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The Influence of Education, Health, and Infrastructure Levels on Income Inequality in Java Island for the Period 2015 - 2024

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Abstract:
The purpose of this study is to analyze the influence of education level, health, infrastructure, and the COVID-19 pandemic on inter-regional income inequality across six provinces on Java Island during the period 2015–2025. This research employs a quantitative approach using secondary data in the form of panel data, which combines time series data (2015–2025) and cross-sectional data (six provinces on Java Island). The data were obtained from the Central Statistics Agency (BPS) and analyzed using a panel data regression model with a Fixed Effect Model (FEM) estimation approach, implemented through EViews software version 12. The analysis results show that the variables of education and health have a negative and significant effect on income inequality, while infrastructure has a positive and significant effect. Meanwhile, the COVID-19 pandemic variable, used as a dummy, has a positive but not significant effect. Simultaneously, the four variables significantly influence income inequality, indicating that equitable development in the fields of education, health, and infrastructure is essential to support inclusive economic growth and reduce income disparities between regions on Java Island.

Keywords: Inequality income , education , Health , Infrastructure , Covid-19,
.

BACKGROUND

Inequality income is issue economy that continues get attention in various countries, including Indonesia. Inequality This occurs in various regions, both rural and also urban areas , as well as on Java Island and outside Java (Bappenas, 2016) . The high inequality widen gap well-being and reflect inequality income between group public (Sarfiah & Yustirania Septiani, 2019) Several factor affecting inequality income including access infrastructure that is not even , level education , health , number poor population , and structure sector economy (Fitriyani et al., 2024; World Bank, 2024) . Inequality in access education and health to worsen quality source Power humans , while the imbalance development infrastructure deepen gap between regions (Bank, 2020; Jones & Pratomo, 2016) .

Java Island, as center economy with population largest , contributing 57.70% of national GDP (Statistics, 2024) (BPS, 2024). However , the inequality income in this area recorded

more tall compared to the national average , and increasingly exacerbated by the COVID-19 pandemic (Aspachs et al., 2021; Furceri et al., 2022) . Inequality the measured through Gini coefficient , which shows inequality distribution income in a particular area (Todaro & Smith, 2006) . Gini coefficient data from 2015 to 2024 shows consistent fluctuations , with the provinces of DKI Jakarta, West Java, and DI Yogyakarta recorded mark more tall from the national average . In addition , the COVID-19 pandemic that hit since early 2020 worsened inequality , especially in the sector education , health , and economy (Aspachs et al., 2021; Furceri et al., 2022). One of the impact significant pandemic seen in the sector education . Education, which is one of the factor main in increase quality source Power man (Sanggelorang et al., 2015) experience obstacle big consequence restrictions social and transition to online learning . The Average Length of Schooling (RLS) indicator shows inequality inter-provincial : DKI Jakarta, DI Yogyakarta, and Banten have an average RLS of 10.21 years (equivalent to junior high school level), while West Java, East Java, and Central Java only reached 8.39 years (equivalent to elementary school). Inequality This exacerbated by differences access to device technology and the internet (Anggraeni et al., 2022)

Apart from education , other factors health also has a big influence to inequality. Human Capital Theory (Gary Becker, 1993) emphasizes that health , together education , contribute in increase productivity and reduce inequality . Increase quality man reflected through three dimensions main : health , education , and per capita income (United Nations Development Programme , 1990). One of the indicator health is Life Expectancy (UHH). Data shows that UHH on Java Island is general increase from 2015 to 2024, although the COVID-19 pandemic has caused UHH decline in some provinces , such as in West Java in 2022–2023. In the context of infrastructure , availability adequate facilities and infrastructure become factor key growth economics (Calderón & Servén, 2004; Sukwika, 2018) . Infrastructure roads , in particular , to facilitate mobility goods and services , increasing efficiency , as well as enlarge access economy society . Data shows that long roads in Java Island the 2015–2024 period fluctuated , with East Java recording long road highest , while DI Yogyakarta is the lowest . Inequality infrastructure This push the need intervention government in equalization development For support growth more economy inclusive (Dhyatmika & Atmanti, 2013; Iqbal et al., 2019) .

Research conducted by Sugiyanto and Pamungkas (2023) find that education , measured through average length of schooling , and health , measured through number hope alive , influential negative and significant to inequality income . Findings This different with research by Sri Indriyani S. Dai, Syarwani Canon, and Devi Oktaviani Bauty (2023), which shows that the average length of schooling influential positive However No significant to inequality income , while number hope life influential negative and significant.While that , research Siswantoro (2024) stated that second variable the No own influence to inequality income . On the other hand , research conducted by Mehdi Zolfaghari, Mahbobe Kabiri, and Hamideh Saadatmanes (2020) shows that infrastructure , education and health in a way overall influential to inequality income . Furthermore , research by Yousef Makhlouf and Christopher Lalley (2023) revealed that education own influence to inequality in term long , especially during the COVID-19 pandemic , even though No influential in term short .

Based on various results study mentioned , as well as notice concept and background the back that has been outlined previously , researchers evaluate important For do study more carry on about inequality income in Java Island, especially in the period before , during , and after COVID-19 pandemic . Research This intended For describe that gap income between area

influenced by differences access in to obtain quality a better life good , and inequality in quality source Power humans . In addition , the area with more access Good to education , health and fields Work tend own more income high , while the areas that are left behind in development infrastructure the more widen canyon inequality income . Therefore that , researcher mean to do study with title **" The Influence of Education Level, Health, Infrastructure and the COVID-19 Pandemic on Inequality Income in Java Island for the Period 2015–2024."**

THEORETICAL FRAMEWORK

Inequality Income

Inequality is multidimensional issues that can hinder development social and economic cross generation (World Bank, 2016). Todaro and Smith (2011) define inequality income as difference reception income that causes inequality access to source power , impact on conflict social as well as health individual . Sen (1997) added that inequality also includes inequality in education , health and opportunities economy. Globally , Milanovic (2016) . highlights inequality between and within countries affected globalization . Meanwhile, according to Kuznets (1995), inequality increase in stage beginning development and decline along growth economy , as depicted in the Kuznets Curve it is in the shape of an inverted "U", which makes it easier understanding dynamics inequality in the development process (Todaro, 2011).

Figure 1. Kuznet Curve (Inverted U)

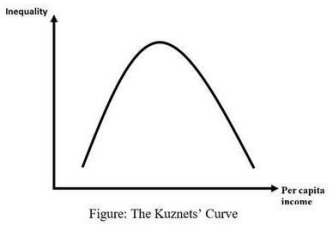


Figure: The Kuznets' Curve

Source : Todaro and Smith, (2011:225)

At the beginning development, distribution results Work tend No evenly , but along progress economy, equality increasing (Kuznets). Inequality This considered as phase experience in national development . Economic and agricultural sectors show that productivity rising start often accompanied by with decline price , affects distribution results Work (Alin et al., 2019) . To measure inequality, several methods are used, including::

- **Gini Ratio** : Introduced by Corrado Gini (1912), it measures inequality income in range 0–1; the more tall its value , the more big inequality . Countries with Gini coefficient above 0.5 is categorized own inequality high (Todaro & Smith, 2006).
- **Lorenz Curve** : Describes distribution cumulative income society ; increasingly Far curve from the diagonal line, the more big inequality (Todaro, 2011).
- **World Bank Method** : Assessing inequality based on percentage income of 40% of the population earn low . Inequality tall happen If group This control not enough from 12% of revenue national (World Bank, 2015).

In general general , inequality distribution income result in difference significant in access to education , health and opportunities economy in society .

Education

Education, as explained by Mankiw (2003) and the Human Capital theory by Becker & Schultz (1960), plays a role in increase quality power work and mobility social , which in turn influence inequality income . Investment in equitable education , as suggested by Romer (1990) in theory Endogenous growth , very important For support development economy . One of the indicators used For evaluate quality education is the Average Length of Schooling (RLS), which reflects duration formal education undertaken by the population 25 years old to above (BPS, 2020). Research show that the more the higher the RLS, the more Good quality source Power human beings , who ultimately contribute to the improvement welfare economy Individuals and Development national (Susanto & Pangesti , 2019; Schultz, 1961; Becker, 1964).

Health

Health according to WHO and Law No. 36 of 2009, involves welfare physical , mental and social support individual For life productive in a way social and economic. Michael Marmot (1970) added that factor social, economic and environmental participate influence health, not only factor biological. Human Capital Theory also explains that health is asset important for productivity and contribution socio-economic . Life expectancy (UHH), which is used as indicator health , describes quality live and support evaluation development economy a country. Mankiw (2015) stated that power healthy and educated work contribute to the improvement productivity and growth economy.

Infrastructure

Infrastructure defined by Grigg (1988) as system physical which includes transportation, sanitation, and facilities general , have a very important role in support welfare social and economic . Mankiw (2007) considers infrastructure as public capital that contributes to growth economy , while Hirschman (1958) and Todaro & Smith (2006) underline that infrastructure is factor important in development economy a region. The theory of social overhead capital by Rostow (1960) emphasizes that infrastructure push productivity and growth . However , if development infrastructure concentrated in certain areas , things This can to worsen inequality income , as expressed in theory Economic Dualism by Boeke and Lewis. Infrastructure , with indicator quality , accessibility and equity distribution , can considered as important means For fulfil need base social and economic man .

COVID 19 Pandemic

COVID-19 was first identified in Wuhan, China, in late 2019 and soon spread to worldwide , forcing WHO to declare the status of Public Health Emergency of International Concern (PHEIC) in January 2020. Governments in various countries implemented policy restrictions effective social and lockdown reduce spread of the virus, but impact negative on the global economy . According to the IMF, developed countries experience contraction economy up to -15.4%, while developing countries experience an average decline of -9.1% (Aneja & Ahuja, 2021). The pandemic also exacerbated inequality income in Indonesia, especially on the island of Java. Research by Aspachs et al. (2021) shows that the disappearance

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work and cuts wages become issue main , especially among group earning low . In addition , the inequality access to technology , education , health and assistance social widen canyon inequality between rich and poor groups and between regions on Java Island.

Research Hypothesis

Based on literature review and previous research, the hypotheses proposed in this study are as follows:

H 1 : Education level has influence to inequality income
H 2 : Health has influence to inequality income
H 3 : Infrastructure own influence to inequality income
H 4 : The Covid – 19 pandemic has influence to inequality income
H 5 : There is influence education , health and infrastructure and the COVID-19 pandemic on inequality income in Java Island 2015 – 2024.

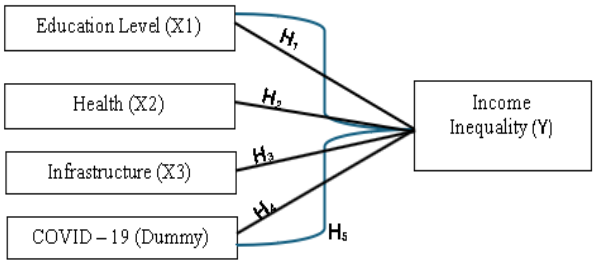


Figure 2. Thinking Framework

METHOD

Study This use approach quantitative , namely approach scientific classification condition between variables and produce numerical data that is analyzed in a way statistics as well as nature causal (Azwar, 2007) . The data used is secondary data in the form of panel data, which combines cross-section and time series data (Ghozali, 2018) . Research This analyze inequality income (gini ratio) as variable dependent , with variable independent in the form of level education (average length of schooling), health (number of hope life), infrastructure (long road), and the COVID-19 pandemic (dummy variable) in the period 2015–2024. Data obtained from BPS publication with focus on provinces in Java Island, namely DKI Jakarta, Banten, West Java, Central Java, Yogyakarta, and East Java. In the research This tool analysis used is a multiple linear regression model with help device soft Eviews 12, for test influence variable free to variable bound . The regression model used in study This arranged as as follows : (Gujarati, 2003) :

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + dummy + \epsilon$$

Information ,
Y : Inequality income ,
α : constant
$\beta_1 \ldots . B_2$: coefficient regression
X_1 : Education (Average Length of Schooling)
X_2 : Health (Life Expectancy)
X_3 : Infrastructure (Total Road Length)
Dummy : COVID-19 Pandemic
ϵ : standard error

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RESULT

Model Selection Test Results

In research with panel data types , best model selection started with a series of model specification tests , namely the Chow Test, the Hausman Test, and if Not yet found the right model , continued with the Lagrange Multiplier (LM) Test.

Effects Test	Statistic	d.f.	Prob.
Cross-section F	25.653560	(5,50)	0.0000
Cross-section Chi-square	76.275835	5	0.0000

Table 1 Chow Test

The Chow test is used For determine the most appropriate model between the Common Effect Model (CEM) and the Fixed Effect Model (FEM) with level significance by 5%. Testing criteria state that hypothesis zero (H_0) is accepted if mark probability ≥ 0.05, which indicates that the CEM model is more appropriate used . On the other hand , if mark probability < 0.05, then H_0 is rejected and the FEM model is stated more according to . Based on Chow Test results in study this , obtained mark cross-section probability F Chi-Square of 0.0000 which is greater small from 0.05. Therefore Therefore , H_0 is rejected and H_1 is accepted , so the model is the most appropriate used is FEM. Next , the analysis to be continued with testing using the Hausman Test.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	18.969950	4	0.0008

Table 2 Hausman Test

Hausman test is used For determine a more precise model appropriate between the Random Effect Model (REM) and the Fixed Effect Model (FEM), with level significance by 5%. Testing criteria show that hypothesis zero (H_0) is accepted if mark probability ≥ 0.05, which means the REM model is more in accordance used . On the other hand , if mark probability < 0.05, then H_0 is rejected and the FEM model is stated more right . Based on results Hausman Test testing in study this , obtained mark the probability of a random cross-section is 0.0008 which is greater small from 0.05. With Thus , H_0 is rejected and can be concluded that the FEM model is the best model in study this . Therefore that , testing No to be continued to Lagrange Multiplier (LM) Test stage .

Normality Test

In the normality test of this study, the Jarque-Bera Test method was used, processed with Eviews 12 software. Using this method, the minimum probability value or value that must be met by the data in order to state that the data is normally distributed is when the value of a probability exceeds the significance value, which is 0.05. Based on the results of the normality test above, it is stated that the probability value produced by the Eviews 12 software is greater than the significance value, which is 0.487851 > 0.05. So the data in this study is normally distributed.

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Multicollinearity Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	5.335875	33249.10	NA
X1	0.023476	691.4302	2.755841
X2	0.316606	36259.36	1.146802
X3	0.000502	23.88179	2.587716
DUMMY	0.000715	1.781057	1.068634

Table 3. Multicollinearity Test

The next test is a multicollinearity test using the Variance Inflation Factors (VIF) estimate. In this case, the data that meets the requirements for multicollinearity testing is the Centered VIF value which is less than 10. Based on the test table above, the Centered VIF value which is the variable of education level (X1), Health (X2), Infrastructure (X3), covid-19 (dummy) is less than 10, which means that the value obtained from the processed data is free from symptoms of multicollinearity.

Heteroscedasticity Test

F-statistic	2.352456	Prob. F(4,55)	0.0652
Obs*R-squared	8.765581	Prob. Chi-Square(4)	0.0672
Scaled explained SS	5.208920	Prob. Chi-Square(4)	0.2665

Table 4. Heteroscedasticity Test

Heteroscedasticity test using the Breusch-Pagan-Godfrey Test, the probability value that must be met to be free from heteroscedasticity symptoms is a significant value or probability greater than 0.05. Based on this test, all probabilities of education level (X1), Health (X2), Infrastructure (X3), covid-19 (dummy) exceed the significance value, which is 0.05. So in this research model, it has been free from heteroscedasticity symptoms.

Multiple Linear Regression Analysis

Based on results regression model testing show that the Fixed Effect Model (FEM) was selected as the best model after through three stages testing , namely the Chow Test, the Hausman Test, and considerations No to be continued to the Lagrange Multiplier Test. This model stated as most appropriate For answer objective research , with results regression shown in the image below This .

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.33331	9.663442	-1.690217	0.0972
X1	-1.229087	0.445072	-2.761543	0.0080
X2	-4.951196	2.430740	-2.036909	0.0470
X3	0.521204	0.147955	3.522713	0.0009
DUMMY	0.035740	0.018475	1.934532	0.0587

Table 5. Multiple Linear Regression Analysis

Based on test output regression the to obtain equality regression as following : Y = -16.333310783 - 1.22908661706*X1 - 4.95119550598*X2 + 0.521203501784*X3 + 0.0357399614332*DUMMY

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Equality the resulting regression in study This can concluded that mark constant of -16.33331 indicates that If all variable independent (education , health , infrastructure , and COVID-19) are valuable zero , inequality income will is at -16.33331 . The regression coefficient For variable education and health were -1.2291 and -4.9512 respectively , indicating that improvement One percent in education or health will lower inequality income . On the other hand , the coefficient For variable infrastructure (0.5212) and COVID-19 (0.0357) show that improvement second variable This will increase inequality income .

Hypothesis Test of Income Inequality (Y)

Statistical t-Test

With a confidence value reaching 95% or 0.05, there are also degrees of freedom of n – k = 60 – 2 = 28, so it can be seen from the two sides that the test value for the t table is 2.001717484.

Influence variable independent to variable dependent in a way partial can explained as following :

1. The results of the t-test on the variables level education (X1) obtained that variable level education (X1) has a t-statistic with a value of -2.775170, more big from t- table of 2.001717484 with mark probability by 0.0080 more small from 0.05. Then we can withdrawn conclusion , that variable level education (X1) has an effect in a way significant to variable inequality income (Y).
2. The results of the t-test for the health variable (X2) show that the t-statistic value is -2.036909, which exceeds the t-table value of 2.001717484, with a p-value of 0.0470, which is below the 0.05 significance level. Thus, it can be concluded that the health variable (X2) significantly affects income inequality (Y).
3. The results of the t-test for the infrastructure variable (X3) indicate a t-statistic value of 3.522713, which is greater than the t-table value of 2.001717484, with a p-value of 0.0009, which is less than 0.05. Therefore, it can be concluded that the infrastructure variable (X3) has a significant influence on income inequality (Y).
4. The results of the t-test for the COVID-19 dummy variable reveal a t-statistic value of 1.934532, which is less than the t-table value of 2.001717484, with a p-value of 0.0587, which exceeds the 0.05 threshold. Hence, it can be concluded that the COVID-19 dummy variable does not have a statistically significant effect on income inequality (Y).

Model Feasibility Test (F Test)

In the F test, it is used as proof whether all independent variables simultaneously affect or not the dependent variable. With the same level of confidence as the T test of 95% or α of 0.05. With degrees of freedom 1 of k - 1 = 5 - 1 = 4, and degrees of freedom 2 of n - k = 60 - 5 = 55, the value of the F-table is 2.539688635

F-statistic	30.30168
Prob(F-statistic)	0.000000

Table 6. Model Feasibility Test (F Test)

Based on the table above, the f-statistic obtained is 30.30168 which is greater than the F-table value of 2.539688635, with Prob (F-Statistic) or a significance value of 0.000000, smaller than the significance value of 0.05. So it can be concluded that the variables of education level (X1), health (X2), infrastructure (X3) and covid 19 (dummy) have a significant effect simultaneously (simultaneously) on the income inequality variable in Indonesia (Y).

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Determination Coefficient Test (R^2)

R-squared	0.845065
Adjusted R-squared	0.817176

Table 7. Determination Coefficient Test (R^2)

In the determination coefficient test or R2, it was obtained that the adjusted r squared value was 0.817176 or it can be said that the value is 82%. This means that the large variation in the level of education (X1), Health (X2), Infrastructure (X3) and the COVID-19 Pandemic (dummy) is able to explain the income inequality variable (Y) by 82%. while the remaining 18% can be explained by other variables outside this research model.

DISCUSSION

The Influence of Education Level (X1) on Income Inequality (Y)

Based on results research , variables level measured education through average length of schooling own influence negative and significant to inequality income in Java Island, with mark coefficient of -1.2291 and the level significance 0.0080 (< 0.05). This means that each increase in average length of schooling 1 % potential lower inequality income by 1.2291%. Findings This support theory endogenous growth and results research by Sugiyanto and Atria Arie Pamungkas (2023), which confirms that education play a role important in increase quality source Power man at a time push equalization income . Increase level education give access to more work good and more income high , so that can reduce disparity income between group public .

The Influence of Health (X2) on Income Inequality (Y)

Based on results research , variables health as measured through age hope life own influence negative and significant to inequality income in Java Island, with coefficient of -4.9512 and the level significance 0.0470 (< 0.05). This means that each improvement age hope life 1 % potential lower inequality income by 4.9512%. Age hope life reflect welfare and quality health public as well as success policy health , where increasingly tall age hope life show improvement quality alive . Findings This in line with human capital theory and endogenous growth which emphasizes that investment in the field health increase productivity and expand access to opportunity economy , so that can press inequality . This result is also supported by research previously , such as Sri Indriyani et al. (2023), Sara (2018), and Detollenaere et al. (2018), which shows connection negative and significant between health and inequality income , both in Indonesia and abroad area Europe .

Influence Infrastructure (X3) Against Income Inequality (Y)

Research results show that variable infrastructure own influence positive and significant to inequality income in Java Island, with mark coefficient of 0.5212 and a probability of 0.0009 (< 0.05), which means every improvement infrastructure by 1% will increase inequality income by 0.5212%. Findings This reflect that development infrastructure , in particular road , not yet even and tend to be more profitable group public earning height that has access to centers economy . inequality This exacerbated by imbalance between long road and number vehicle , height congestion in urban areas , as well as limitations transportation in the area isolated that hinders distribution results production . In line with findings of Purwanto Widodo et al. (2022) and Ferdian & Sari (2022), the conditions This show that development infrastructure that is not inclusive contribute to increasing gap income between regions on Java Island.

Influence COVID-19 Pandemic (X4) Against Income Inequality (Y)

The research results show that the COVID-19 pandemic variable (dummy) has a positive but not significant impact on income inequality in Java Island, with a coefficient of 0.0357 and

a p-value of 0.0587 (> 0.05). This indicates that although the pandemic tends to increase inequality, its influence is not statistically strong enough to be considered significant. These findings are consistent with the research by Narayan et al. (2021), which states that although the pandemic disrupted the economy, various mitigation policies such as social assistance and fiscal stimulus were successful in curbing the surge in inequality, thereby limiting its impact on income distribution.

The Influence of Education Level, Health, Infrastructure and the COVID-19 Pandemic on Income Inequality (Y)

Based on simultaneous test results (F test), there are significant relationship between variable level education , health , infrastructure , and the COVID-19 pandemic on inequality income in Java Island, with F value of 30.29481 and probability of 0.000000 (< 0.05). The coefficient value determination (R^2) of 0.943977 shows that fourth variable independent give contribution by 81.71% against variation inequality income . This result in line with study Siswantoro (2024) stated that that education , health and infrastructure in a way together influence inequality income , while the COVID-19 pandemic does not influential significant . This is consistent with Kuznets' theory states that that inequality Can increase in stage beginning development , but in context pandemic , surge inequality succeed pressured by policy mitigation like help social , subsidies , and fiscal stimulus . Although in a way theoretical pandemic potential to worsen inequality , intervention fast and focused government capable dampen the impact so that No cause improvement significant inequality (Todaro & Smith, 2012) .

CONCLUSION

Study This done in six provinces in Java Island during 2015–2025 for analyze influence education, health, infrastructure, and the COVID-19 pandemic on inequality income interregional . Analysis results show that education and health influential negative and significant to inequality , support theory endogenous growth and human capital that emphasizes importance investment source Power man in expand access economy. For variable infrastructure influential positive and significant , reflecting inequality development that enlarges gap inter-regional . Meanwhile , the COVID-19 pandemic has an impact positive However No significant , possible Because policy mitigation government succeed withhold its impact and in a simultaneous , fourth variable the influence inequality income , in line with Kuznets theory , so that needed development sustainable and evenly distributed in the field education , health and infrastructure For support growth inclusive economy .

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