# การบูรณาการระหว่าง ผลิตภัณฑ์มวลรวมของประเทศ ความร่วมมือเพื่อการพัฒนา การลงทุนโดยตรงจากต่างประเทศ และการส่งออก: หลักฐานเชิงประจักษ์จาก สาธารณรัฐประชาธิปไตยประชาชน ลาว

# COINTEGRATION BETWEEN GDP, ODA, FDI AND EXPORTS: EVIDENCE OF LAO PDR.

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## บทคัดย่อ

วัตถุประสงค์ของการศึกษาครั้งนี้ เพื่อทดสอบรูปแบบการเชื่อมโยงระยะสั้นและระยะยาวระหว่างผลิตภัณฑ์มวลรวมภายในประเทศที่แท้จริง (Ca) ความช่วยเหลือในการพัฒนาอย่างเป็นทางการจากประเทศ DAC ไปยัง สปป.ลาว (ODA) โดยพิจารณาจาก การลงทุนโดยตรงจากต่างประเทศ (FDI) และการส่งออก นักวิจัยใช้เทคนิคการวิเคราะห์ข้อมูลอนุกรมเวลาตั้งแต่ พ.ศ. 2531 ถึง พ.ศ. 2562 เก็บตัวอย่าง 32 รายการจากธนาคารแห่ง สปป. ลาวและองค์การเพื่อความร่วมมือทางเศรษฐกิจและการพัฒนา (OECD) ร่วมกับการใช้เทคนิค แบบจำลองการแก้ไขข้อผิดพลาดของเวกเตอร์ ซึ่ง Ca เป็นสมการตัวแปรเป้าหมาย เนื่องจากสาเหตุระหว่าง ODA ยังคงเป็นปัญหาที่ถกเถียงกันอยู่ นอกจากนี้ นักวิจัยบางท่านแนะนำว่า ODA, FDI และ Ex จะมีผลกระทบต่อ GDP ในขณะที่บางท่านก็แนะนำว่า GDP ดึงดูด ODA, FDI และ Ex ดังนั้น การวิเคราะห์ในกรณีศึกษาของ สปป. ลาว มีเพื่อทดสอบความชัดเจนในการวิเคราะห์การรวมตัวระหว่างตัวบ่งชี้เหล่านั้น

ผลการวิเคราะห์เชิงประจักษ์ระบุว่าตัวแปรที่เสนอมีสาเหตุระยะยาวทั้งทางบวกและทางลบ ซึ่ง ODA และ FDI มีความสัมพันธ์เชิงบวก แสดงให้เห็นว่าหากปัจจัยดังกล่าวเพิ่มการไหลเข้าของ ODA และ FDI ก็จะทำให้ GDP ที่แท้จริงเพิ่มขึ้น ต่อหัว ในขณะที่ Ex มีความสัมพันธ์เชิงลบชี้ให้เห็นว่าการส่งออกที่เพิ่มขึ้นจะทำให้ GDP ต่อหัวที่แท้จริงลดลง ซึ่งขัดกับทฤษฎีทางเศรษฐศาสตร์ ผลที่เกิดขึ้นอาจจะเกิดจากจำนวนกลุ่มตัวอย่างที่ใช้ในการศึกษามีน้อยหรือการกระจายรายได้ไม่เท่าเทียมกัน ในแง่ของระยะสั้น ผลการวิจัยยังพบว่าไม่มีความสัมพันธ์เชิงสาเหตุแบบสองทิศทาง แต่มีความสัมพันธ์เชิงสาเหตุแบบทิศทางเดียวที่เรียกใช้จาก FDI ถึง Ca สาเหตุที่ทำงานจาก ODA และ Ex ถึง FDI และจาก ODA ไปยัง Ex ดังนั้นผู้กำหนดนโยบายควรส่งเสริมและดึงดูด FDI และ ODA ให้มากขึ้น เพื่อกระตุ้นการส่งออกและการเติบโตทางเศรษฐกิจ

**คำสำคัญ**: ผลิตภัณฑ์มวลรวมของประเทศ ความร่วมมือเพื่อการพัฒนา การลงทุนโดยตรงจากต่างประเทศ การส่งออก แบบจำลองการแก้ไขข้อผิดพลาดของเวกเตอร์

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## ABSTRACT

The objective of this study is to test the short-term and long-term links model between real gross domestic product (Ca), official development assistance from DAC countries to Laos (ODA), foreign direct investment (FDI) and exports (Ex). The researchers used time series data starting 1988 to 2019 (32 observations or samples) from the Bank of Lao PDR and Organization for Economic Co-operation and Development (OECD). This paper, we analyzed by using the Vector Error Correction Model (VECM) which Ca is the target variable equation because the causality between ODA still a controversial problem. Furthermore, some researchers suggest that ODA, FDI and Ex have the impact on GDP or GDP per capita, but some also suggests that GDP attract ODA, FDI and Ex. Thus, making the case of Lao PDR more clearly motivated me to analyze the cointegration between those indicators.

The results of empirical analysis indicated that there is a long-term causality among the proposed variables which also have a positive and negative causality which ODA and FDI have positive relationship, suggests that if they increase in ODA and FDI inflows it causes increase in real GDP per capita. While as the Ex has a negative relationship suggest that an increase in Exports will cause decrease in real GDP per capita which against economics theories, this may cause from the number of samples used in the study was small or inequality of income distribution. In terms of short-run, we also found that there is no bidirectional causal relationship but have unidirectional causal relationship that run from FDI to Ca, causal running from ODA and Ex to FDI and from ODA to Ex. Therefore, policymakers should promote and attract more FDI and ODA to stimulate the exports and economic growth.



**Keywords:** GDP, ODA, FDI, Exports and VECM

**Article history:**

**Received 12 April 2021** **Revised 20 June 2021**

**Accepted 23 June 2021** **SIMILARITY INDEX = 0.00 %**

## 1. Introduction

Although Laos is the only country in Southeast Asia that has no sea access (land-locked country) but more decades ago its economic development growth rapidly with an average of 7% a year and real GDP per capita increased from $441 in 1986 to $ 1,841 in 2019 due to the policy of opening the country to attract foreign investment especially the one stop service policy. Despite the continued economic growth, developed countries continue to provide assistance to Lao PDR in the form of loans or grants due to most of people remain live below the poverty line of $1.9 per day especially the population who live in remote areas. However, the world bank report (2020) is projected that Lao economic growth range between negative 1.8% and 1% due to the impact of the COVID-19 pandemic.

Since opened the country in 1986, the net ODA received per capita of Laos have been continuously increasing from $10.69 in 1986 to $88.08 in 2019 shows that the assistance inflows to local countries increasingly which in 2019 the Development Assistance Committee (DAC) countries disbursed of $329.25 million to Laos, decreased from previous year by 10.84%. At the same time FDI also increase too, in 2019 the net inflows for Laos were around $755 million which decreased from the last year by 55.37%. Currently, China become the biggest investor and China invested in Laos around $1.07 billion in 2019. However, world investment report (2020) expected FDI inflows to Laos will dropped considerably in 2020 due to the COVID-19 pandemic. In 2019, the exports of goods, services and primary income was around $7,079 million, export to Thailand around $2,422 million and exports to China around $2,037 million.

Those reasons motivated the researchers to study the cointegration between real GDP per capita (Ca), foreign direct investment (FDI) and exports (Ex) to specify clearly about the factors cause economic or real GDP per capita of local people increasing because there are many researchers suggests that ODA support economic development (Minoiu & Reddy, 2010) but some researchers indicated that there is a significant relationship between ODA and economic growth (Gounder,2003 and Levine, & Roodman, 2004). In terms of FDI and Growth, theoretical framework shows that FDI has a positive impact on economic growth as new technology transferred (Sokang, 2018, Tamar Baiashvili and Luca Gattini, 2019). Otherwise, Iamsiraroj and Doucouliagos (2015) expressed that growth is slightly more correlated with FDI in developing countries. In addition, Grossman & Helpman (1991) also suggest that the openness trade has a positive impact on economic growth. But Harrison & Hanson (1999) pointed out that trade openness is no significant effect on economic growth.

The researchers interested in examining the relationship between these variables by using the vector error correction model (VECM) to imply with the case of Lao PDR because this model can explain the long-term and short-term effects or causality. Otherwise, it could express the bi-directional and unidirectional relationship which the outcome will give some important guidelines for policymakers and readers.

**Objective of the Study**

The main objective of this paper, to test the short-term and long-term links model between real gross domestic product, official development assistance from DAC countries to Laos, foreign direct investment and exports

## 2. Literature Review

According to literature reviews see that the relationship between foreign aid and economic growth, no unanimous conclusions could be reached. Sandrina (2005) has studied the impact of foreign aid on economic growth by using GMM estimator and he found that foreign aid has positive impact on economic growth which the short-run has less effects than the long-run which an increase in the ODA per GDP ratio of 1% leads to a per capita growth rate increase of 0.16% and the impact on per capita growth of 1% increase in the ODA per GDP ratio oscillates between 0.34% and 0.43%. Edmore, & Nicholas (2019) used panel data to test the causality between foreign aid, poverty and economic growth in developing countries and found that in the short run, there is a bidirectional causal relationship between economic growth and poverty and there is a unidirectional causal relationship from economic growth to foreign aid and from poverty to foreign aid. For long-run both economic growth and poverty jointly Granger cause foreign aid. Kawthar, and Karim, (2017) used the VECM testing a linking aid to economic growth and he indicated that there is the short-run and long-run causality between ODA and economic growth meaning that that the foreign aid promotes growth through government consumption in the short term but aid has negative impact on economic growth in long-term. In short-run estimation, the coefficient associated with the aid variable is positive and significant (0.053) in the regression at the 5% level. For long-run, an increase of 1% of ODA contributes to a decrease of 0.18% of GDP. In addition, Geetilaxmi, et al (2016) also used VECM testing the causality between foreign aid, trade and economic growth and found that there is the short-run and long-run unidirectional causality running from foreign aid, government expenditure and trade openness to economic growth of India which the India economic growth mostly explained by foreign aid.

Chakanyuka, Mashoko (2016) indicated that no evidence of a relationship between ODA and FDI in Zimbabwe and there is neither correlation nor causality between these flows. In light of these findings, Zimbabwe should make deliberate actions to create the necessary domestic and international conditions that facilitate foreign direct investment. Sahraoui, et al (2015) used VECM to analyze the causality between FDI and GDP, the outcome shown that there is unidirectional causality from FDI to GDP, which could be a good tool to prioritize the allocation of resources across sectors to promote foreign direct investment. Zuzana, (2014) indicated that there is a long-term causal links between FDI, economic growth and exports which FDI and exports has positive impact on economic growth. Song, and Zhang (2017) tested

causality between foreign direct investment and economic growth for Cambodia by using VECM and the results indicated that there is the causal impact of FDI on economic growth of Cambodia but it does not confirm causality to run from GDP to FDI. In addition, Andreas, and Anastasios. (2011) also used VECM testing the causality GDP per capita and FDI in Greece and the outcome indicated that economic growth as measured by GDP per capita Granger-causes the FDI, meaning that there is a unidirectional causality running from GDP to FDI. But there is no evidence that the causality link between FDI and GDP is bi-directional, during the tested period 1970 - 2009.

## 3. Research Methodology

Cointegration analysis helps to identify long-run economic relationships between two or several variables and to avoid the risk of spurious regression. However, cointegration is leaving aside the possibility of the short-term fluctuations between the two examined variables, if two non-stationary variables are cointegrated, a Vector Autoregression (VAR) model in the first difference is mis-specified due to the effect of a common trend. If a cointegration relationship is identified, the model should include residuals from the vectors that lagged one period in the dynamic Vector Error Correction Model (VECM). VECM is adequate tool to analyze short-term deviations, necessary to achieve long-term balance between the two variables (Cipra, T. & Tlusty 2008) Therefore, it attracted the researchers try to use for the evidence of Lao PDR.

This paper, the researchers used the time series starting 1988 to 2019 from the Bank of Lao PDR and Organization for Economic Co-operation and Development (OECD), equal to 32 observations and used the Vector Error Correction Model which developed by Engle and Granger (1987) and Johansen (1988) to construct the causality between Ca, ODA, FDI and Ex which can be developed in equation as following:

$$\Delta logCa_t = \gamma + \sum_{i=1}^{k-1} \alpha_i \, \Delta logCa_{t-i} + \sum_{j=1}^{k-1} \beta_i \, \Delta logODA_{t-j} + \sum_{m=1}^{k-1} \theta_m \, \Delta logFDI_{t-m} + \sum_{n=1}^{k-1} \vartheta_n \Delta logEx_{t-n} + \lambda_1 ECT_{t-1} + \varepsilon_{1t} \quad (1)$$

$$\Delta logODA_t = \varphi + \sum_{i=1}^{k-1} \alpha_i \, \Delta logCa_{t-i} + \sum_{j=1}^{k-1} \beta_i \, \Delta logODA_{t-j} + \sum_{m=1}^{k-1} \theta_m \, \Delta logFDI_{t-m} + \sum_{n=1}^{k-1} \vartheta_n \Delta logEx_{t-n} + \lambda_2 ECT_{t-1} + \varepsilon_{2t} \quad (2)$$

$$\Delta logFDI_t = \omega + \sum_{i=1}^{k-1} \alpha_i \, \Delta logCa_{t-i} + \sum_{j=1}^{k-1} \beta_i \, \Delta logODA_{t-j} + \sum_{m=1}^{k-1} \theta_m \, \Delta logFDI_{t-m} + \sum_{n=1}^{k-1} \vartheta_n \Delta logEx_{t-n} + \lambda_3 ECT_{t-1} + \varepsilon_{3t} \quad (3)$$

$$\Delta logEx_t = \delta + \sum_{i=1}^{k-1} \alpha_i \, \Delta logCa_{t-i} + \sum_{j=1}^{k-1} \beta_i \, \Delta logODA_{t-j} + \sum_{m=1}^{k-1} \theta_m \, \Delta logFDI_{t-m} + \sum_{n=1}^{k-1} \vartheta_n \Delta logEx_{t-n} + \lambda_4 ECT_{t-1} + \varepsilon_{3t} \quad (4)$$

Where $logCa_t$: the nature log of real GDP per Capita (dollars) of Laotian in year t
$logODA_t$: the nature log of official development assistance (million dollars) from DAC countries at t period
$logFDI_t$: the nature log of net foreign direct investment inflows (million dollars) to Laos at t period
$logEx_t$: the nature log of the exports of goods, services and primary income (million dollars) at t period
$\gamma, \varphi, \omega, \delta$: the constants of the equation
$k-1$: the lag length reduced by 1
$\alpha_i, \beta_i, \theta_m, \vartheta_n$: short-run coefficients of the model's adjustment long-run equilibrium
$\lambda_i$: Speed of adjustment parameters with a negative sign
$ECT_{t-1}$: the error correction term is the lagged value of the residual obtained from the cointegrating regression of the dependent variable on the regressors which contains long-run information derived from the long-run cointegrating relationship.
$\varepsilon_{it}$: error terms

The cointegrating equation or long-run model written as:

$$ECT_{t-1} = [y_{t-1} - \tau_i X_{t-1} - \sigma_m R_{t-1}] \quad (5)$$

$y_{t-1}$: lag target variable in this means the first lag of $logCa_t$
$\tau_i$: the coefficients of short-term modification
$X_{t-1}$: the lag of short-run variables
$\sigma_m R_{t-1}$: the coefficients of long-run equation

And the target Variable Equation written as:

$$\Delta logCa_t = \gamma + \sum_{i=1}^{k-1} \alpha_i \, \Delta logCa_{t-i} + \sum_{n=1}^{k-1} \tau_i \Delta logX_{t-i} + \sum_{m=1}^{k-1} \sigma_m \Delta logR_{t-m} \, \lambda_1 ECT_{t-1} + \varepsilon_{1t} \quad (6)$$

### 1.1 Unit Root Tests

The augment Dickey Fuller test (Dickey, & Fuller, 1979) is used testing the stationary of time series data due to the conditional of VECM analysis have to stationary at first order and written as:

- For none intercept and trend: $\Delta y_t = \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (7)
- For Intercept: $\Delta y_t = \alpha + \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (8)
- For Intercept and Trend: $\Delta y_t = \alpha + \beta t + \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (9)

Where, $y_t$: the series at t period, $t-$i: the lag length reduced by 1,
$\alpha, \beta, \theta, \emptyset$: the coefficients, $t$: trend, $u_i$: error term

### 1.2 Cointegration Test

The Johansen cointegration test (Johansen,1988) to determine the short-run and long-run relationships between the variables.

$$Y_t = \alpha_1 Y_{t-1} + \cdots + \alpha_p Y_{t-p} + \beta X_t + \varepsilon_t \quad (10)$$

Where $Y_t$ : vector of endogenous variables.

$\alpha_p$ are the autoregressive matrices

$X_t$is the deterministic vector

$\beta$ are the parameter matrices

$p$ is the lag order

$\varepsilon_t$ : vector of innovation

Hypothesis: $H_0$: There is no cointegration means that construct only the short-run causality.

$H_1$: There is cointegration, construct both short-run and long-run causality.

If the result rejects null hypothesis, the model should include residuals from the vectors mean that it has long-run causality and we should run Vector Error Correcting Model (VECM).

### 1.3 Granger Causality Test

To indicate the direction of causality among the variables of models Granger Causality Test must be done (Engle & Granger, 1987). Granger causality really implies a correlation between the current value of one variable and the past values of others, it does not mean changes in one variable cause changes in another. By using a F-test to jointly test for the significance of the lags on the explanatory variables. It is performed by the following model:

$$Y_t = \beta + \sum_{j=1}^{n} \theta_i X_{t-1} + \sum_{j=1}^{m} \gamma_j Y_{t-j} + e_t \quad (11)$$

Where $\beta$ :constant coefficient

$\gamma_j$ : the coefficient of lag variable

$\theta_i$ : the coefficient of instrument variable.

$Y_t$: the dependent variable

t-j: the lag length reduced by 1

Hypothesis: $H_0$: $\theta_i = 0$ there is short run causality from X to Y

$H_1$: $\theta_i \neq 0$ there is not short run causality from X to Y

### 1.4 Lagrange Multiplier Test

Lagrange Multiplier Test (LM test) is conducted to check the auto correlation (Johansen, 1995) and formula as:

$$\Delta y_t = \alpha \hat{E}_t + \sum_{i=1}^{p-1} \tau_i \Delta y_{t-i} + \epsilon_t \quad (12)$$

Where $\tau_i$ : the coefficients

$p-1$: a VAR lags where the endogenous variables have been first-differenced

$\hat{E}_t$ : augmented with the exogenous variables

Hypothesis: $H_0$: there is no auto correlation at lags order

$H_1$: there is auto correlation at lags order

### 1.5 Jarque-Bera Test

The Jarque-Bera test (Jarque, & Bera, 1987) is used for testing the autocorrelation of the model and can be defined as:

$$JB = \frac{n}{6}(S^2 + \frac{1}{4}(K-3)^2) \quad (13)$$

Where n is the number of observations, S is the sample of Skewness and K is the sample of Kurtosis.

$$K = \frac{1}{N}\sum_{i=1}^{N}(\frac{y_i - \bar{y}}{\hat{\sigma}})^4 \quad (14)$$

$\hat{\sigma}$: the biased estimator for the variance

Hypothesis: $H_0$: Residual are normally distributed or P-value > 0.05

$H_1$: Residual are not normally distributed or P-value < 0.05

## 4. Research Results

Based on the basic conditional of VECM, the series must be stationary. The first part of the table 1 below show the value of tested non-stationary and the second part of the table express the stationary of time series data at the 1st differences of the statistically 5% level.

**Table 1:** Unit Root Test Results

| | Before Differences | After First Differences |
|---|---|---|
| Variables | ADF Statistic | ADF Statistic |
| $\boldsymbol{logCa_t}$ | 1.132 (0.9955) | -4.836 (0.0000) |
| $\boldsymbol{logODA_t}$ | -1.653 (0.8352) | -3.246 (0.0175) |
| $\boldsymbol{logFDI_t}$ | -1.726 (0.4177) | -5.239 (0.0000) |
| $\boldsymbol{logEx_t}$ | -0.767 (0.8286) | -5.822 (0.0000) |

Note: the value in parentheses is MacKinnon approximate p-value

From table 1 above we found that the variables non-stationary at level, I(0) and after converted with first differences and lags (1), the null hypothesis ($H_0$) for the existence of a unit root in the variables is rejected meaning that we can imply it for the next testing.

For cointegration test by Johansen (1988) method indicated we used the maximum lags (3) and the result illustrated that the trace statistic at the 2nd rank equal to 2.3824 is less than the 5% critical value (3.76) meaning that we cannot reject null hypothesis that there is no cointegration and confirm that this model there are two cointegrated equation or real GDP, remittance and FDI has long-run association ship, then the VECM was applied for testing the causality of those variables. For the selection order criteria denoted that lag (3) is an appropriate lag order because the FPE, AIC and SBIC value is lower than other levels. The empirical results for model (1) written as.

**Table 2:** The Results of Short-run and Long-run Granger Causality Analysis by the Way of Ca is Dependent Variable.

| Dependent Variables | Independent Variables | Coefficients | Std. Err | P-value |
|---|---|---|---|---|
| $\Delta logCa_t$ | Cons | 0.0002 | 0.0019 | 0.921 |
| | $\Delta logCa_{t-1}$ | -0.4702 | 0.1949 | 0.016** |
| | $\Delta logCa_{t-2}$ | 0.0149 | 0.1234 | 0.903 |
| | $\Delta logODA_{t-1}$ | 0.00003 | 0.0001 | 0.564 |
| Short-run | $\Delta logODA_{t-2}$ | 0.000001 | 0.00004 | 0.972 |
| | $\Delta logFDI_{t-1}$ | 0.0105 | 0.0046 | 0.024** |
| | $\Delta logFDI_{t-2}$ | 0.0029 | 0.0031 | 0.341 |
| | $\Delta logEx_{t-1}$ | -0.0408 | 0.0258 | 0.114 |
| | $\Delta logEx_{t-2}$ | -0.0141 | 0.0147 | 0.338 |
| Long-run | $ECT_{t-1}$ | -0.0709 | 0.0345 | 0.040** |
| Observations | 28 | | | |
| AIC | 6.4726 | | | |
| HQIC | 7.098067 | | | |
| SBIC | 8.5185 | | | |
| Log-likelihood | -47.6166 | | | |
| Det(Sigma_ml) | 0.0003 | | | |

Note: *,**,*** the statistically significant at 1%,5% and 10% level respectively

From the table 2 or model (1) above found that in long-term when $\Delta logCa_t$ is used by the way of dependent variable illustrated the error correction or the coefficient of lagged ECT is negative sign and statistically significant at 5% level meaning that real GDP per capita (Ca) has a coverage tendency to its long-term equilibrium in response to changes in its regressors, but one can see there is a comparatively high speed (7.09%) of changes to the long-term equilibrium, this results expressed that there is a long-run Granger causality running from ODA, FDI and Ex to Ca and consistent with an empirical of Sahraui, (2015), Zuzana, (2014). In short-run, the causality link between ODA and Ca is not found.

**Table 3:** The Results of Short-run and Long-run Granger Causality Analysis by the Way of ODA is Dependent Variable

| Dependent Variables | Independent Variables | Coefficients | Std. Err | P-value |
|---|---|---|---|---|
| $\Delta logODA_t$ | Cons | 0.0114 | 8.2221 | 0.999 |
| | $\Delta logCa_{t-1}$ | 333.5316 | 801.803 | 0.677 |
| | $\Delta logCa_{t-2}$ | 43.9716 | 507.7054 | 0.931 |
| | $\Delta logODA_{t-1}$ | -0.7485 | 0.2218 | 0.001* |
| Short-run | $\Delta logODA_{t-2}$ | -0.7098 | 0.1793 | 0.000* |
| | $\Delta logFDI_{t-1}$ | 5.376 | 19.2914 | 0.780 |
| | $\Delta logFDI_{t-2}$ | -7.3198 | 12.8907 | 0.570 |
| | $\Delta logEx_{t-1}$ | -5.6114 | 106.2709 | 0.958 |
| | $\Delta logEx_{t-2}$ | 18.4339 | 60.8649 | 0.762 |
| Long-run | $ECT_{t-1}$ | -83.5496 | 142.2798 | 0.557 |

**Table 3:** (cont.)

| Dependent Variables | Independent Variables | Coefficients | Std. Err | P-value |
|---|---|---|---|---|
| Observations | 28 | | | |
| AIC | 6.4726 | | | |
| HQIC | 7.098067 | | | |
| SBIC | 8.5185 | | | |
| Log-likelihood | -47.6166 | | | |
| Det(Sigma_ml) | 0.0003 | | | |

Note: *,**,*** the statistically significant at 1%,5% and 10% level respectively

When $\Delta logODA_t$ is used by the way of dependent variable see that the coefficient of lagged ECT is negative sign and insignificant meaning that there is not long-run causality running from the Ca, FDI and Ex to ODA. In terms of short-run found that only its lags statistically significant at 5% level indicated that Ca, FDI and Ex does not have causality to ODA. This result suggests that whether long-term or short-term Ca, FDI and Ex will not have causality with ODA which is consistent with the empirical of Chakanyuka & Mashoko (2016).

**Table 4:** The Results of Short-run and Long-run Granger Causality Analysis by the Way of FDI is Dependent Variable.

| Dependent Variables | Independent Variables | Coefficients | Std.Err | P-value |
|---|---|---|---|---|
| $\Delta logFDI_t$ | Cons | -0.1153 | 0.1489 | 0.439 |
| | $\Delta logCa_{t-1}$ | 8.2705 | 14.5292 | 0.569 |
| | $\Delta logCa_{t-2}$ | 5.4908 | 9.1999 | 0.551 |
| | $\Delta logODA_{t-1}$ | 0.0073 | 0.004 | 0.068*** |
| Short-run | $\Delta logODA_{t-2}$ | 0.0026 | 0.0032 | 0.410 |
| | $\Delta logFDI_{t-1}$ | 0.1271 | 0.3495 | 0.716 |
| | $\Delta logFDI_{t-2}$ | -0.0261 | 0.2335 | 0.911 |
| | $\Delta logEx_{t-1}$ | -4.7646 | 1.9257 | 0.013* |
| | $\Delta logEx_{t-2}$ | -2.3422 | 1.1029 | 0.034** |
| Long-run | $ECT_{t-1}$ | -8.2241 | 2.5782 | 0.001* |
| Observations | 28 | | | |
| AIC | 6.4726 | | | |
| HQIC | 7.098067 | | | |
| SBIC | 8.5185 | | | |
| Log-likelihood | -47.6166 | | | |
| Det(Sigma_ml) | 0.0003 | | | |

Note: *,**,*** the statistically significant at 1%,5% and 10% level respectively

When $\Delta logFDI_t$ is used by the way of dependent variable see that the coefficient of lagged ECT is negative sign and statistically significant at 1% level, meaning that there is long-run causality running from the Ca, ODA and EX to FDI, in this equation the speed of adjustment (the coefficient of lagged ECT) of changes to the long-term equilibrium is very high around 822%. In terms of short-run found that ODA has positive significant at 10% level and Ex has negative significant at 1% and 5% levels, meaning that in short-term ODA and Ex has

causality with FDI. The finding of this results expressed that for the evidence of Lao PDR, whether short-run and long-run has causality link between Ca, ODA, Ex and FDI which are consistent of Kawthar, and Karim, (2017) and Geetilaxmi, et al (2016)

**Table 5:** The Results of Short-run and Long-run Granger Causality Analysis by the Way of Exports is Dependent Variable.

| Dependent Variables | Independent Variables | Coefficients | Std. Err | P-value |
|---|---|---|---|---|
| $\Delta logEx_t$ | Cons | 0.0021 | 0.0360 | 0.953 |
| | $\Delta logCa_{t-1}$ | 3.0136 | 3.5140 | 0.391 |
| | $\Delta logCa_{t-2}$ | -2.5434 | 2.2251 | 0.253 |
| | $\Delta logODA_{t-1}$ | -0.0016 | 0.0009 | 0.091*** |
| Short-run | $\Delta logODA_{t-2}$ | -0.0011 | 0.0007 | 0.145 |
| | $\Delta logFDI_{t-1}$ | -0.1347 | 0.0845 | 0.111 |
| | $\Delta logFDI_{t-2}$ | -0.0410 | 0.0564 | 0.467 |
| | $\Delta logEx_{t-1}$ | 0.2630 | 0.4657 | 0.572 |
| | $\Delta logEx_{t-2}$ | 0.1989 | 0.2667 | 0.456 |
| Long-run | $ECT_{t-1}$ | 1.4395 | 0.6235 | 0.021** |
| Observations | | 28 | | |
| AIC | | 6.4726 | | |
| HQIC | | 7.098067 | | |
| SBIC | | 8.5185 | | |
| Log-likelihood | | -47.6166 | | |
| Det(Sigma_ml) | | 0.0003 | | |

Note: *,**,*** the statistically significant at 1%,5% and 10% level respectively

When $\Delta logEx_t$ is used by the way of dependent variable see that the coefficient of lagged ECT is positive sign and statistically significant at 5% level, shows Ex has a coverage tendency to its long-term equilibrium with a very high speed of adjustment around 143% and there is long-run causality running from the Ca, ODA and FDI to Ex. In terms of short-run indicated that only ODA has a negative significant at 10% level meaning that ODA has the effects on Ex in short-term.

Based on the empirical results showing in the above tables demonstrate that in short-run there are no bidirectional causal relationship but there has unidirectional causal relationship such as FDI to Ca, ODA and Ex to FDI and ODA to Ex.

For the long-run equation from where the error correction time is generated as:

$$ECT_{t-1} = [1.00logCa_{t-1} - 0.898logEx_{t-1} + 0.001logODA_{t-1} + 0.16logFDI_{t-1} + 0.28] \quad (5)$$

Because $logCa_t$ is the target variable therefore we get the equation as:

$$\Delta logCa_t = 0.0002 - 0.4702\Delta logCa_{t-1} + 0.0149\Delta logCa_{t-2} + 0.00003\Delta logODA_{t-1} + 0.000001\Delta logODA_{t-2} + 0.0105\Delta logFDI_{t-1} + 0.0029\Delta logFDI_{t-2} - 0.0408logEx_{t-1} - 0.0141\Delta logEx_{t-2} - 0.0709ECT_{t-1} \quad (6)$$

The adjustment (-0.0709) is the statistically significant at 5% level, expressed that previous year's errors are corrected for within the current year at a convergency speed of 7.09%. The finding of this results express that in long-run there has causality links between ODA, FDI, Ex and real GDP per capita of Laotian which are consistent with a numbers of empirical of Zuzana (2014), Geetilaxmi, et al (2016), Kawthar, & Karim (2017) and against the empirical of Andreas, and Anastasios, (2011).

For diagnostic checking by the LM test for residual autocorrelation found that we cannot reject the null hypothesis meaning that there is no autocorrelation at lag order, result in.

**Table 6:** Langer multiplier test

| lags | Chi2 | df | Prob > Chi2 |
|---|---|---|---|
| 1 | 15.6043 | 16 | 0.4809 |
| 2 | 11.6974 | 16 | 0.7645 |

For normal distribution by Jargue-Bera test illustrated that the series is not normally distribution (table 7), but many researchers argue that is a very weak problem thus this model satisfactory.

Table 7: Jarque-Bera Test

| Equation | Chi2 | df | Prob > Chi2 |
|---|---|---|---|
| $D\_logCa$ | 0.115 | 2 | 0.9442 |
| $D\_logODA$ | 28.809 | 2 | 0.0000 |
| $D\_logFDI$ | 0.004 | 2 | 0.9982 |
| $D\_logEx$ | 2.267 | 2 | 0.3219 |
| All | 31.194 | 8 | 0.0001 |

For checking the stability condition of VEC estimates found that the VECM specification imposes only 3-unit moduli. So, this model is also good.

## 5. Conclusion and Discussion

According to the empirical analysis, the cointegration results indicate that there is a long-term causality among the proposed variables which also have a positive and negative causality which ODA and FDI have positive relationship, suggests that if they increase in ODA and FDI inflows it causes increase in real GDP per capita. While as the Ex has a negative relationship suggest that an increase in Exports (Ex) will cause decrease in real GDP per capita which against economics theories, this may cause from the number of samples used in the study was small or inequality of income distribution. However, the finding of this results indicate that in long-run there has causality links between ODA, FDI, Ex and real GDP per capita of Laotian which are consistent with a numbers of empirical of Zuzana, (2014), Geetilaxmi, et al (2016), Kawthar, & Karim, (2017) and against the empirical of Andreas, and Anastasios, (2011). In terms of short-run, we also found that there is no bidirectional causal relationship but have unidirectional causal relationship that run from FDI to Ca, ODA (Sahraui, 2015) and Ex to FDI

(Chakanyuka & Mashoko, 2016). and ODA to Ex (Zuzana, 2014). Therefore, the finding on the causality link between real GDP per capita, official development assistance, foreign direct investment and Exports are still controversial.

### 5.2 Suggestions for Use in This Research

This study will provide some important information for related policymakers for implementation of short-run and long-run policies to meet the development goals. The relative departments or sectors should attract more ODA, FDI and Exports due to it generates the real GDP per capita of Laotian because the FDI increase it will create more job for local people. Moreover, the ODA will make the export increase through FDI, if the allocation is effectiveness and equality.

### 5.3 Further Research

1). To makes the analysis more clearly, further researchers should consider the panel data and samples of the study because large samples will more accurate and panel data could make the researcher compare the results with other countries.

2). If further researchers will go on with these results, they could imply them with fixed and random effects models because it will illustrate the effects to each local.

## References


Andreas, G. and Anastasios,D. (2011). The causal links between FDI and economic development: Evidence from Greece. **European Journal of Sciences, 27**(1), 12-20

Baiashvili,T., and Gattini,L. (2019). Impact of FDI on economic growth: The role of country income levels and institutional strength. **European Investment Bank, Working Paper** 2020/02

Cipra, T. & Tlusty, P. (2008) . Estimation in multiple autoregressive -moving average model using periodicity. **Journal of Time Series Analysis, 8**, 293-301

Chakanyuka & Mashoko (2016). The relationship between FDI and ODA: The case of Zimbabwe (1980-2012), Retrieved July 28, 2020 ,from https://ir.uz.ac.zw/handle/10646/3186

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. **Journal of the American Statistical Association, 74**(366), 427-431.

Edmore & Nicholas (2019). Foreign aid, poverty and economic growth in developing countries: A dynamic panel data causality analysis. **Cogent Economics & Finance, 7**:1, DOI: 10.1080/23322039.2019.1626321

Engle & Granger (1987). Co-integration and error correction: Representation, estimation, and testing. **Econometric, 55**(2), 251–276.

Geetilaxmi, M., et al (2016). Foreign aid, macroeconomic policies and economic growth nexus in India: An ARDL bounds testing approach. **Theoretical and Applied Economics, 4**(69), 183-202.

Gounder, R. (2003). Causality analysis of development assistance and economic growth in Solomon Islands. Pacific **Economic Bulletin .18** (1), 31-40.

Grossman & Helpman (1991). **Innovation and growth in the global economy.** Cambridge, MA: MIT Press.

Harrison & Hanson (1999). Who gains from trade reform? Some remaining puzzles. **Journal of Development Economics, 59**(1), 125-154.

Iamsiraroj, S., and Doucouliagos, H. (2015). Does growth attract FDI? **E-Journal, Kiel Institute for the World Economy,9**, 1-35

Jarque, C. M., & Bera, A. K. (1987). A test for normality of observations and regression residuals. **International Statistical Review/Revue Internationale de Statistique, 55** (2).163-172.

Johansen, S. (1988). Statistical analysis of cointegration vectors. **Journal of Economic Dynamics and Control, 12**(2), 231–254.

Johansen, S. (1995). **Likelihood-based inference in cointegrated vector autoregressive models.** Oxford: Oxford University Press.

Kawthar, A and Karim, M. (2017). The Impact of foreign aid on economic growth in Morocco: Econometric analysis using VECM. International **Journal of Economics and Finance 9**(5), 87-93

Levine, & Roodman (2004). Aid, policies, and growth: comment. **American Economic Review, 94**(3), 774-780.

Minoiu & Reddy (2010). Development aid and economic growth: A positive long-run relation. **The Quarterly Review of Economics and Finance, 50**(1), 27-39.

Sahraoui, M.A., Belmokaddem,M., Guellil, M.S., and Ghouali, Y.Z. (2015). Causal interactions between FDI, and economic growth: Evidence from dynamic panel co-integration. **Procedia Economics and Finance, 23**(15), 276-290.

Sandrina, B.M. (2005). Evaluating the impact of foreign aid on economic growth: A cross-country study. **Journal of Economic Development, 30**(2), 25-48.

Sokang, K. (2018). The impact of foreign direct investment on the economic growth in Cambodia: Empirical evidence. **International Journal of Innovation and Economic Development, 4**(5), 31-38.

Song, S., and Zhang,X. (2017). Causality between foreign direct investment and economic growth for Cambodia. **Cogent Economics & Finance, 5**(1). https://doi.org/10.1080/23322039.2016.1277860

Zuzana, S. (2014). A causal relationship between foreign direct investment, economic growth and export for Slovakia. **Procedia Economics and Finance, 15**(14), 123-128.