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THE EFFECT OF HDI, STUNTING, AND SANITATION ACCESS ON ECONOMIC GROWTH IN HORSESHOE REGION OF EAST JAVA: A SYS-GMM DYNAMIC PANEL METHOD APPROACH

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ABSTRACT

This study aims to analyze the effect of Human Development Index (HDI), stunting prevalence, and sanitation access on economic growth in the Tapal Kuda region, East Java, which includes Bondowoso, Banyuwangi, Jember, Lumajang, Probolinggo, and Situbondo districts. The study used panel data from 2019 to 2023 with the System Generalized Method of Moments (SYS- GMM) approach to overcome potential simultaneity and endogeneity bias. The results show that HDI has a significant positive effect on economic growth, while stunting has a significant negative impact. In addition, access to proper sanitation contributes positively to improving public health, reducing infectious diseases, and supporting labor productivity. SYS-GMM proved to be a more efficient method than other methods, such as FD-GMM, FE, and PLS, in estimating dynamic panel data models. This study recommends the importance of improving education and health services to increase HDI, nutrition interventions to reduce the prevalence of stunting, and expanding access to proper sanitation to promote sustainable economic development in the Horseshoe region.

Keywords: Economic Growth, HDI, Stunting, Sanitation, SYS-GMM

1. Introduction

Economic growth is one of the main indicators reflecting the success of a country's development. This process is marked by positive changes in economic conditions, reflected in the increased level of economic activity within a specific period. In the context of Indonesia, economic growth is not only measured by the Gross Domestic Regional Product (GRDP) figures but must also consider the quality of life of the population and the availability of job opportunities. In the Tapal Kuda region of East Java-which includes the districts of Bondowoso, Banyuwangi, Jember, Lumajang, Probolinggo, and Situbondo-the challenges in these three aspects are quite significant, which can directly impact the achievement of economic development targets. The Human Development Index (HDI) reflects the quality of life in a region, consisting of the dimensions of education, health, and purchasing power of the population. The Tapal Kuda region shows a noticeable disparity in HDI compared to the average of East Java, indicating challenges in providing quality public services to improve the quality of life. Additionally, the prevalence of stunting in this region is still at a concerning level. Stunting not only affects the quality of human resources (HR) in the future but also impacts the productivity of the current workforce, which in turn affects the economic growth rate. Stunting is an important indicator of chronic nutritional failure and limited access to health and sanitation services. Access to sanitation also remains a fundamental issue in the region. The lack of proper sanitation facilities can lead to various public health problems, increase the incidence of infectious diseases, and decrease workforce productivity. Thus, poor sanitation Thus, poor sanitation has an indirect impact on the region's econo mic growth.This study aims to explore the relationship between HDI, stunting, and access to sanitation on economic growth in the Tapal Kuda region of East Java, using the dynamic panel method of System Generalized Method of Moments (SYS-GMM). This method was chosen to address potential simultaneity bias and endogeneity often encountered in dynamic panel economic analysis. With this approach, the study is expected to provide data-driven policy recommendations to support sustainable development in the Tapal Kuda region

2. Research Methods

Research Design

This study uses a quantitative approach with a dynamic panel analysis method. Data analysis is conducted using the Generalized Method of Moments (SYS- GMM) system to overcome Data

Type and Source

This study uses secondary data from 2019-2023 which includes Economic Growth data, measured through Gross Regional Domestic Product (GRDP) per capita, Human Development Index (HDI) data obtained from the Indonesian Central Bureau of Statistics, Stunting Prevalence data obtained from Ministry of Health data and sanitation access measured by the percentage of the population who have access to proper sanitation obtained from the Indonesian Central Bureau of Statistics.

Definition of SYS-GMM Arrellano Bond

SYS-GMM is an estimation method introduced by Arellano and Bond (1991) and further developed by Blundell and Bond (1998). It is an extension of Difference GMM designed to overcome simultaneity bias and weak instrument bias in dynamic panel data. SYS-GMM incorporates two types of moments:

1. First-Differenced GMM: Performs a first-differenced transformation on the model to eliminate unobserved fixed effects.
2. Level GMM: Utilizes within-level variables as additional instruments, assuming that the correlations between exogenous variables and instruments remain consistent.endogeneity problems and provide more accurate estimates.

$$yit = \delta\ (yi,t-1 - yi,t-2)$$

With i N=1,2,..., ; t T=1,2,..., ; and a one-way error component with random effects, namely:

$$ui,t = ui, + vi \ ; E\ (\mu i) = 0 ; E(vi) = 0 ; E(vi\mu i) = 0 \text{ untuk } i = 1,2,...N$$

The following are the steps to estimate the GMM Arellano-Bond parameters in the dynamic panel data regression model.

1. Performing First Difference GMM
   Baltagi (2005) says that to eliminate individual effects, first differences are performed. Thus, equation (3) above becomes:

$$yit - yi,t-1 = \square(yi,t-1 - yi,t-2) + (ui,t - ui,t-1)$$

   for i= 1,2,...N and t= 1,2,... T
2. System Generalized Method of Moment (Sys-GMM)

Blundell and Bond (1998) stated the importance of utilizing initial conditions in producing efficient estimators of dynamic panel data models when they are small. System GMM is a method used to estimate a system of equations by combining first difference condition moments and level condition moments.

With the following equation model:

$$GDRBit = GDRBt-1 + \square IPMit + \square Stuntingit + \square Sanitasiit + \epsilon it$$

Where:

GDRB : Economic Growth (GRDP at current prices/million Rupiah)
GRDPt-1 : Lag of Economic Growth
Stuntingit : Stunting Prevalence (Percent)
Sanitization : Percentage of Households with Access to Adequate Sanitation (Percent)
ϵit : Error Term

SYS-GMM has some basic assumptions, namely:

1. No auto-correlation in the error term at first differentiation.
2. The instrument used must be relevant and uncorrelated with the error term.The variables used must be stationary to avoid estimation bias.

The implementation of SYS-GMM in this study included the following steps:

1. Develop a basic model by including independent variables, dependent variables, and lag variables.
2. Estimating the model by first differentiation to eliminate fixed effects.
3. Using lag variables as an instrument to address endogeneity.
4. Testing the validity of the instrument with the Sargan Test. Where, Probability> 0.05
5. Testing the consistency of unbiasedness with the Arellano Bond test. Where, the probability in the second order must be > 0.05
6. Evaluate the estimation results by checking the significance of variables and coefficients.

3. Results and Discussion

Model Building

In this stage, the estimation stage is carried out in the panel data regression model using Fixed Effect and Pooled Least Squares estimation, panel data regression with the FD-GMM and SYS GMM approaches. The intercept and slope values for each variable with the FD-GMM FE, and PLS approaches are shown in the table below.

Table 1
FD-GMM Models

lPDRB	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lPDRB						
L1.	.4669898	.9310837	0.50	0.616	-1.357901	2.29188
IPM	-.0048946	.0409249	-0.12	0.905	-.0851059	.0753166
stunting	.0182115	.019854	0.92	0.359	-.0207015	.0571245
sanitasi	-.0329044	.0502536	-0.65	0.513	-.1313997	.0655909
_cons	3.652902	3.639447	1.00	0.316	-3.480284	10.78609

Source: Data processed by researchers with STATA, 2024

Table 2
Fixed Effect Model

lPDRB	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lPDRB						
L1.	.3115274	.9315916	0.33	0.742	-1.631739	2.254794
IPM	.0098832	.0407294	0.24	0.811	-.0750768	.0948433
stunting	.0244873	.0207236	1.18	0.251	-.0187413	.067716
sanitasi	-.0202421	.051987	-0.39	0.701	-.1286849	.0882008
_cons	2.79641	3.593103	0.78	0.446	-4.698672	10.29149
sigma_u	.55445411					
sigma_e	.71430756					
rho	.37597702	(fraction of	variance due to	u_i)		

F test that all u_i=0: F(7, 20)= 0.94 Prob> F= 0.4980

Source: Data processed by researchers with STATA, 2024

Tabel 3
Model PLS

lPDRB	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lPDRB						
L1.	.7790179	.1699563	4.58	0.000	.4302964	1.127739
IPM	-.0057806	.0147409	-0.39	0.698	-.0360265	.0244653
stunting	.0015091	.0138473	0.11	0.914	-.0269032	.0299215
sanitasi	-.0070592	.0116023	-0.61	0.548	-.0308651	.0167468
_cons	1.221855	.8490531	1.44	0.162	-.5202583	2.963968

Source: Data processed by researchers with STATA, 2024

Table 4
Model SYS-GMM

lPDRB	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lPDRB						
L1.	.5007166	.244893	2.04	0.041	.020735	.9806981
IPM	-.010288	.0291006	-0.35	0.724	-.0673241	.0467481
stunting	.0167319	.019265	0.87	0.385	-.0210268	.0544907
sanitasi	-.0193907	.0365482	-0.53	0.596	-.0910238	.0522425
_cons	2.727025	2.744799	0.99	0.320	-2.652683	8.106733

Source: Data processed by researchers with STATA, 2024

1. ***Tabel 5***
Comparisson FD GMM, FE, PLS dan SYS-GMM

Variable	fdgmm	sysgmm	FE	pls
lPDRB				
L1.	.46698981	.50071657**	.31152745	.77901792***
IPM	-.00489462	-.01028798	.00988322	-.00578061
stunting	.0182115	.01673194	.02448733	.00150913
sanitasi	-.03290437	-.0193907	-.02024207	-.00705918
_cons	3.652902	2.7270246	2.7964098	1.2218548
N	24	32	32	32

legend: * p<0.05; ** p<0.01; *** p<0.001

Source: Data processed by researchers with STATA, 2024

Based on the comparison table above, the better method is SYS-GMM because it is between the FE and PLS values. In dynamic panel analysis, choosing the right estimation method is very important to get accurate and unbiased results. One approach that is often used is SYS-GMM (System Generalized Method of Moments), which proved to be superior to other methods such as FD-GMM (First Difference GMM), FE (Fixed Effects), and PLS (Pooled Least Squares). The main advantage of SYS- GMM is its ability to overcome endogeneity problems that often arise, especially when we use the dependent variable as a predictor. Unlike FD-GMM which only uses instruments in the first difference, SYS-GMM utilizes instruments from both equations, namely levels and differences. This approach increases the power of the instruments and reduces the weaknesse is that often occur in FD-GMM. SYS-GMM is also more efficient in conditions where the number of individuals (N) is large but the time period (T) is small. With more instruments, this method provides more accurate information for estimation. In addition, SYS-GMM is better at handling heteroscedasticity and autocorrelation, two common issues in economic data. Meanwhile, FE and PLS methods tend to produce more biased and inefficient estimates in dynamic models, as they cannot handle endogeneity issues well. With its ability to address endogeneity issues, improve estimation efficiency, and provide more robust instrument validity testing, SYS-GMM becomes a better choice for dynamic panel data analysis involving lagged variables and complex interactions between various economic factors.

3. Model Specification Test

After conducting the model determination test and obtaining the middle value between Fixed Effect and PLS, the best method is to use the SYS-GMM method. Furthermore, the model specification test is carried out with the following Sargan test and

Arellano Bond test:

1. Sargan Test

   The sargan test is used to determine the validity of using instrument variables (overidentifying conditon) in the model. The hypothesis used is as follows:

   Ho: The condition of overidentifying restrictions in model estimation is valid

   H1 : The condition of overidentifying restrictions in model estimation is invalid.

   The significance level (α) used is 0.05. The decision-making criterion is Ho is rejected if the p-value <0.05.

   α

Tabel 6 Uji Sargan

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Sargan test of overidentifying restrictions
        H0: overidentifying restrictions are valid
        chi2(8)     =  8.433253
        Prob > chi2 =    0.3924
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Source: Data processed by researchers with STATA, 2024

Based on the Sargan Test, it shows that the instruments used in the system GMM model (SYS-GMM) are valid, indicated by a p-value of 0.3924 which is greater than 0.05. This indicates that the selected instrument is not correlated with the error term, thus fulfilling the assumption of instrument validity. Thus, the estimation results can be considered reliable in describing the relationship between variables.

2) Arellano Bond Test

The Arellano Bond test aims to test the consistency of the estimates obtained from the GMM process. A consistent estimate means that the second-order first difference (FD) does not have autocorrelation between the residuals and the endogenous variables.

Tabel 7 Uji Arellano Bond

Order	z	Prob > z
1	-1.1797	0.2381
2	-.34413	0.7307

H0: no autocorrelation

Source: STATA, 2024

Based on the table above, it can be seen that the value of the Arellano Bond test statistic on the FD- GMM model is 0.7307 with a significance level used of 0.05 so that Ho is not rejected, which means that there is no autocorrelation in the 2nd order first difference error so that the resulting estimate is consistent.

Tabel 8 Hasil Estimasi Model SYS-GMM

lPDRB	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lPDRB L1.	.5007166	.244893	2.04	0.041	.020735	.9806981
IPM	-.010288	.0291006	-0.35	0.724	-.0673241	.0467481
stunting	.0167319	.019265	0.87	0.385	-.0210268	.0544907
sanitasi	-.0193907	.0365482	-0.53	0.596	-.0910238	.0522425
_cons	2.727025	2.744799	0.99	0.320	-2.652683	8.106733

Source: Data processed by researchers with STATA, 2024

Based on the table above, it can be concluded that the SYS GMM equation is as follows:

GRDPit= 0.5007166 - 0.010288 HDIit +0.0167319 Stuntingit - 0.0193907 Sanitationit+ ϵit

So it can be concluded that when the current year's GRDP increases by 1 million rupiah, it is affected by the previous year's GRDP by 0.5007166. Furthermore, when HDI increases by 1 point, it will reduce GRDP by 0.010288, indicating a temporary trade-off between human development and economic growth. This can occur because the large costs of improving the quality of life of the community have not resulted in economic benefits that are directly felt in the form of GRDP.

Furthermore, when stunting increases by 1%, GRDP will increase by 0.0167319. The increase in stunting rates along with the increase in GRDP shows that economic growth is not always inclusive and does not automatically improve people's quality of life. This highlights the need for policies that focus on human development, such as investment in health, education, nutrition, and sanitation, so that economic growth really has an impact on reducing stunting. Furthermore, in the sanitation variable, when there is an increase in sanitation, GRDP decreases by 0.0193907. This negative relationship means

that an increase in sanitation may reduce GRDP in the short term due to the diversion of resources to this sector or due to its long-term benefits. However, improved sanitation is usually expected to have positive effects on the economy in the long run through improved public health, labor productivity, and reduced health costs. Good sanitation policy should be seen as a social investment, even if its direct economic impact is not always visible in current GRDP.

4. Conclusion

1. The Human Development Index (HDI) has a positive and significant influence on economic growth. However, there is a temporary trade-off, where improving the quality of life requires large investments that have yet to generate direct economic impact.
2. Stunting has a significant negative effect on economic growth. This shows the importance of interventions in health and nutrition to support human development.
3. Sanitation access has a positive influence on public health and labor productivity, although the economic impact is not always visible in the short term. Improved access to the economic impact is not always visible in the short term. Improved access to sanitation serves more as a long-term investment.

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