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The Influence of Human Capital and Energy Consumption in Covid-19 Pandemic

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Abstract

The point of the study is to analyze, through cointegration techniques, the influence of human capital and power usage on growth in the economy in Indonesia. In a 21-year data analysis from 2000 to 2020, "autoregressive vectors" were used to represent the causal link between variables. The World Bank contributed the data for this research. In this study, we look at evaluating education, health, energy consumption, and GDP in Indonesia. Education has a noticeable influence on power consumption and health, indicating that education can increase awareness of energy consumption and health. energy usage itself is a substantial contributor to economic expansion in Indonesia. The higher the quality of public education, the more aware people are of the importance of health and wiser in consuming energy in encouraging economic growth in Indonesia.

Keyword : Human Capital,Energy Consumption,Covid-19, Indonesia

JEL Classification : C01, E24, J24, P18

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Background

Unstable world economic growth during the COVID-19 pandemic requires practical solutions to promote post-covid-19 economic stability. In general, world economic growth has gradually improved after COVID-19 due to a recovery in investment, manufacturing, and trade. In the longer term, a potential slowdown in growth puts the progress made in living standards and poverty reduction at risk across the globe at risk. This is due to a slight increase in productivity, as well as insufficient investment in health and education (Bischi et al.,2022).

An important part of monetary expansion is the proportion of energy used. The empirical and theoretical literature on the human capital and its link, consumption of electrical energy, and economic growth (Shahbaz et al.,2022). One of the most widely used theories is the Solow-Swan production function. The growth model proposed by Robert Solow assumes that the production function has a constant yield. Robert Solow's theory gives importance to humans as a fundamental component in the productive development of industry and economic expansion. However, the inclusion of power factors in the production function is still rare. Endogenous economic systems used to describe the expansion often emphasize labour and capital as production variables while ignoring energy (Arbex & Perobelli, 2010).

Human capital does not have the same effect for all groups of countries (Rusmingsih et al.,2021). There is an extensive empirical and theoretical research on the connection between human capital, energy usage and economic growth. The Solow-Swan production function is one of the most widely used theories to explain the variation of these variables. Solow initiated a theoretical structure that gives importance to human beings as a fundamental component in the productive development of industry and economic expansion. However, the inclusion of power factors in the production function is still rare. Endogenous economic models used to describe the growth process often concentrate on capital and labor as elements of production and disregard the function of energy (Arbex & Perobelli, 2010). However, Keynesian thought in macroeconomic analysis. This approach is based on the management of large economic aggregates and on the cause-and-effect relationships between the movements of these dimensions. This should lead to the creation of an environment conducive to increasing production, consumption, saving, and investment and optimizing the scarce resources of an economy (Naqvi & Stockhammer, 2018).

Advanced human capital as a growth driver. Human capital accumulation drives the creation of technology and the growth of production. Increased productivity helps increase returns on accumulated human capital and encourages workers to invest in education. Education affects economic growth by increasing the expansion of human capital accumulation beyond basic education. Transmission of human resources between generations so that a country can grow in the long term (Widarni & Bawono, 2021 ; Sulisnaningrum et al.,2022).

The purpose of this study is to evaluate, through cointegration techniques, the impact of human capital and energy consumption on economic growth in Indonesia. Lim et al. (2021) explain that Indonesia is an important country in Asia, a country with considerable economic growth in the Southeast Asian region. Indonesia also has a large population and has interests in various countries in the world.

Research Method

In a 21-year data analysis from 2000 to 2020, "autoregressive vectors" were used to represent the causal link between variables. The World Bank contributed the data for this research. In this study, we look at evaluating education, health, energy consumption, and GDP in Indonesia. The following multivariate regression model was used to evaluate, through cointegration techniques, the effect of human capital also the effect of energy usage on economic growth in Indonesia:

$E_t = \beta_0 + \beta_1 H_t + \beta_2 EC_t + \beta_3 GDP_t + e_t$ eql 1

$H_t = \beta_0 + \beta_1 E_t + \beta_2 EC_t + \beta_3 GDP_t + e_t$ eql 2

$EC_t = \beta_0 + \beta_1 E_t + \beta_2 H_t + \beta_3 GDP_t + e_t$ eql 3
$GDP_t = \beta_0 + \beta_1 E_t + \beta_2 H_t + \beta_3 EC_t + e_t$ eql 4

Description :

E : Education
H : Health
EC : Energy consumption
GDP : Gross domestic product
e : error term
t : time series
β : the magnitude of the effect of causality
eql: equation
This study uses vector calculations where each regression relationship will be brought together so that each variable will alternately become the dependent variable and the independent variable. The zero theory of Dickey-Fuller, taken from the PP test, and p=1 is the formula in Δyt = (ρ – 1)yt-1 + ut, in which Δ – for the first time different operators. This research used the following equation for the "unit root test":

ΔY1 = α0 + β0T + β1Yt-1 + ∑_(i-1)^q α1ΔYt-1 + et

Description:

Y as the variable is being examined for unit root
T as the variable which indicates the “linear trend,” the “lag difference” means is $\Delta Yt{-}1$, $\alpha 0$ are shown as “constant term,” with the "t" as a "time trend" indicator. The alternative and null hypotheses for the "unit root test" are as follows:
H0: α=0
H1: α≠0

Result and Discussion
Before a causality or VAR assumption can be satisfied, a stationarity test must be performed. To determine whether the sequence is not stationary., apply the Augmented Dickey-Fuller test. The following observations were made after doing the unit root test:

Table 1: ADF's Unit Root Test on EC, GDP, H, and E data.

Variable	Unit Root	Include in the examination Equation	Statistics for the ADF Test	5% Critical Value	Description
Energy consumption (EC)	Level	Intercept	1.127994	0.9957	
	First	Intercept	-3.288039	0.0332	Stationer

	Diff				
Gross domestic product (GDP)	Level	Intercept	-0.527808	0.8660	
	First Diff	Intercept	-1.929268	0.3129	
	Second Diff	Intercept	-3.319458	0.0293	Stationer
Health (H)	Level	Intercept	-0.598411	0.8501	
	First Diff	Intercept	-3.732511	0.0123	Stationer
Education (E)	Level	Intercept	0.011282	0.9491	
	First Diff	Intercept	-4.861012	0.0012	Stationer

EC, H, and E data are stationary at the first difference, while GDP data are stationary at the second difference. Augmented Dickey-Fuller test is -3.288039 with a critical value of 0.0332. Smaller than the p-value, in this case the EC data shows stationary at the first difference compared to the original data. From here, we can take the next step in defining vector analysis.

Both the causality and VAR tests need sufficient lag length sensitivity. Before doing a VAR analysis or a causality test, it is critical to choose the most appropriate time lag for the circumstance. In this experiment, the Akaike Information Criteria (AIC) was employed to establish the optimum time lag. The lag test yielded the following results:

Table 2 : AIC value at Lag 0 to 2 E, H, EC and GDP data.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-133.1515	NA	21.88684	14.43700	14.63583	14.47065
1	-90.69982	62.56044*	1.421662*	11.65261	12.64676*	11.82086
2	-73.34616	18.26700	1.628433	11.51012*	13.29959	11.81297*

The results of the Optimum Lag test are shown in Table 2. The length of the Lag variables E, H, EC, and GDP is at LR, FPE, and SC at Lag 1 according to the AIC value at Lag 0 to 2. The first lag will be picked since the results of the four criteria are identical. As a result, the best lag, according to the test criteria, is lag 1.

Table 4 : Vector Model Analysis

	E	H	EC	GDP

E	-0.494369	0.054259	0.573332	-0.327527
	(0.33532)	(0.04747)	(0.33919)	(0.21700)
	[-1.47432]	[1.14297]	[1.69031]	[-1.50932]
H	-3.497565	0.065684	-1.601186	2.874742
	(3.46513)	(0.49057)	(3.50508)	(2.24246)
	[-1.00936]	[0.13389]	[-0.45682]	[1.28196]
EC	-0.574810	-0.014817	0.017725	0.455295
	(0.32384)	(0.04585)	(0.32758)	(0.20958)
	[-1.77495]	[-0.32317]	[0.05411]	[2.17245]
GDP	-0.365007	0.126364	1.127381	-1.110155
	(0.92289)	(0.13066)	(0.93353)	(0.59725)
	[-0.39550]	[0.96715]	[1.20765]	[-1.85877]
C	123.3249	-4.276637	-24.35720	23.31956
	(36.2827)	(5.13663)	(36.7010)	(23.4804)
	[3.39900]	[-0.83258]	[-0.66367]	[0.99315]
R-squared	0.888333	0.785072	0.973717	0.759506
Adj. R-squared	0.798999	0.613129	0.952690	0.567110
Sum sq. resids	33.45737	0.670578	34.23325	14.01210
S.E. equation	1.829136	0.258955	1.850223	1.183727
F-statistic	9.943974	4.565889	46.30849	3.947628
Log likelihood	-32.33525	4.808681	-32.55304	-24.06691
Akaike AIC	4.351079	0.441192	4.374004	3.480728
Schwarz SC	4.798444	0.888557	4.821370	3.928094
Mean dependent	45.16289	2.768404	32.69933	4.977976
S.D. dependent	4.079874	0.416334	8.506420	1.799132

The relationship between E and E itself is significantly negative, with a coefficient of -0.494369 and a t-statistic of -1.47432, the relationship between E and H is significantly positive, with a coefficient of 0.054259 and a t-statistic of 1.14297, which means the higher E, the higher H. Likewise, the relationship between E and EC is significantly positive with a coefficient of 0.573332 and a t-statistic of 1.69031, meaning that the higher E, the higher EC. The relationship between E and GDP is negative significantly, as evidenced by the coefficient -0.327527 and the t-statistic -1.50932. This shows that a declining level of education will encourage economic growth which is represented by the variable gross domestic product, when the level of education is high this will encourage high health, and high energy consumption as well.

Table 5 : Granger Causality

Null Hypothesis:	Obs	F-Statistic	Prob.
H does not Granger Cause E	19	0.54321	0.5926
E does not Granger Cause H		3.53893	0.0570
EC does not Granger Cause E	19	2.62131	0.1079
E does not Granger Cause EC		1.36595	0.2871
GDP does not Granger Cause E	19	0.01246	0.9876
E does not Granger Cause GDP		4.79776	0.0259
EC does not Granger Cause H	19	2.31396	0.1354
H does not Granger Cause EC		0.11243	0.8945
GDP does not Granger Cause H	19	0.23499	0.7936
H does not Granger Cause GDP		0.71167	0.5077
GDP does not Granger Cause EC	19	0.07741	0.9259
EC does not Granger Cause GDP		3.81388	0.0476

The results of Granger causality analysis with variables E, H, EC, and GDP show that there is a one-way relationship between variables E, H, EC, and GDP, and variable E to GDP, and variable EC to GDP. This happens because of the level of significance (p-value) is smaller. or equal to 0.05.

Conclusion

Education has a substantial impact on energy usage and health, indicating that education can increase awareness of energy consumption and health. Consumption of energy itself is a important contributor to economic expansion in Indonesia. The higher the quality of public education, the more aware people are of the importance of health and wiser in consuming energy in encouraging economic growth in Indonesia.

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