Causal Modelling of Economic Growth: A Review of Four Key Variables Using SAS

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Abstract. In an effort to understand the elements that contribute to economic growth, the theory of growth has evolved over many years in the economic sector. Alternative human capital measurements, fiscal policy, the amount and nature of public and private investment, monetary policy and inflation, as well as a number of political and demographic aspects, have all been covered in some past research. The renewal process used in this study is centered on village development, which is thought to be important for economic development. In order to develop a better model for observing the causal relationship between the Village Development Index (IVD), Village Fund Allocation (ADD), Poverty (POP), Human Development Index (HDI), and Economic Growth (GE) with path analysis in the short term, this research will also be focused on econometric analysis for time-lapse data. Examining the causal connections between the Village Development Index (IVD), Village Fund Allocation (ADD), Poverty (POP), Human Development Index (HDI), and Economic Growth is the primary goal of this study (GE). This study employed route analysis to examine linked variables (IVD, ADD, POP, HDI, and GE) with a focus on 154 districts in Sumatra. In order to better understand the direct and indirect impacts of variables that are considered to be the source of variables that are being treated as effects, path analysis is a crucial statistical tool. Such analysis can be used to determine the degree to which each distinct source contributes to the variation of a given effect.

Keywords: Village Development Index (IVD) · Village Fund Allocation (ADD) · Poverty (POP) · Human Development Index (HDI) · and Economic Growth (GE)

1 Introduction

Many empirical articles using cross-country data have used it to try to understand the driving forces behind it. Those articles examined a number of variables. Alternative human capital metrics, fiscal policy, the volume and makeup of public and private investment, monetary policy and inflation, as well as a wide range of political and demographic issues are some of the topics covered in some of the articles on the list [1]. With so many

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articles published on the subject, why is the study of economic growth so popular? One possible explanation is the need to analyze results below the line. There is something. Policy analysis increasingly recognizes the importance of considering impacts below the line and potentially wide ranges above and below [2]. The continuous emphasis on measuring macro and micro variables shows that these factors' effects on economic growth remain a key area of research.

By discussing the causal model of the relationship between the following variables in 154 regencies in Sumatra during a research period in 2019, we add to the body of literature on economic growth. These variables are the Index of Village Development (IVD), Allocation of Village Funding (AVF), Poverty (POP), Human Development Index (HDI), and Growth of Economy (GE). One of the relationships that is discussed touches on poverty, education, and economic development. The HDI is an indicator that is close to education. The relationship between poverty and educational attainment has been the subject of continuous discussion. Education level and poverty are closely related. Investment in education lowers the likelihood of poverty through increasing production and wages or income. Additionally, education enables individuals to acquire some crucial abilities that enhance their potential to generate in a more effective manner. Contrarily, poverty imposes restrictions on the level of education [3]. As an extension of that, another HDI founding demonstrated how it connected HDI to economic growth by claiming that there are a lot of elements, including human development, that can boost economic growth [4]. The effort to link poverty to economic progress is continued in the conversation. There is evidence that poverty and economic growth are causally linked in both directions [5]. Therefore, the contribution of the poverty and human development index is empirically examined in this research.

Such programs to foster social development are largely developed by the government. Similar to the economic development, the pace of social growth has experienced positive growth [6]. As a result, the Keynesian model predicts that raising government spending (on infrastructure) will boost economic development. Neoclassical growth models contend, however, that fiscal policy by the government has no bearing on the expansion of the country's output. It has been asserted, however, that fiscal policy (intervention) by the government aids in reducing failure that may result from market inefficiencies. However, the findings provided fzresh insight into how to investigate how government spending (fiscal policy) affects economic growth. Some of the ideas concerning government and growth are supported by empirical data from different countries [7]. This article examines the direct impact of government spending on economic growth in relation to the concept of how government spending affects economic growth. The village funding allotment is the closest form of government spending. The association between village allocation funds and the village development to economic growth index is also measured in this article.

The standard univariate and multivariate methodologies are used in some measurements and analyses in the Statistic Analysis System, Generalized Linear Model (SAS, GLM) procedure. General linear models are fitted using the least squares method by the GLM process. Regression, analysis of variance, analysis of covariance, multivariate analysis of variance, and partial correlations are some of the statistical methods supported by PROC GLM. Using a more general covariance structure approach, the SAS

GLM technique [8]. This essay employs route analysis, which verifies a relationship model among variables and aids in your comprehension of their methods. This path analysis-GLM model, which was created using a variety of concepts and theories, seeks to close a research gap when used. This contribution clears the way for future adaptation in terms of knowledge discovery and national implementation.

2 Literature Review

Since the emergence of classical economic theory, research on economic growth has been growing. These studies frequently link macroeconomic factors to economic growth. In order to do something different, this study links economic growth to several aspects of village development, education, and poverty. Researchers believe that when village development variables are included, an economic growth model will be developed that is participative, responsive, and uses a path analysis model. Path analysis is used in this study because models may deal with patterns that connect one or more bound variables to one or more free variables continually. On the basis of the notion that analysis can be used to determine "the extent to which changes in a particular impact are determined by a particular cause" (8), this paper will discuss the dimensions, variables, and indicators used as a measuring tool for the concept of village development need to be carefully compiled so that it will be compositely able to describe the level of progress and development of village development (GE).

A. *Village Fund Allocation*

This study used a qualitative method with a descriptive approach, and the results show that the management of village fund allocation was improved normatively and administratively. Village Fund Allocation is the central and local funds received from the county and its allocation is distributed proportionally to each village. This is at least 10% (11).

B. *Human Development Index (HDI)*

The HDI was introduced by the United Nations Development Program (UNDP) in 1990 and is regularly published in the annual Human Development Report (HDR) by including the average length of schooling and the expectation figures for the length of schooling, can be obtained a more relevant picture in education and the changes that occur. HDI is formed by 3 (three) basic dimensions: income, health, and education.

C. *Poverty*

Poverty is linked to the best employment opportunities, and in general, those who are classified as poor are unemployed (unemployed), the overall level of education and health is inconsistent (13). Poverty is also associated with the top employment opportunities (14).

D. *Economic Growth Theory*

The government's contribution to economic growth can be explained by its effect on the growth of consumption or the collection of taxes. This group of theories also takes into account of the infrastructure of legislation political stability government's invitation to bureaucracy and the international exchange system as important factors (11).

However, there are signs that the effect of total human capital is not positively related to economic growth due to a negative spillover effect, a direct effect of strengthening the need for local investment in human capital. Another argument suggests that there is a new model of economic geography, in which a more skilled labor force is an important factor shaping the centripetal forces leading to geographic concentration.

3 Methodology

A. *PATH Evaluation*

Path evaluation is a technique of inspecting causal styles among a fixed of variables. An vital statistical device for knowledge relationships among variables, evolved through Sewall Wright [9].

Figure 1 illustrates the structural model proposed by (Erlando et al., 2020), which may be expressed as follows:

$$\text{Model 1: IVD} = \text{P\_01 AVF} + 〖\text{p}〗\text{\_1 u\_1} \tag{1}$$

$$\text{Model 2: HDI} = \text{P\_02 POP} + 〖\text{p}〗\text{\_2 u\_2} \tag{2}$$

$$\text{Model 3: GE} = \text{P\_01 IVD} + \text{P\_02HDI} + \text{P\_03AVF} + \text{P\_04POP} + 〖\text{p}〗\text{\_3 u\_3} \tag{3}$$

There are three null hypotheses to test based on models (1), (2), and (3). (1) There is no direct effect of AVF on IVD. (2) There is no direct effect of POP on HDI. (3) IVD, HDI, AVF and POP have no direct impact on GE. The error term can be calculated as: 2

$$\text{The error term is calculatedas :: pi} = (1 - \text{R}^2)\text{i, where i} = 1, 2, 3 \tag{4}$$

PROC GLM therefore handles models in which the independent variable is either a continuous variable or a classification variable that divides the observations into discrete groups. The analysis could be used to determine "the extent to which variation of a given effect is determined by each particular cause" [8].

B. *Correlations' Decomposition*

This study focuses on 154 regencies in Sumatra by studying those interrelated variables (IVD, ADD, POP, HDI, and GE). The main aim of this study is to investigate the causal relationship between Village Development Index (IVD), Village Resource Allocation (ADD), Poverty (POP), Human Development Index (HDI) and Economic Growth (GE). Panel regression of path analysis is considered the method of this study.

Figure 1 shows a causal model of the relationship between the variables Human Development Index (HDI). Growth of Economy, Index of Village Development (IVD), and Allocation of Village Funding (AVF) (GE) [10]. Data from IVD, ADD, POP, HDI, and GE are transformed into standardized data with mean = 0 and standard deviation =

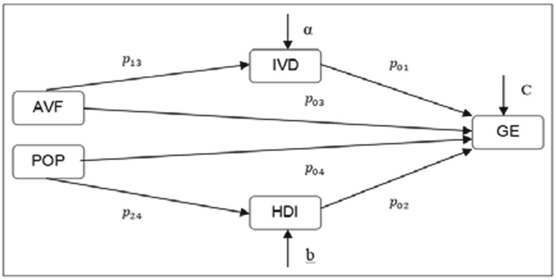

Fig. 1. Causal model of the relationship among variables: Index of Village Development (IVD), Allocation of Village Funding (AVF), Poverty (POP), Human Development Index (HDI), and Growth of Economy (GE)

1. Therefore, the expected value of: E(IVD.IVD) = 1, E(ADD.ADD) = 1, E(POP.POP) = 1, E(HDI.HDI) = 1, E(GE.GE) = 1, E(IVD.GE) = r_{12}, E(IPM.GE) = r_{13}, E(IDM.GE) = r_{23}, E(POP.GE) = r_{24}, and E(AVF.GE_2) = r_{34}. Where r_{12}, r_{13}, r_{23}, r_{24}, and r_{34} are the correlations between variables: IVD, ADD, POP, HDI and GE respectively.

AVF and IVD, POP and HDI, IVD, HDI, AVF and POP each with GE. From model (1), Algebra and tracking rules can be used to determine the composition of the correlation. Multiplying both sides of the model by the AVF gives the expected values shown in the table below.

$$\text{E (IVD.AVF)} = P_{13}.\text{E(AVF.AVF)}$$

So that,

$$r_{12} = P_{13} \tag{5}$$

Find the configuration of correlations r_ and r_ from model (2). Multiply both sides of the model (2) by POP to get the correlation configuration that yields the expected value:

$$\text{E (HDI.POP)} = P_{24}.\text{E(POP.POP)}$$

So that,

$$r_{24} = P_{24} \tag{6}$$

To find the composition of the correlations r_ and r_ from model (3), multiply both sides of model (3) by GE's HDI, IVD, HDI, AVF, and POP to get the expected value as:

$$\text{E(IVD.GE)} = P_{01}.\text{E(IVD.IVD)} + \text{E(IVD.HDI)} \tag{7}$$

So that,

$$r_{12} = P_{01} \tag{8}$$

$$\text{E(HDI.GE)} = P_{02}.\text{E(IVD.HDI)} + \text{E(HDI.AVF)}$$

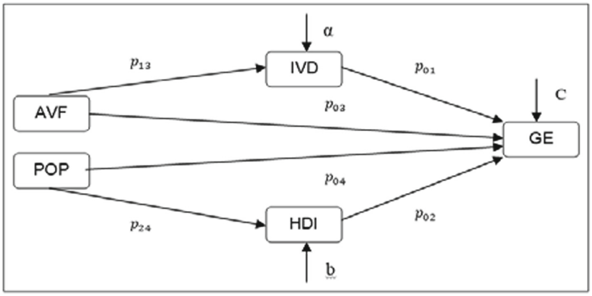

Fig. 2. Causal model of the relationship among variables: Index of Village Development (IVD), Allocation of Village Funding (AVF), Poverty (POP), Human Development Index (HDI), and Growth of Economy (GE)

So that,

$$r_{24} = P_{02} \tag{9}$$

$$\text{E(AVF.GE)} = P_{03}.\text{E(HDI.AVF)} + \text{E(AVF.POP)}$$

$$r_{34} = P_{03} \tag{10}$$

So that,

$$\text{E(POP.GE)} = P_{04}.\text{E(AVF.POP)} + \text{E(POP.POP)}$$

$$r_{34} = P_{04} \tag{11}$$

Figure 4 shows a causal model for the link between the variables Human Development Index (HDI), Growth of Economy, Index of Village Development (IVD), and Allocation of Village Funding (AVF) (GE). In this bottom line of the structure, it draws the correlation between Poverty (POP), Human Development Index, and Growth of Economy (GE).

The paper models the direct determinants of economic growth, emphasizing variables that approximate government spending on poverty, education, and village development. In doing so, it develops an analytical framework to address issues at the village level. Our strategy was to first briefly describe the relationship between rural development and economic growth.

C. *Statistical Models and Method of Analysis*

Path analysis is a method developed by Sewall Wright to examine patterns of causality between a set of variables. It is a method of analyzing the direct and indirect effects of variables considered causative of variables treated as effects [9]. The Village Development Index (IVD), Village Funding Allocation (ADD), and Rural Development Index (IRD) causal models are formulated as follows::

Figure 1 illustrates the structural model proposed by (Erlando et al., 2020), which may be expressed as follows:

$$\text{Model 1: IVD} = \text{p01 AVF} + \text{a}, \tag{12}$$

$$\text{Model 2: HDI} = \text{p02 POP} + \text{b, and} \tag{13}$$

$$\text{Model 3: GE} = \text{p01 IVD} = \text{p02 HDI} + \text{p03 AVF} + \text{p04 POP} + \text{c} \tag{14}$$

Based on models (1), (2), and (3), three null hypotheses are tested: (1) AVF, POP, IVD, and HDI directly impact GE. (2) AVF, POP, IVD and HDI have no direct impact on GE. (1) There is a direct impact of AVF, POP, IVD and HDI on GE.

$$\text{The error terms can be determined using the formula: pi} = \sqrt{(1^{-}\text{R}^2)\text{i}}, \text{ where i} = 1, 2, 3 \tag{15}$$

PROC GLM therefore handles models in which the independent variable is either a continuous variable or a classification variable that divides the observations into discrete groups. This analysis can be used to determine the extent to which variation in a particular effect is determined by individual causes. (Zulfikar, 2018).

4 Discussion and Implication

Table 1 shows the results of the analysis of the data for model (1). The data used in this study are the Village Development Index (IVD), Village Allocation (ADD), Poverty (POP), Human Development Index (HDI) and Economic Growth (GE).

From Table 1, to test the null hypothesis that there is no direct effect of AVF on IVD, test $F = 10.95$ at $P = 0.0012$. The null hypothesis was then rejected and there is a direct effect of AVF on IVD. R-Squared = 0.067176. This means that the model can explain 6.71% of the IVD variation. From Table 2, the parameter estimate for model (1) is p13 = 0.3597. To test the partial model parameters (1) (To test Ho: p13 = 0), $t = -3.31$ is calculated with $P = 0.0012$, rejecting the null hypothesis. According to Land (1969), Heisse (1969), and Pedhazur (1997), values of $p13 = -.2591 > 0.05$ are significant.

Figure 2 shows a positive trend corresponding to the estimated parameter value p13 = −.2591. The graph shows that as AVF increases, so does IVD. According to Land (1969) and Pedhazur (1997), POP has a direct effect on HDI. A 1 standard deviation increase in POP results in a 0.0165 standard deviation increase in HDI. Therefore, POP directly affects HDI. Figure 3 shows a positive trend consistent with the value of the estimated parameter p24 = 0.0165.. The error is identified as, the IVD will increase by −.2591 standard deviation. The error is identified as, $p_{13} = \sqrt{1 - 0.067176} = 0{,}9658$.

From Table 3, to test the null hypothesis that there is no direct effect of POP on HDI, we test $F = 0.04$ at $P = 0.8384$ and accept the null hypothesis that there is a direct effect of POP on HDI. Reject. The coefficient of determination = 0.000275, indicating that the model can explain 0.2% of the HDI variation. From Table 2, the parameter estimate for model (1) is p13 = 0.0165. To test the partial model parameters (1) (To test Ho: p13

Table 1. Analysis of variance for testing model (1)

Source	DF	Sum of squares	Mean square	F-value	P-value
Model	1	10.2778692	10.2778692	10.95	0.0012
Error	152	142.7221308	0.9389614		
Corrected total	153	153.0000000			
R-Squares = 0.067176					

Table 2. Parameter estimated and testing for partial parameter of model (1)

Source	DF	Parameter Estimate	Standar Error	t-value	P-value
AVF	1	−.2591825920	0.07833902	−3.31	0.0012

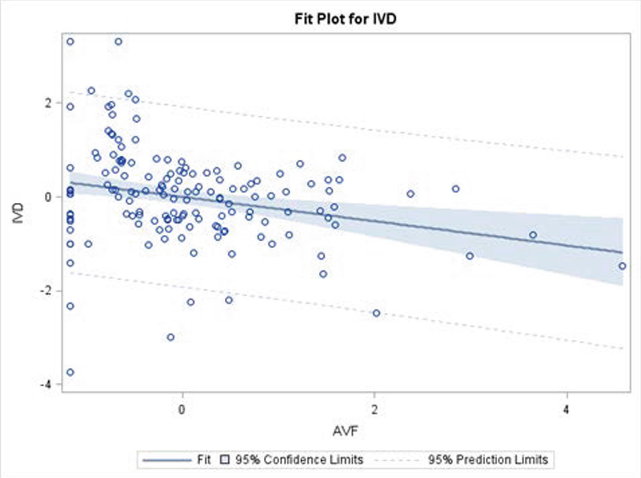

Fig. 3. Fit plot of model (1)

= 0), t = 0.2 is computed with P = 0.8384, rejecting the null hypothesis. The value of $p_{24} = 0.0165 < 0.05$ which according to Land (1969) and Heisse (1969) and Pedhazur (1997) is significant.

Figure 3 shows a positive trend consistent with the value of the estimated parameter p24 = 0.0165. The graph shows that as POP increases, so does HDI. According to Land (1969) and Pedhazur (1997), GE directly affects IVD, HDI, AVF, and POP.When GE increases by 1 standard deviation, IVD, HDI, AVF, and POP increase by 0.0165 standard deviations. The error is identified as, $p_{24} = \sqrt{1 - 0.000275} = 0{,}9997$ (Table 4).

From Table 5, to test the null hypothesis that IVD, HDI, AVF, and POP do not directly affect GE, testing F = 2.69 with P = 0.0333 rejects the null hypothesis. HDI. R-square = 0.067380. This means that the model can explain 6.7% of the GE variation. From

Table 3. Analysis of variance for testing model (2)

Source	DF	Sum of squares	Mean square	F-value	P-value
Model	1	0.0420175	0.0420175	0.04	0.8384
Error	152	152.9579825	1.0063025		
Corrected Total	153	153.0000000			
R-Squares = 0.000275					

Table 4. Parameter estimated and testing for partial parameter of model (2)

Source	DF	Parameter Estimate	Standar Error	t-value	P-value
POP	1	0.0165717822	0.08109957	0.20	0.8384

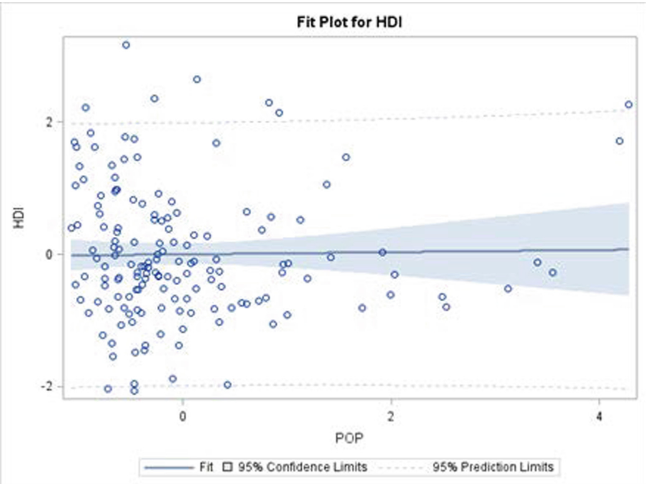

Fig. 4. Fit plot of model (2)

Table 6, the parameter estimate for model (1) is p13 = 0.01657. To test the partial model parameters (1) (To test Ho: p13 = 0), t = 0.20 is calculated with P = 0.8384, rejecting the null hypothesis. Value of p13 = 0.01657 < 0 xss = deleted xss = deleted xss = deleted xss = deleted xss = deleted > 0.05.The parameter estimate for model (3) is P03 = 0.1272 for parameter (3) (to test Ho: p03 = 0), t = 1.43 is calculated with P = 0.1536, rejecting the null hypothesis. The value for p03 = 0.1536 > 0.05 is p04 = .1672 (To test Ho: p04 = 0), t = −1.67 is calculated with P = 0.0961, rejecting the null hypothesis. Value of p04 = 0.0961 > 0.05. According to Land (1969) and Pedhazur (1997), GE directly affects IVD, HDI, AVF, and POP, with a 1 standard deviation increase in GE significantly increasing IVD, HDI, AVF, and POP.

Table 5. Analysis of variance for testing model (3)

Source	DF	Sum of squares	Mean square	F-value	P-value
Model	4	10.3090943	2.5772736	2.69	0.0333
Error	149	142.6909057	0.9576571		
Corrected Total	153	153.0000000			
R-Squares = 0.067380					

Table 6. Parameter estimated and testing for partial parameter of model (3)

Source	DF	Parameter Estimate	Standar Error	t-value	P-value
IVD	1	0.0165717822	0.08109957	0.20	0.8384
HDI	1	−.1092251360	0.08378086	−1.30	0.1943
AVF	1	0.1272612189	0.08872791	1.43	0.1536
POP	1	−.1672414330	0.09986985	−1.67	0.0961

Figure 4 shows a positive trend corresponding to the values of the estimated parameters p13 = 0.01657, p24 = −0.1092, P03 = 0.1272, p04 = −0.1672. The graph shows that as POP increases, so does HDI. Thus, according to Land (1969) and Pedhazur (1997), GE has a direct impact on his IVD, HDI, AVF, and POP. If the GE increases one standard deviation, the IVD, HDI, AVF and POP will increase by $p_{13} = 0.01657$, $p_{24} = -.1092$, $P_{03} = 0.1272$, $p_{04} = -.1672$. Standard deviation. The error is identified as, $p_0 = \sqrt{1 - 0.067380} = 0{,}9657$.

From Table 1, to test the null hypothesis that there is no direct effect of AVF on IVD, test F = 10.95 at P = 0.0012. The null hypothesis was then rejected and there is a direct effect of AVF on IVD. R-Squared = 0.067176. This means that the model can explain 6.71% of the IVD variation. From Table 3, to test the null hypothesis that there is no direct effect of POP on HDI, test F = 0.04 at P = 0.8384. The null hypothesis is then rejected and there is a direct effect of POP on HDI. R-squared = 0.000275. This means that the model can explain 0.2% of the HDI variation. From Table 5, to test the null hypothesis that IVD, HDI, AVF, and POP do not directly affect GE, testing F = 2.69 with P = 0.0333 rejects the null hypothesis. HDI. R-squared = 0.067380, which means that 6.7% of the GE variation can be explained by the model. Figure 3 shows the contour fit plot model (1). Also, as AVF increases and IVD decreases, other variables remain constant and show a negative trend (blue area). The fit plot model (2) shows a positive trend when POP increases, HDI increases, and the other variables remain constant. Implementing a truly multidimensional approach often complicates welfare rankings for welfare states (including policies).

5 Conclusion

This also influences the types of models used to understand the processes that drive economic growth. This is because there may be some correspondence between macroeconomic variables and welfare targets, especially related to economic growth. Not only do more dependent variables need to be considered, but potentially complex relationships between variables can exist.

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