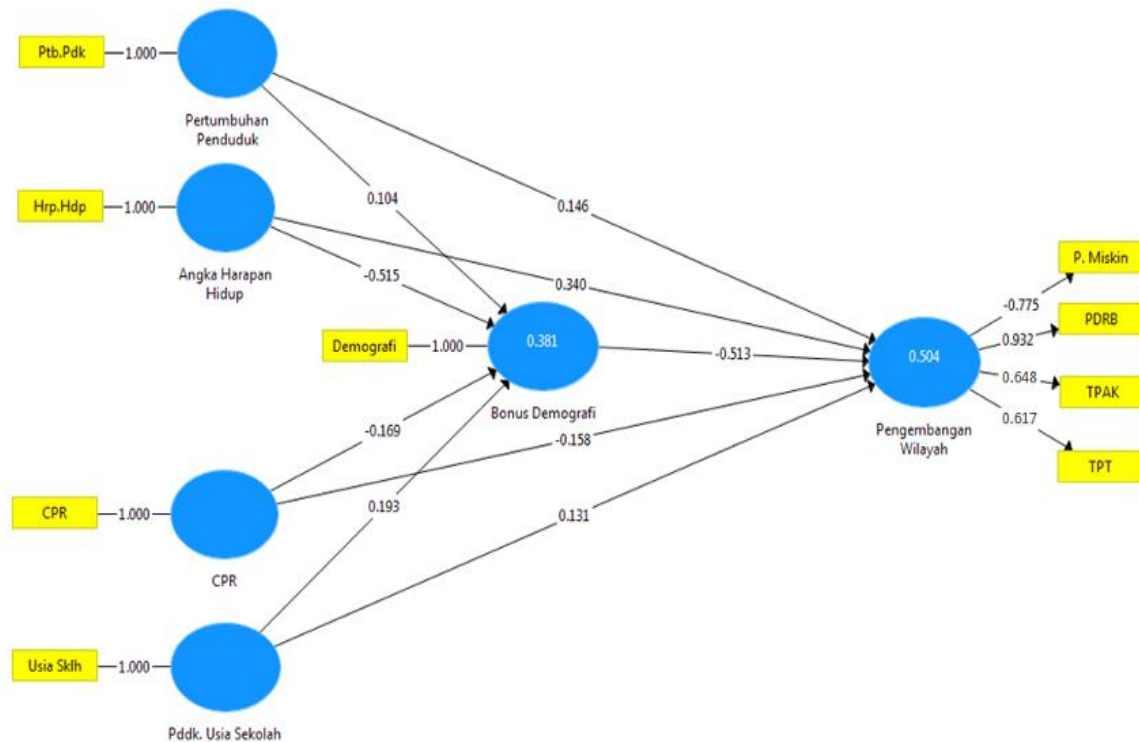
#### b. Inner Model Evaluation:

Evaluates relationships between constructs, significance values, and R-square values of the model. The model's predictive relevance is assessed using Q-Square, with values greater than 0 indicating good predictive relevance.

## Result and Discussion

### *Partial Least Square (PLS) Model*

In this study, hypothesis testing utilized the Partial Least Square (PLS) analysis technique using smartPLS 3.0 software. The measurement model for assessing validity and reliability, as well as the coefficients of determination and path coefficients for the structural model, can be observed in Figure 1 (Outer Model PLS Path Modelling) and Figure 2 (Inner Model PLS Path Modelling).



**Figure 1.** Outer model PLS path modeling.

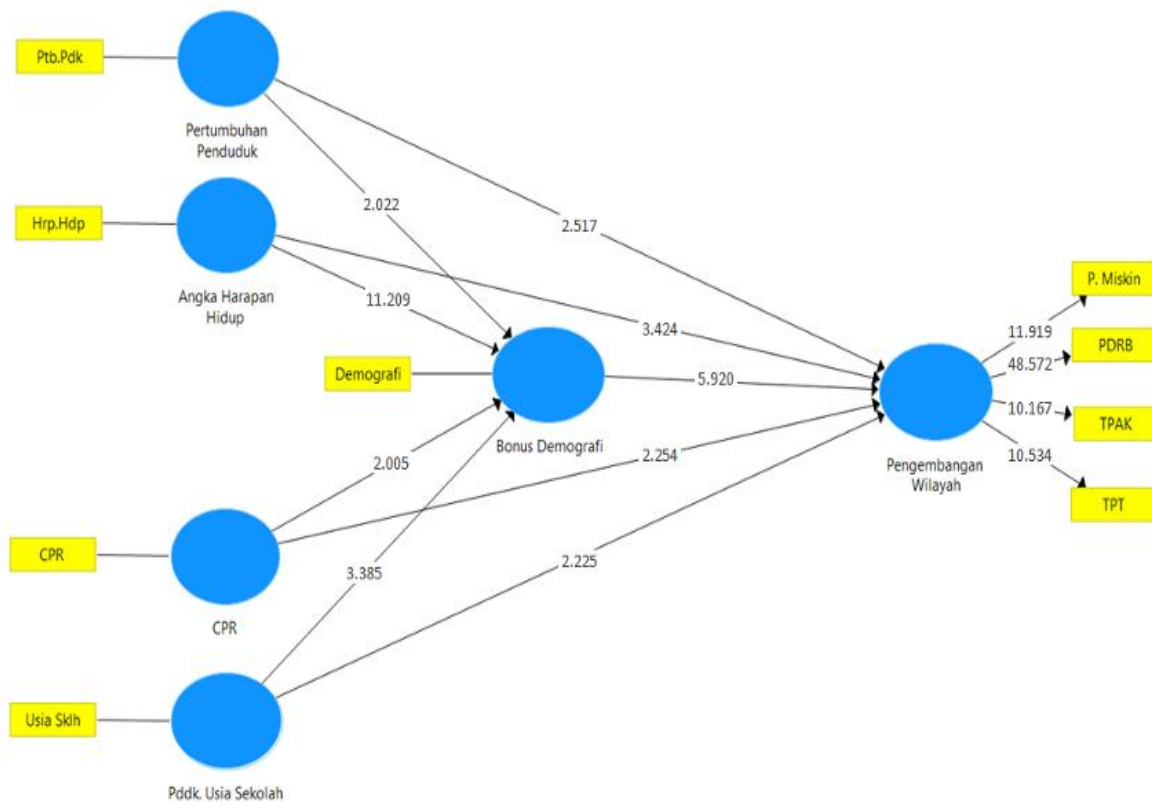


Figure 2. Inner model PLS path modeling.

Outer Model Evaluation

a. Convergent Validity

Convergent validity was assessed using the outer loading values (loading factors) of the research variables. All variables exhibited outer loading values > 0.7, indicating strong convergent validity as per Chin cited by Imam Ghozali (2014).

Table 1. Outer loading.

Variable	Life Expectancy	Demographic Bonus	Contraceptive Prevalence Rate	School-Age Population	Regional Development	Population growth
Contraceptive Prevalence Rate			1.000			
Demographic Bonus		1.000				
Life Expectancy	1.000					
Poverty					-0.784	
GDP					0.929	
Population growth						1.000
TPAK					0.648	
TPT					0.617	
School-Age Population				1.000		

b. Discriminant Validity

Discriminant validity was evaluated by examining the Average Variant Extracted (AVE) values for each variable. All variables showed AVE values > 0.5, indicating satisfactory discriminant validity.

**Table 2.** Average variant extracted (AVE).

Variable	AVE
Life Expectancy (LE)	1,000
Demographic Bonus (DB)	1,000
Contraceptive Prevalence Rate (CPR)	1,000
School-Age Population (SAP)	1,000
Regional Development (RD)	0,680
Population growth (PG)	1,000

### c. Composite Reliability

Composite reliability of each variable was also assessed. All variables demonstrated composite reliability values > 0.6, indicating high reliability.

**Table 3.** Composite reliability.

Variable	Composite Reliability
Life Expectancy (LE)	1,000
Demographic Bonus (DB)	1,000
Contraceptive Prevalence Rate (CPR)	1,000
School-Age Population (SAP)	1,000
Regional Development (RD)	0,760
Population growth (PG)	1,000

### d. Cronbach Alpha

Cronbach Alpha values were used to assess internal consistency reliability. All variables showed Cronbach Alpha values > 0.7, confirming good internal reliability.

**Table 4.** Cronbach alpha.

Variable	Cronbach Alpha
Life Expectancy (LE)	1,000
Demographic Bonus (DB)	1,000
Contraceptive Prevalence Rate (CPR)	1,000
School-Age Population (SAP)	1,000
Regional Development (RD)	0,862
Population growth (PG)	1,000

These results indicate that the model employed in the study exhibits strong validity, reliability, and measurement quality for further analysis.

### Inner Model Evaluation

#### a. Path Coefficient Testing

The evaluation of path coefficients indicates the strength of the effect of independent variables on the dependent variables. The coefficient of determination (R-Square) measures the extent to which endogenous variables are influenced by other variables. According to Chin in Ghazali (2014:42), an R<sup>2</sup> value of 0.67 and above for endogenous latent variables in the structural model indicates a good level of influence from exogenous variables. An R<sup>2</sup> value between 0.33 and 0.67 indicates a moderate level of influence, and an R<sup>2</sup> value between 0.19 and 0.33 indicates a weak level of influence. The results of the path coefficient testing are presented in Table 5.

**Table 5.** Path coefficient.

Variable	Original Sample	T Statistic	P Values
PG → DB	0.104	2.022	0.044
LE → DB	-0.515	11.209	0.000
CPR → DB	-0.169	2.005	0.046
SAP → DB	0.193	3.385	0.001

PG → RD	0.216	2.517	0.012
LE → RD	0.340	3.424	0.001
CPR → RD	-0.158	2.254	0.027
SAP → RD	0.131	2.225	0.027
BD → RD	-0.513	5.920	0.000

Based on Table 5. and the inner model results shown in Figure 5.2, the largest path coefficient is indicated by the effect of life expectancy on the demographic bonus, with a T statistic of 11.209 and P Values of 0.000, in a negative direction. This means life expectancy positively affects the demographic bonus. The second-largest effect is the demographic bonus on regional development, with a T statistic of 5.920 in a negative direction. The smallest effect is shown by the contraceptive prevalence rate on the demographic bonus, with a T statistic of 2.005 in a negative direction. The positive or negative direction can be seen from the original sample values.

These results show that the free variables on the demographic bonus in this model have path coefficients with both positive and negative values. A positive direction indicates that the larger the path coefficient value of an independent variable on the dependent variable, the stronger the influence between the independent and dependent variables. The free variables on regional development in this model have path coefficients with both negative and positive values, as shown by the original sample values. A negative direction indicates that the larger the path coefficient value of an independent variable on the dependent variable, the weaker the influence between the independent and dependent variables.

#### b. Goodness of Fit Testing

Based on the data processing using the smartPLS 3.0 program, the R-Square values are as follows:

**Table 6.** R-square values.

Variable	R Square Value
Demographic Bonus	0,371
Regional Development	0,495

Based on Table 6, the R-Square value for the demographic bonus variable is 0.371, indicating that 37.1% of the variance in the demographic bonus can be explained by population growth (X1), life expectancy (X2), contraceptive prevalence rate (X3), and school-age population (X4). The R-Square value for regional development is 0.495, indicating that 49.5% of the variance in regional development can be explained by population growth (X1), life expectancy (X2), contraceptive prevalence rate (X3), school-age population (X4), and the demographic bonus (Z).

The goodness of fit is also assessed using the Q-Square value. The Q-Square value is analogous to the coefficient of determination (R-Square) in regression analysis; the higher the Q-Square, the better the model fits the data. The Q-Square value is calculated as follows:

$$\begin{aligned}
 Q\text{-Square} &= 1 - [(1 - R^2_1) \times (1 - R^2_2)] \\
 &= 1 - [(1 - 0,371) \times (1 - 0,495)] \\
 &= 1 - (0,629 \times 0,505) \\
 &= 1 - 0,318 \\
 &= 0,682
 \end{aligned}$$

The Q-Square value of 0.682 indicates that 68.2% of the variance in the data can be explained by the research model, while the remaining 31.8% is explained by factors outside the model. Therefore, the research model demonstrates a good goodness of fit. These comprehensive evaluations demonstrate the robustness and reliability of the PLS model used in this study.

*Hypothesis Testing*

## a. Direct Effects

Direct Effect Hypothesis testing in this study was conducted by examining the T-Statistics and P-Values. A research hypothesis is accepted if the P-Values < 0.05. The following table presents the direct effects hypothesis testing results obtained in this study through the inner model:

**Table 7.** Direct effects.

Hypothesis	Effect	T-Statistic	P-Values	Result
H1	Population growth => Demographic bonus	2.022	0.044	Accepted
H2	Life expectancy => Demographic bonus	11.209	0.000	Accepted
H3	Contraceptive Prevalence Rate => Demographic bonus	2.005	0.046	Accepted
H4	School-age population => Demographic bonus	3.385	0.001	Accepted
H5	Population growth => Regional development	2.517	0.012	Accepted
H6	Life expectancy => Regional development	3.424	0.001	Accepted
H7	Contraceptive Prevalence Rate => Regional development	2.254	0.027	Accepted
H8	School-age population => Regional development	2.225	0.027	Accepted
H9	Demographic bonus => Regional development	5.920	0.000	Accepted

Based on the data in Table 7, all hypotheses proposed in this study are accepted, as each effect shown has a t-statistic value > 1.96 and P-Values < 0.05. Therefore, it can be stated that the independent variables have significant positive and negative effects on their dependent variables.

## b. Indirect Effects

The indirect effects of population growth, life expectancy, contraceptive prevalence rate, and school-age population on regional development through the demographic bonus can be observed from the total indirect effect presented in the following table:

**Table 8.** Indirect effects.

Hypothesis	Effect	T-Statistic	P-Values	Result
H10	Population growth => Regional development through demographic bonus	1.860	0.063	Rejected
H11	Life expectancy => Regional development through demographic bonus	5.307	0.000	Accepted
H12	Contraceptive Prevalence Rate => Regional development through demographic bonus	1.755	0.080	Rejected
H13	School-age population => Regional development through demographic bonus	3.040	0.002	Accepted

Based on Table 5.18, the demographic bonus does not mediate the effect of population growth on regional development, with a T-Statistic of 1.860 < 1.96. The demographic bonus does mediate the effect of life expectancy on regional development, with a T-Statistic of 5.307 > 1.96. The demographic bonus does not mediate the effect of contraceptive prevalence rate on regional development, with a T-Statistic of 1.755 < 1.96. The demographic bonus does mediate the effect of school-age population on regional development, with a T-Statistic of 3.040 > 1.96.

**Discussions**

## a. Hypothesis 1: Population Growth =&gt; Demographic Bonus

The acceptance of Hypothesis 1 indicates a significant positive relationship between population growth and the demographic bonus (T-Statistic = 2.022, P-Values = 0.044). This finding aligns with the theory that a growing population, particularly in developing countries, can potentially lead to a demographic dividend if accompanied by appropriate socio-economic policies. The demographic dividend arises when a country's working-age population grows larger relative to the dependent (younger and older) population, potentially boosting economic growth (UN DESA, 2022; Liang, 2024; Lo-oh, 2023). This effect, however, is contingent



on successful integration of the working-age population into productive employment sectors (Ssewamala, 2015).

b. Hypothesis 2: Life Expectancy => Demographic Bonus

Hypothesis 2 is also accepted, revealing a strong positive influence of life expectancy on the demographic bonus (T-Statistik = 11.209, P-Values = 0.000). Improvements in life expectancy are often indicative of better health and economic conditions, which in turn can enhance the quality of the workforce. According to He, Aboderin, and Adjaye-Gbewonyo (2020), countries that experience increases in life expectancy tend to see enhanced economic performance as a healthier population is more productive. This supports the idea that longevity can contribute significantly to realizing a demographic dividend.

c. Hypothesis 3: Contraceptive Prevalence Rate => Demographic Bonus

The acceptance of Hypothesis 3 suggests a significant positive relationship between contraceptive prevalence rate and the demographic bonus (T-Statistik = 2.005, P-Values = 0.046). Higher contraceptive prevalence rates generally lead to lower fertility rates, which can facilitate a demographic transition where the proportion of the working-age population increases relative to dependents. This transition is crucial for harnessing a demographic dividend, as evidenced in various studies (Bongaarts, 2016). The use of contraceptives helps in family planning, allowing for better allocation of resources and improved economic stability.

d. Hypothesis 4: School-age Population => Demographic Bonus

Hypothesis 4 is supported by data showing a significant impact of the school-age population on the demographic bonus (T-Statistik = 3.385, P-Values = 0.001). A well-educated school-age population is pivotal for economic development as it ensures a future workforce that is capable, skilled, and ready to meet market demands. Mason (2003) highlights that investing in education is essential for countries to take full advantage of their demographic dividend. Therefore, ensuring that the school-age population has access to quality education is critical for economic growth.

e. Hypothesis 5: Population Growth => Regional Development

Finally, Hypothesis 5 shows a significant direct effect of population growth on regional development (T-Statistik = 2.517, P-Values = 0.012). Rapid population growth can drive regional development through increased labor supply, higher demand for goods and services, and potential for innovation. However, this relationship can be double-edged; if not managed well, it could strain resources and infrastructure (Korenman & Neumark, 2020). Effective policies are needed to balance population growth with sustainable regional development to harness its benefits fully.

f. Hypothesis 6: Life Expectancy => Regional Development

The acceptance of Hypothesis 6 demonstrates a significant positive influence of life expectancy on regional development (T-Statistik = 3.424, P-Values = 0.001). Improved life expectancy often reflects better health care, nutrition, and living conditions, which collectively enhance the productivity and economic contributions of the population. Research indicates that regions with higher life expectancy tend to experience better economic outcomes due to a more robust and capable workforce (Bloom, Canning, & Fink, 2020). This positive relationship highlights the importance of health improvements as a catalyst for regional development.

g. Hypothesis 7: Contraceptive Prevalence Rate => Regional Development

Hypothesis 7 is accepted, showing a significant impact of the contraceptive prevalence rate on regional development (T-Statistik = 2.254, P-Values = 0.027). Effective contraceptive use contributes to lower fertility rates, which can lead to a demographic transition with a higher proportion of working-age individuals. This demographic shift can drive economic growth and regional development by easing the pressure on resources and enabling better investment in human capital (Cleland et al., 2019). Furthermore, family planning programs are crucial for sustainable development, as they allow families to better manage their resources and improve their socio-economic status (Sippel et al., 2018).

h. Hypothesis 8: School-age Population => Regional Development

The acceptance of Hypothesis 8 reveals a significant positive effect of the school-age population on regional development (T-Statistik = 2.225, P-Values = 0.027). A well-educated school-age population is a critical asset for future regional development, as education is strongly linked to economic productivity and innovation. The positive relationship suggests that investments in education can yield significant returns in terms of regional economic performance (Hanushek & Woessmann, 2020). Educated youth are better equipped to contribute to and benefit from economic opportunities, thereby fostering sustainable regional development.

i. Hypothesis 9: Demographic Bonus => Regional Development

Finally, Hypothesis 9 shows a significant impact of the demographic bonus on regional development (T-Statistik = 5.920, P-Values = 0.000). The demographic bonus, characterized by a larger working-age population relative to dependents, provides a unique opportunity for economic growth and development. This demographic shift can enhance labor supply, increase savings and investments, and spur innovation, ultimately driving regional development (Lee & Mason, 2018). The positive influence of the demographic bonus on regional development underscores the importance of leveraging demographic changes through appropriate policies and investments in education, health, and job creation (Bloom et al., 2020).

j. Hypothesis 10: Population Growth => Regional Development via Demographic Bonus

The rejection of Hypothesis 10 (T-Statistik = 1.860, P-Values = 0.063) indicates that the demographic bonus does not mediate the relationship between population growth and regional development significantly. This finding suggests that mere population growth does not automatically translate to regional development benefits through the demographic bonus. Research by Bloom and Canning (2019) suggests that without adequate investments in health, education, and employment opportunities, population growth alone may not yield substantial economic benefits. Additionally, rapid population growth can strain resources and infrastructure, potentially hindering development if not managed properly (Bongaarts, 2020).

k. Hypothesis 11: Life Expectancy => Regional Development via Demographic Bonus

Hypothesis 11 is accepted, demonstrating that the demographic bonus significantly mediates the relationship between life expectancy and regional development (T-Statistik = 5.307, P-Values = 0.000). This result aligns with the understanding that improvements in life expectancy enhance human capital by increasing the working lifespan and productivity of the population. According to Bloom, Kuhn, and Prettnner (2020), healthier populations with longer life expectancies contribute more effectively to economic development, particularly when combined with a favorable demographic structure. This highlights the importance of health investments as a crucial factor in leveraging the demographic bonus for regional development.

l. Hypothesis 12: Contraceptive Prevalence Rate => Regional Development via Demographic Bonus

The rejection of Hypothesis 12 (T-Statistik = 1.755, P-Values = 0.080) indicates that the demographic bonus does not significantly mediate the relationship between the contraceptive prevalence rate and regional development. This finding suggests that while contraceptive prevalence can influence population dynamics, it may not directly translate into regional development through the demographic bonus without additional supportive measures. Cleland et al. (2019) argue that effective family planning programs need to be part of broader socio-economic strategies, including education and employment policies, to fully realize their developmental potential.

m. Hypothesis 13: School-age Population => Regional Development via Demographic Bonus

The acceptance of Hypothesis 13 reveals a significant mediating effect of the demographic bonus on the relationship between the school-age population and regional development (T-Statistik = 3.040, P-Values = 0.002). This underscores the critical role of education in harnessing the benefits of a demographic transition. A well-educated school-age population, when transitioning into the workforce, can significantly boost regional economic performance and innovation capacity (Hanushek & Woessmann, 2020). The findings are consistent with research by Lee and Mason (2018), which highlights the importance of investing in education to maximize the economic benefits of a demographic bonus.

## Conclusion and Recommendation

Population growth in Indonesia has a positive and significant impact on the demographic bonus. However, life expectancy has a negative and significant effect on the demographic bonus. Additionally, the contraceptive prevalence rate (CPR) also negatively and significantly influences the demographic bonus in Indonesia. Meanwhile, the school-age population positively and significantly impacts the demographic bonus. Not only on the demographic bonus, but population growth also has a positive and significant effect on regional development in Indonesia. Life expectancy also shows a positive and significant impact in this context. Conversely, the contraceptive prevalence rate (CPR) has a negative and significant effect on regional development. The school-age population once again shows a positive and significant impact on regional development in Indonesia. However, the demographic bonus itself has a negative and significant impact on regional development in Indonesia. Nonetheless, the demographic bonus cannot mediate the effect between population growth and regional development. On the other hand, the demographic bonus can mediate the effect between life expectancy and regional development. Conversely, the demographic bonus cannot mediate the effect of the contraceptive prevalence rate (CPR) on regional development. However, the demographic bonus can mediate the effect of the school-age population on regional development in Indonesia.

The management of population growth should be a primary focus for the government to maximize the benefits of the demographic bonus. Policies that support a healthy and productive population growth are essential, including enhancing access to education and skill development for the school-age population. Despite the current negative impact of life expectancy on the demographic bonus, improving the quality of healthcare services and overall well-being remains crucial. The government must find ways to increase life expectancy while ensuring that the older population remains productive and integrated into the economy.

Birth control programs must be carefully managed to ensure they do not hinder the potential benefits of the demographic bonus. Policies supporting contraceptive use need to be adjusted to minimize the negative impact on the demographic bonus and regional development. Given the significant positive impact of the school-age population on both the demographic bonus and regional development, investment in the education sector should be increased. This includes building educational infrastructure, enhancing the quality of teaching, and broadening access to education for all age groups. Considering the negative impact of the demographic bonus on regional development, development strategies must be more inclusive and holistic. Policies should ensure equitable development across various regions and improve economic opportunities for the entire population. The government should develop policies that facilitate the active participation of the working-age population in the economy. This can include training and skill development programs, incentives for entrepreneurship, and job creation initiatives. Lastly, continuous research and development are essential to monitor and evaluate the impact of various factors on the demographic bonus and regional development. Accurate data and analysis will aid in formulating more effective and responsive policies to the dynamics of the population.

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