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The Testing of Existence Wagner's Law in Papua Province

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Abstrak. Hukum Wagner diduga tidak bisa diterapkan secara universal. Masih ada perdebatan mengenai kebenaran hukum ini. Oleh karena itu, tujuan dari penelitian ini adalah untuk mengkaji implementasi Hukum Wagner dalam perekonomian Provinsi Papua. Data yang digunakan adalah PDRB dan Pengeluran pemerintah dalam bentuk logaritma natural (tahun dasar 2000) dari seluruh kota/kabupaten di Provinsi Papua dari tahun 2000 sampai 2013. Sumber data berasal dari Badan Pusat Statistik. Metode yang digunakan dalam penelitian ini adalah Uji Kointegrasi Kao dan Uji Kausalitas Granger. Dua metode ini mampu mengindikasikan kemungkinan adanya pengaruh jangka pendek dan jangka panjang antar variabel ekonomi. Hasil penelitian ini menyimpulkan bahwa ada hubungan yang signifikan antara pengeluaran pemerintah dan PDB. Hasil ini membawa konsekuensi bahwa Hukum Wagner tidak terbukti dalam perekonomian Papua. Hal ini didukung oleh uji kausalitas yang menunjukkan bahwa pengeluaran pemerintah menyebabkan (*granger cause*) terjadinya perubahan GDP riil, tetapi tidak sebaliknya. Meskipun demikian, kedua variabel tersebut kointegrasi

Keywords:
Wagner's Law, Papua, Cointegration, Economy

Abstract. The Law of Wagner is supposedly not universally applicable. There are debates about the truth of this law. Based on this phenomenon, the purpose of this study is to examine the existence of Wagner's Law in the economy of Papua Province. Data used in this research are GRDP (Gross Regional Domestic Product) at the constant price (Real GRDP) and government expenditure at the constant price (Real GOV) in the form of natural logarithms (the base year 2000) from all municipalities in Papua Province from 2000 to 2013. Data source comes from Badan Pusat Statistik-Statistics Indonesia. The method used in this research is The Kao Cointegration Test and The Granger Causality Test. These methods indicate the possibility of short-term and long-term effects across economic variables. The result of this study concludes that there is a significant relationship between government expenditure and Gross Regional Domestic Product (GRDP). This result means that The Wagner's Law is not proven in the Papuan economy. This is supported by a causality test which shows government expenditure is granger cause of the real GDP, but not vice versa. However, the two variables are cointegrating.

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1. Introduction

The relationship between government expenditure and Gross Domestic Product is one of the most topics interesting to observe. Government expenditure affects the GDP in a country. The government plays an important role in the economy. Government expenditure is one of the components of aggregate demand that can increase domestic products. That's why government expenditure affects economic activities.

Adolph Wagner is the first researcher who demonstrates a positive relationship between economic growth and public sector expenditures. In "Grundlegung der politischen Ökonomie", published in 1893, Wagner investigated the law of increasing public expenditures and state activities. The result of this investigation is that the direction of long-term causality between state activities and economic growth has been found from national income to public expenditures by Wagner's Law.

Wagner's Law explains that the direction of causality in a relationship over three reference points. The first one is the function of the government that takes place of the private sector within the industrialization process. The second one for the direction of causality is the change in income elasticity induced by economic growth increase demand for public goods which have socio-cultural character. The last one is an inability to make requiring projects of the public sector aimed to improve the welfare of industrialized societies and the obligation of carrying out these projects with public finance point out the direction of causality among public expenditures and economic growth. Responsibilities and duties are improved in connection with economic growth and economic development in developed countries.

Wagner's Law was used by some previous researchers. Lall [1] used cross-section data for the period 1962-1964 from 46 developing countries. His result is that Wagner's Law did not occur in the economies of those 46 countries [1]. Landau [2] showed a negative relationship between government expenditure and the growth of GDP per capita. Singh and Sahni [3] used the Granger Causality Test to determine the direction of causality between national income and public expenditure in India. Their study results showed that there was no causality between the two variables. Kormendi and Meguire [4], in their study, concluded that there was no relationship between government expenditure and GDP growth rate.

Barro showed that large government expenditure reduces the growth in per capita production [5]. Ansari et al. in their study to determine the direction of causality between government expenditure and national income in three countries, namely Ghana. Kenya and South Africa with the Granger Causality Test. The results of his study indicate that there was no long-term balance between government expenditure and national income in these three countries. Wagner's law only applies to Ghana on a short-term basis [6]. Islam shows that there is cointegration between the relative size of government expenditure and the real GNI per capita [7]. Rafiee and Zibaii used the ARDL model to explore the relationship between the amount of government expenditure and Iran's economic growth, which concluded that the amount of government expenditure has a significant positive effect on the growth of agriculture sector [8].

Based on the findings of previous studies and the author's considerations, the authors use the Peacock-Wiseman specification to test Wagner's Law in the Papua Province economy. This model uses main variables and not derivative variables, such as the share of government expenditure on GDP, GDP per capita, and government expenditure per capita. On the other hand, the province of Papua was chosen with the consideration that much social assistance was disbursed from both the central and regional governments to improve the welfare of the community. The Gross Domestic Product (GDP) per capita of Papua from the period 1996 to 2002 had a downward trend. Meanwhile, from the period 2003 to 2013, GDP per capita of Papua began to increase in growth although moving slowly. Changes in GDP trends indicate that there are determinant factors behind them. It must be

tested with Wagner's Law. This paper aims to examine the existence of Wagner's Law in the economy of Papua Province.

2. Method

Data used in this research are GRDP (Gross Regional Domestic Product) at the constant price (Real GRDP) and government expenditure at the constant price (Real GOV) in the form of natural logarithms (the base year 2000) from all municipalities in Papua Province from 2000 to 2013 (panel data). Data source comes from Badan Pusat Statistik-Statistics Indonesia.

The stages of the procedure in this study are:

a. Determination of the optimum lag applied to unit root, cointegration, and causality tests with the Schwarz Information Criterion.
b. Stationarity check of Real GRDP and Real GOV by detecting the presence of unit root as a prerequisite for cointegration test. If the two data series are integrated in the same order (non-zero order integration), further analysis can be applied (cointegration test and causality test can be applied). However, if the two data series are not integrated in the same order, further analysis cannot be applied (cointegration test and causality test cannot be applied) and the analysis only uses ordinary regression (the implication is that it does not conclude that Wagner's Law exists or does not exist).
c. Cointegration test between Real GRDP and Real GOV. If there is cointegration between Real GRDP and Real GOV, then the two variables have a long-term relationship so that this can be continued to the causality testing stage. However, if there is no cointegration, there is no long-term relationship and cannot proceed to the causality test (the implication is that there is no conclusion that Wagner's Law exists or does not exist).
d. Conducting a causality test with the Toda-Yamamoto procedure. Based on the results of causality testing, if Real GRDP causes Real GOV then Wagner's Law exists. However, if Real GOV causes Real GRDP then Wagner's Law doesn't exist.
e. Draw conclusions based on points (2), (3), (4), and (5).

2.1. Lag criteria

Determination of the lag time for unit root testing, cointegration, and causality in the study using the Schwarz Information Criterion (SIC). The formulation of the SIC is as follows:

$$SIC = -2(l/O) + k\,log(O)/O \tag{1}$$

where: l is the log-likelihood function of a model, k is the number of estimated parameters, and O is the number of data observations (for balanced panel data, $O = NT$ where T: time index and N: number of cross-section).

2.2. Unit Root Test

The Hadri Test for unit root testing on panel data is similar to the KPSS test [9]. It tests the null hypothesis that there is no unit root on panel data. The Hadri Test is based on the residuals of the individual OLS regressions of y_{it} (LGRDP_Real and LGov_Real) over a constant or on constants and trends. For example, if we enter constants and trends, we can derive the estimate from:

$$y_{it} = \delta_i + \eta_i t + \varepsilon_{it}, i = 1, \dots, N, t = 1, \dots, T \tag{2}$$

Where y_{it} is the interested variable, δ_i is intercept i-th, η_i is coefficient i-th. Estimating the residual ($\hat{\varepsilon}$) from individual regression, we find the LM statistic, namely:

$$LM_1 = \frac{1}{N}\left(\sum_{i=1}^{N}\left(\sum_{T} S_i(t)^2/T^2\right)/\hat{f}_0\right) \quad (3)$$

where $S_i(t)$ is the cumulative summation of the residuals.

$$S_i(t) = \sum_{S=1}^{t} \hat{\varepsilon}_{it} \quad (4)$$

$\hat{f}_0$ is the average of the individual estimators of the residual spectrum at zero frequency:

$$\hat{f}_0 = \sum_{i=1}^{N} f_{i0}\,/N \quad (5)$$

An alternative form of LM statistic accommodating for heteroscedastic:

$$LM_2 = \frac{1}{N}\left(\sum_{i=1}^{N}\left(\sum_{T} S_i(t)^2/T^2\right)/\hat{f}_{i0}\right) \quad (6)$$

Hadri pointed out that [9]:

$$z = \frac{\sqrt{N}(LM_2 - \xi)}{\xi} \rightarrow N(0,1) \quad (7)$$

2.3. Kao's Cointegration Test

The Kao Test [10] follows the same basic approach as the Pedroni Test [11], but the cross-section specifics at the intercept and the coefficient are homogeneous for the first stage regressor.

For example for two variables

$$y_{it} = \alpha_{it} + \beta x_{it} + e_{it} \quad (8)$$

where:

$$y_{it} = y_{it-1} + u_{it} \quad (9)$$
$$x_{it} = x_{it-1} + \epsilon_{it} \quad (10)$$

For *t = 1,..., T; i = 1,...., N*. α_{it} is the heterogeneous intercept, β is the homogeneous coefficient for the cross-section, $e_{it}, \epsilon_{it}, u_{it}$ are error terms, and all trend coefficients are assumed to be absent. Kao then runs a pooled regression, namely:
$e_{it} = \rho e_{it-1} + v_{it}$ or another version, that is

$$e_{it} = \bar{\rho} e_{it-1} + \sum_{j=1}^{p} \psi \Delta e_{it-j} + v_{it} \quad (11)$$

Under the null hypothesis: no cointegration occurs, Kao shows the following statistics [10]:

$$DF_\rho = \frac{T\sqrt{N}(\hat{\rho} - 1) + 3\sqrt{N}}{\sqrt{10.2}} \quad (12)$$

$$DF_t = \sqrt{10.2}t_\rho + \sqrt{1.875N} \tag{13}$$

$$DF_\rho^* = \frac{T\sqrt{N}(\hat{\rho}-1) + 3\,\hat{\sigma}_v^2/\hat{\sigma}_{0v}^2\sqrt{N}}{\sqrt{3 + 36\,\hat{\sigma}_v^4/(5\hat{\sigma}_{0v}^4)}} \tag{14}$$

$$DF_t^* = \frac{t_\rho + \sqrt{6N}/2\hat{\sigma}_{0v}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}} \tag{15}$$

For $p > 0$, then

$$ADF = \frac{t_\rho + \sqrt{6N}/2\hat{\sigma}_{0v}}{\sqrt{\frac{\hat{\sigma}_{0v}^2}{2\hat{\sigma}_v^2} + \frac{3\hat{\sigma}_v^2}{10\hat{\sigma}_{0v}^2}}} \tag{16}$$

Converts asymptotically towards $N(0,1)$, where the estimated variance is $\hat{\sigma}_v^2 = \hat{\sigma}_u^2 - \hat{\sigma}_{u\epsilon}^2\hat{\sigma}_\epsilon^2$, and the long run variance estimate is $\hat{\sigma}_{0v}^2 = \hat{\sigma}_{0u}^2 - \hat{\sigma}_{0u\epsilon}^2\hat{\sigma}_{0\epsilon}^2$

Covariance of $w_{it} = \begin{bmatrix} u_{it} \\ \epsilon_{it} \end{bmatrix}$ estimated as follows:

$$\hat{\Sigma} = \begin{bmatrix} \hat{\sigma}_u^2 & \hat{\sigma}_{u\epsilon} \\ \hat{\sigma}_{u\epsilon} & \hat{\sigma}_\epsilon^2 \end{bmatrix} = \frac{1}{NT}\sum_{i=1}^{N}\sum_{t=1}^{T}\widehat{w}_{it}\widehat{w}_{it}' \tag{17}$$

The long run covariance is estimated with the kernel estimator, namely:

$$\widehat{\Omega} = \begin{bmatrix} \hat{\sigma}_{0u}^2 & \hat{\sigma}_{0u\epsilon} \\ \hat{\sigma}_{0u\epsilon} & \hat{\sigma}_{0\epsilon}^2 \end{bmatrix}$$

$$= \frac{1}{N}\sum_{i=1}^{N}\left[\frac{1}{T}\sum_{t=1}^{T}\widehat{w}_{it}\widehat{w}_{it}' + \frac{1}{T}\sum_{\tau=1}^{\infty}\kappa(\tau/b)\sum_{t=\tau+1}^{T}\widehat{w}_{it}\widehat{w}_{it-\tau}' + \widehat{w}_{it-\tau}\widehat{w}_{it}'\right] \tag{18}$$

where $\kappa(.)$is the kernel function and b is the bandwidth.

2.4. Granger Causality Test with Toda-Yamamoto Procedure

The VAR (p) of the panel data:

$$Y_{i,t} = a_0 + a_{1,i}Y_{i,t-1} + a_{2,i}Y_{i,t-2} + \cdots + a_{p,i}Y_{i,t-p} + b_{1,i}X_{i,t-1} + b_{2,i}X_{i,t-2} + \cdots + b_{p,i}X_{i,t-p} + u_{i,t} \tag{19}$$

$$X_{i,t} = c_0 + c_{1,i}Y_{i,t-1} + c_{2,i}Y_{i,t-2} + \cdots + c_{p,i}Y_{i,t-p} + d_{1,i}X_{i,t-1} + d_{2,i}X_{i,t-2} + \cdots + d_{p,i}X_{i,t-p} + v_{i,t} \tag{20}$$

Then we test it with:

$H_0: b_1 = b_2 = \cdots = b_p = 0$ versus $H_1: not\ all\ b_i = 0$

and

$H_0: d_1 = d_2 = \cdots = d_p = 0$ versus $H_1: not\ all\ d_i = 0$

Toda-Yamamoto procedures [12]**:**

1. Checking the root unit on the time series data.
2. Find the maximum integration order (m) in the time series data group. If there are two data series, one series integrates into I(1) and the other into I(2). Then, the maximum order of integration is $m = 2$, and so on.
3. Create a VAR(p) model based on level data.
4. Determine the optimum lag on VAR, namely p, with the information criterion with SIC.
5. Make a VAR $(p + m)$ model based on the level data.

Perform the granger test as usual by producing the Wald Test statistics which is asymptotically distributed as chi-squared with degrees of freedom p.

3. Result and Discusions

3.1. Unit Root

Table 1. Unit Root Hadri Test Results (constants and trends) on Panel Data

Method	LGRDP_real		LGOV_real	
	Level	1st Difference	Level	1st Difference
Hadri Z-stat	10.256	8.926	2.558	6.992
	p-value: 0.000	p-value: 0.000	p-value: 0.000	p-value: 0.000
Heteroscedastic Consistent Z-stat	10.312	13.845	2.558	6.992
	p-value: 0.000	p-value: 0.000	p-value: 0.0000	p-value: 0.000

Note: LGRDP_real is the natural logarithm of real GRDP

LGOV_real is the natural logarithm of Municipality/Regency Government Real Expenditure

Based on the results of Hadri's Test on the unit root on panel data with a significance level of five percent, it shows that the LPDRB_real and LGOV_real series are stationary integrated in the same order, namely I(1). It means that these two variables can be analyzed for cointegration and causality testing

3.2 Cointegration Test

Based on the results of the Kao Cointegration Test, the ADF value was -4.480 with a p-value of 0.00. So, it can be concluded that there is cointegration between real GRDP and real expenditure of the municipality government at the five percent significance level.

Table 2. Kao Cointegration Test Results

ADF	**Residual variance**	**HAC Variance**
t-statistic: -4.480 p-value : 0.000	0.012	0.0189

3.3 Causality Test

Before the causality test, SIC is used to determine the lag so that the optimum lag for the test is 8, then the order of integration between LGRDP_Real and LGOV_Real (I(1)) is 1, so the lag used in Granger causality testing with the Toda Yamamoto procedure is 9. Based on Wagner's law, the direction of causality must be from regional output to local

government expenditure. But if we look at the results of the Granger causality test in Table 3 with the Toda Yamamoto procedure, it turns out that at the five percent significance level, it shows that real government expenditure causes real GRDP. Based on these results, Wagner's Law is not proven in the case of the economy of Papua Province. It means that Wagner's Law does not apply universally to economic activity for all regions/countries.

Table 3. Granger Causality Test Results

Hypothesis Null	Chi-squared Statistic	Degree of Freedom	p-value
LGRDP_Real does not granger cause LGOV_Real	8.821	9	0.454
LGOV_Real does not granger cause LGRDP_Real	22.017	9	0.009

This results are consistence with Lall [1], Landau [2], and Kormendi and Meguire [4]. The cause of the absence of Wagner's law through the specification of the model used is that the contribution of household consumption expenditure is more than 50% to GRDP, compared to government expenditure, which has a little share. So that, GRDP and regional economic growth are still dominantly supported by household consumption.

4. Conclusion

Based on the results of the discussion in the previous chapter, Wagner's Law does not exist in the economic mechanism of Papua Province. It is indicated from government expenditure granger causes GRDP, and not vice versa. Even though there is cointegration between government expenditure and GRDP, it can be explained because Wagner's Law is not universal for all countries/regions. The cause of the absence of Wagner's law through the specification of the model used is that the contribution of household consumption expenditure is more than 50% to GRDP, compared to government expenditure, which has a little share. So that, GRDP and regional economic growth are still dominantly supported by household consumption.

For further research, model specifications beside Peacock-Wiseman can be used to test Wagner's Law and in terms of analytical tools, you can use non-parametric cointegration tests, so that a broader spectrum of conclusions can be obtained.

For stakeholders in Papua, government expenditure can increase economic growth and people's welfare. If government expenditure is used on a basic economic sector, that is under regional potential and more equitable development of community infrastructure, as well as tighter supervision of budget, use to prevent corruption.

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