

# Sigma Convergence and VECM Approach in Explaining the Relationship among Macro Variables in Indonesia

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## ABSTRACT

**Objective** – Inequality of regional income, government expenditure and government revenue can show the performance of these variables in improving the economic and non-economic conditions of each region. Previous literature discusses, in part, the inequality among these three variables. This research fills the gap left by previous research by analyzing the inequality of the three variables and analysing the relationship between them in driving the provincial economy in Kalimantan. The first objective of this study is to analyze the reduction of regional income inequality, government revenue and government expenditure. The second objective is to analyze the relationship among macro variables.

**Methodology/Technique** – Using data from 4 provinces in Kalimantan across a 15-year period (2002-2016), this study concludes that in the short term, only changes of government revenue have an impact on regional income and only changes of government revenue has an impact on government expenditure. Meanwhile, in the long term, changes in regional income, government revenue, and government expenditure can all have an impact on regional income.

**Type of Paper:** Empirical.

**Keywords:** Inequality; Regional Income; Government Expenditure; Government Revenue.

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## 1. Introduction

Inequality is a fundamental problem faced by all nations, including both developed and developing countries. Inequality can be caused by ownership of different economic resources from one region to another. The concentration of economic activity in some regions has left other regions lagging. Inequality in several economic factors causes constraints in regional development, even though sustainable growth in various economic elements is needed to maintain sustainable regional development. Several studies have analyzed this inequality using various sigma convergence methods. Sigma convergence emphasizes that there is a reduction in economic inequality from time to time. The results of previous research in this area are quite varied. Young et. al., (2007) identifies a convergence of regional

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income sigma in the US using 3,058 district data from the period between 1970 and 1998. Simionescu (2014) examines the convergence of regional income sigma in 28 European Union countries between 2000 and 2012. The results of that study explicate a decrease in the divergence process in 2012 compared to 2000, which is evidence of sigma convergence. Fouquet and Broadberry (2015) conclude that there is a trend of regional income divergence in the initial observation period. Through the catch-up process, countries with low regional income were able to overtake within 500 years.

Previous studies have shown that there is a two-way relationship between regional income and government expenditure in North Africa (Idenyi *et. al.*, 2016), and in Sub-Saharan Africa (Kimaro, 2017). However, Gabriel *et. al.*, (2016) identified a relationship between the two in Nigeria only in the long term, not in the short term. Similarly, in Jammu and Kashmir Provinces, there is a positive relationship between government expenditure and regional income but only in the long term. In contrast, Hasan and Kashmir (2016) identified a negative relationship in the short term. Furthermore, the relationship in the long-term of government expenditure and government revenue was also observed in Ghana (Aidam, 2018), and Pakistan (Raza *et. al.*, 2019). Whilst the relationship between government revenue and regional income has been identified in Pakistan (Aisha & Khatoon, 2009), and in Sub-Saharan Africa (Kimaro *et. al.*, 2017).

This study comprehensively examines the sigma convergence of regional income, government expenditure and government revenue through the analysis of the coefficient of variation. Some previous studies focus only on one of the variables used to analyze sigma convergence without analyzing the relationship among those variables. The novelty of this research is to analyze the sigma convergence on regional income, government expenditure, and government revenue simultaneously, and to enrich the results by examining the relationship among regional income, government expenditure, and government revenue.

## **2. Literature Review**

### **2.1. The Theory of Convergence**

The theory of convergence is based on the neoclassical growth model of income developed by Solow. Solow (1956) predicts that at some time, the income gap between countries will shrink because low-income countries experience higher growth rates than higher-income countries. According to regional economic growth theory, inequality is a consequence of the development process and will change in line with the development process itself. Each region will attempt to reduce inequality by promoting its regional economy (Barro & Sala-i-Martin, 1995).

Fiscal convergence is an extension of the study of regional income convergence. The Solow growth model states that the growth rate of tax revenue and government expenditure are the same as the rate of revenue growth. This statement underlies the research of Coughlin *et. al.* (2007) which explains income convergence and fiscal convergence and identifies the convergence of tax growth (government revenue), government expenditure and growth of income.

### **2.2. The Theory of the Relationship Among Variables (Keynes's Theory and Wagner's Law)**

This study applies the Theory of Keynes by analyzing the relationship among macro variables, specifically regional income, government expenditure, and government revenue. Keynes's theory asserts that government expenditure will significantly increase national income through the equation  $Y = C + I + G$ , where Y is national income, C is consumption expenditure, I is a private expenditure, and G is government expenditure. This equation shows the relationship between regional income and government expenditure. On the revenue side, taxes can cause changes in regional income. Wagner's Law explains the effect of regional income on government expenditure (also representing government revenue).

### 2.3. Empirical Studies

The sigma convergence of regional income occurred in 28 European Union (EU) countries in 2012 after the previous divergence (Simionescu, 2014) and in the provinces of Vietnam (Vu & Nghiem, 2016). Romania is one of the countries in Europe which is considered the most converging. However, Goschin (2015) and Iancu (2007) identified a long-term divergence in this country. This indicates that there is an imbalance of development between regions in Romania which tends to widen. Similar to economic growth and per capita income, sigma convergence can also arise from government expenditure and government revenue. Government expenditure depends on taxes. Therefore, tax convergence will result in convergence of government expenditure (Sarue et. al., 2007) while taxes in the European Union are found not to be convergent with an increased coefficient of variation (Tibulca, 2014).

Previous studies have independently identified a relationship between regional income, government revenue, and government expenditure. An analysis of the relationship between regional income growth and government expenditure can yield both unidirectional and two-way relationships. For instance, Gabriel (2016) finds that there is no relationship between government expenditure and GDP in Nigeria for the short term. However, in the long term, there is undoubtedly a relationship between the two variables. Likewise, in Jammu and Kashmir, in the long term, there is a relationship between government expenditure and GDP. Nevertheless, in the short term, the relationship between government expenditure and GDP is negative and indirect (Hasan & Mishra, 2016). Interestingly, public spending is not interpreted as infrastructure development to increase a higher standard of living but is defined as regular government expenditure.

A long-term relationship has been identified between government expenditure and government revenue in Nigeria. There is a direct relationship between regional income and government expenditure, to reduce a large fiscal deficit (Dada, 2013). The increase of government expenditure in Ghana in the short-term induces an improvement in government revenue. On the other hand, in the long-term, an increase in government expenditure provokes a decrease in government revenue (Aidam, 2018). The relationship between government revenue and government expenditure in Pakistan shows that government revenue and expenditure have a relationship and are proven to be mutually sustainable in the budgeting process (Raza et. al., 2019). In Pakistan, an indirect relationship between government expenditure and tax revenue was also identified. However, tax revenue responds faster when changes in government expenditure occur (Hussain, 2015). This occurrence is caused by political influence, where this effect is seen from the amount of government expenditure on military and democracy infrastructure.

In the relationship between government expenditure and government revenue, we can analyze how government revenue can further affect regional income. Government expenditure caused by tax revenue in Pakistan, for example, is an expansive fiscal policy when public expenditure exceeds public revenue. This problem forces the government to increase its expenditure to offset the increase in public expenditure. If the expansion policy has been implemented and the budget deficit continues, there is a tax delay which will have an indirect effect on long-term economic growth (Aisha & Khatoon, 2009). In addition, research findings through analysis using the Generalized Moment Method (GMM) have shown that increased government expenditure can play an active role in accelerating the economic growth of low-income countries in Sub-Saharan Africa (Kimaro et. al., 2017).

### 3. Research Methodology

**3.1. Sigma Convergence**

This study employs the coefficient of variation to analyze regional income inequality, expenditure and government revenue through the concept of sigma convergence. The formulation refers to Goschin (2015) as follows:

$$CV_i = \sqrt{\frac{\sum_{i=1}^n (y_i - \bar{y})^2}{n \bar{y}^2}} \dots\dots\dots (1)$$

If  $CV_i < CV_{t-1}$ , it can be perceived that a reduction in inequality has occurred. However, if  $CV_t > CV_{t-1}$ , the decrease in inequality does not occur or in other words the gap continues to widen.

**3.2. Relationship of Regional Income, Government Expenditures, and Government Revenues**

The relationship between the variables of regional income, government expenditure and government revenue applies a regression model of Vector Auto Regression (VAR). The advantage of using VAR, as stated by Gujarati (2004), is that VAR is simpler because there is no need to separate the independent and dependent variables. This advantage is in line with the study objectives where the researcher does not determine the independent variables and the dependent variables between the three variables used. In general, the VAR model (Sims, 1980) can be interpreted as follows:

$$Y_t = \alpha_1 + \beta_{11}Y_{t-1} + \beta_{12}Y_{t-2} + \beta_{13}Y_{t-1} + \beta_{14}Y_{t-2} + \varepsilon_{1t} \dots\dots\dots (2)$$

$$X_t = \alpha_2 + \beta_{21}Y_{t-1} + \beta_{22}Y_{t-2} + \beta_{23}Y_{t-1} + \beta_{24}Y_{t-2} + \varepsilon_{2t} \dots\dots\dots (3)$$

VAR is an econometric model that is based on the relationship among variables that refer to the model and is used to identify the causal relationship between variables.

**4. Results**

**4.1 Sigma Convergence**

Based on the results of the coefficient of variation, this study confirms that there had been a sigma convergence of regional income, government revenue, and expenditure at different times. Regional income and government expenditure were converged in 2012, while government revenue was concentrated relatively faster in 2006.

**4.2 VECM Results**

Based on the stationary test with the ADF unit root test, all variables are not stationary at the level but on the statement of the first difference seen from a probability value smaller than 0.05. Based on the cointegration test, all trace statistic and maximum eigenvalue values are more significant than critical values with a significance level of 1% and 5%. This finding suggests the null hypothesis, which states that there is no rejected cointegration.

Table 1. Johansen Cointegration Result

H0	H1	Trace Statistic	Max-Eigen Statistic
$r=0$	$r>0$	43,8644**	26,88964**
$r\leq 1$	$r>1$	16,9747*	15,7925*
$r\leq 2$	$r>2$	1,182198	1,182198

Therefore, the null hypothesis is rejected. There are two cointegrations between regional income, government expenditure and government revenue which indicate that among the movements the three variables have a stable / balanced relationship and a similar movement in the long term.

Furthermore, according to the cointegration test, all trace statistic and maximum eigenvalue values are more distinguished than critical values with a significance level of 1% and 5%. This finding implies the null hypothesis, which affirms that there is also no rejected cointegration. There are two cointegrations between regional income, government expenditure and government revenue which indicate that among the movements the three variables have a stable / balanced relationship and similar movement in the long term.

Table 2. VECM with 4 lags

Dependent Variables	Independent Variables			
	$\Delta\log$ (regional income)	$\Delta\log$ (government revenue)	$\Delta\log$ (government expenditure)	ECTt-1
$\Delta\log$ (Regional Income)	0,28696	0,16571*	0,06585	-0,843*
$\Delta\log$ (Government Revenue)	-0,51582	-0,01171	0,12421	-0,259
$\Delta\log$ (Government Expenditure)	0,09830	0,32478*	-0,07724	-1,729*

The results of the causality test VECM indicate that in the short term, only government revenue causes regional income and government revenue causes government expenditure, while in the long term, regional income, government revenue, and government expenditure cause regional income. Moreover, regional income, government revenue, and government expenditure causes government expenditure in the long term. The elasticity shows that government revenue has a positive effect on regional income and government expenditure.

## 5. Discussion

The reduction in inequality or convergence of sigma begins at different times. Inequality in government revenue has begun to decline since 2006, whereas a reduction in regional income inequality and government expenditure only occurred in 2012. However, the three variables have a relationship in both the short and long term. In the short term, government revenue has a positive impact on regional income and government expenditure. Government revenues from West Kalimantan, Central Kalimantan and South Kalimantan continue to pursue East Kalimantan so that they can have a positive impact on increasing regional income and government expenditure. The higher government revenue from optimizing potential regional resources,

the more flexible each province in Kalimantan is in using its budget to finance government expenditure. Increasing government revenue will reduce the budget deficit and encourage economic growth.

On the other hand, regional income, government revenue and government expenditure are simultaneously integrated with regional income and government expenditure in the long term. High regional income, government revenue, as well as increased productive expenditure by the government, can be a competent driver for increasing regional revenue and government expenditure in the future. This statement is in line with the policy objectives of fiscal decentralization to improve efficiency in the public sector, reduce budget deficits, and enhance economic growth. An increase in government revenue can cause the provincial government to use its wealth to improve public welfare. A prosperous society will have the ability to pay taxes and become a potential player in the market for both local and imported products as a result of their better purchasing power.

Based on the analysis of sigma convergence, inequality of government revenue decreases faster compared to regional income and government expenditure. The statement may encourage the movement of regional income and an increase in government spending. The government revenues of West Kalimantan, Central Kalimantan and South Kalimantan continue to move upward to balance East Kalimantan so that they can have a positive impact on increasing regional income and government expenditure.

In general, the findings of this study are in line with the findings of research conducted by Aidam (2018) and Raza et. al. (2019) which identifies a relationship between government revenue and government expenditure, both in the short and long term. These findings are also in line with Hasan and Mishra (2016), which identifies a positive relationship between regional income and government expenditure. However, the results of this study are not in line with research conducted by Hussain (2015) which only uses taxes for proxying government revenue, while this study employs total government revenue.

## 6. Conclusion

The findings of this study indicate that there has been a convergence of sigma in regional income, government revenue, and government expenditure that began at different times. The findings also reveal a short-term and long-term relationship between the variables of regional income, government revenue, and government expenditure. In the short term, only changes in government revenue have an impact on regional income, and only changes in government revenue cause changes in government expenditure. In the long term, there is a two-way causal relationship between regional income and government expenditure.

The government applies the Theory of Keynes to restrain expenditure and increase regional income. The government also implements Wagner's Law to show the relationship of regional income which causes an increase in public consumption. This increase causes the government to continue to increase expenditure. Public consumption requires the provision of facilities and infrastructure by the government so that public needs can be achieved in the long term.

## References

- Aidam, P. W. (2018) Dynamics between Government Capital Expenditure and Revenue in Ghana: A Vector Error Correction Model Approach. *International Journal of Academic and Applied Research*, 2 (11). 27-38.
- Aisha, Z., & Khatoun, S. (2009). Government Expenditure and Tax Revenue, Causality and Cointegration: The Experience of Pakistan (1972–2007). *The Pakistan Development Review*, 48(4-II), 951-959. <http://www.pide.org.pk/pdf/PDR/2009/Volume4/951-959.pdf>
- Barro, R. J., & Sala-i-Martin, XX. (1995). *Economic Growth*. McGraw-Hill, New York.
- Coughlin, C. C., Garrett, T. A., & Hernández-Murillo, R. (2007). Spatial dependence in models of state fiscal policy convergence. *Public Finance Review*, 35(3), 361-384. <https://doi.org/10.1177/1091142106295766>

- Dada, M. A. (2013). Composition effects of government expenditure on private consumption and output growth in Nigeria: A single-equation error correction modelling. *Romanian Journal of Fiscal Policy (RJFP)*, 4(2), 18-34. <https://www.econstor.eu/handle/10419/107949>
- Fouquet, R., & Broadberry, S. (2015). Seven centuries of European economic growth and decline. *Journal of Economic Perspectives*, 29(4), 227-44. <https://www.aeaweb.org/articles?id=10.1257/jep.29.4.227>
- Gabriel, M. T., Austin, A., & Llewellyn, D. N. (2016). Macro-economic Variable and Its Behavioural Effect on Government Spending in Nigeria (a) (VECM Analysis). *Oman Chapter of Arabian Journal of Business and Management Review*, 34(3815), 1-7. <https://doi.org/10.12816/0031497>
- Goschin, Z. (2015). Regional divergence in Romania based on a new index of economic and social development. *Procedia Economics and Finance*, 32, 103-110.
- Gujarati, D. N. (2004). *Basic Econometrics*. Fourth edition, Singapore. McGraw-Hill Inc.
- Hassan, S. U., & Mishra, B. Government expenditure and Economic Growth in the State of Jammu and Kashmir: A Unit Root and Co-integration Approach with Error Correction Model. <https://www.icgfm.org/wp-content/uploads/2017/06/1-1.pdf>
- Hussain, M. H. (2004). On the causal relationship between government expenditure and tax revenue in Pakistan. <http://121.52.153.178:8080/xmlui/handle/123456789/5629>
- Iancu, A. (2007). Economic convergence applications. *Romanian Journal of economic forecasting*, 53, 24-48.
- Idenyi, O. S., Ogonna, I. C., Chinyere, U. C., & Chibuzor, C. B. (2016). Public expenditure and economic growth in South Africa: Long run and causality approach. *Asian Journal of Economics, Business and Accounting*, 1-17. <https://doi.org/10.9734/AJEBA/2016/29677>
- Kimaro, E. L., Keong, C. C., & Sea, L. L. (2017). Government expenditure, efficiency and economic growth: a panel analysis of Sub Saharan African lowincome countries. *African Journal of Economic Review*, 5(2), 34-54. <https://www.ajol.info/index.php/ajer/article/view/161690>
- Raza, S. A., Hassan, S. Z., & Sharif, A. (2019). Asymmetric Relationship Between Government Revenues and Expenditures in a Developing Economy: Evidence from a Non-linear Model. *Global Business Review*, 20(5), 1179-1195. <https://journals.sagepub.com/doi/abs/10.1177/0972150919846800>
- Sarue., Tolga, N., Sagbas, I., & Cigerci, I. (2007). The geographical distribution of public expenditures and tax revenues in the Turkish case: A Convergence analysis. *Proceedings. Third International Conference of Business, Management, and Economics*. Cesme, Izmir, Turkey.
- Simionescu, M. (2014). Testing sigma convergence across EU-28. *Economics & Sociology*, 7(1), 48-60. [https://www.economics-sociology.eu/files/09\\_25\\_Simionescu.pdf](https://www.economics-sociology.eu/files/09_25_Simionescu.pdf)
- Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: journal of the Econometric Society*, 1-48.
- Solow, R. M. (1956). A contribution to the theory of economic growth. *The quarterly journal of economics*, 70(1), 65-94.
- Țibulcă, I. L. (2014). Fiscal convergence in the european union in the context of the global financial crisis. *convergence*, 4(2), 152-158. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.677.9958&rep=rep1&type=pdf>
- Vu, X. B., & Nghiem, S. (2016). Analysis of GDP trends and inequalities in Vietnam's provinces and groups of provinces. *Asian Journal of Empirical Research*, 6(7), 167-186. <http://eprints.qut.edu.au/100072/>
- Young, A. T., Higgins, M. J., & Levy, D. (2008). Sigma convergence versus beta convergence: Evidence from US county-level data. *Journal of Money, Credit and Banking*, 40(5), 1083-1093. <https://doi.org/10.1111/j.1538-4616.2008.00148.x>