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Original Research Article

Causal Nexus Analysis of FDI, Trade Openness, Labor Force, Financial Development, and Economic Growth in Laos: An Empirical Study (2000-2018)

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Abstract: This research study explores the intricate web of causal relationships among foreign direct investment (FDI), trade openness, labor force participation, financial development, and economic growth in Laos. The analysis employs time series data spanning the period from 2000 to 2018, utilizing the advanced technique of bounds testing through the Auto Regressive Distributed Lag (ARDL) co-integration approach. Before delving into the econometric framework, it is imperative to ascertain the stationarity of the entire dataset to prevent the occurrence of spurious regression issues. To achieve this, we conducted the Augmented Dickey-Fuller (ADF) unit root test. The results of the unit root test indicate that the variables under consideration exhibit stationarity at both the level and first difference, providing a strong foundation for the subsequent ARDL modeling. The study's findings shed light on the intricate relationships between labor force participation, FDI, financial development, and economic growth. Notably, the research highlights a positive correlation among these variables, suggesting that an increase in labor force participation, FDI inflows, and financial development serves as a catalyst for heightened economic growth in Laos. However, an intriguing aspect of our findings is the negative impact of trade openness on economic growth, both in the short-run and long-run, a phenomenon warranting further investigation. This study contributes valuable insights to the understanding of Laos's economic dynamics and offers important implications for policymakers and stakeholders seeking to foster sustainable economic growth in the region.

Keywords: FDI, Trade Openness, Economic Growth, Labor Force, Financial Development, ARDL Model.

1. INTRODUCTION

In the realm of nation-building and socio-economic development, the allure of foreign direct investment (FDI) and the embrace of trade openness have transcended geographical boundaries, emerging as indispensable lifelines for both developed and developing nations. The transformative potential of FDI and the widening embrace of open trade policies have not only breathed vitality into host economies but have also catalyzed technological transfers, paving the way for progress on an unprecedented scale.

As capital pours into these investments, industries burgeon, international trade flourishes, and jobs materialize, seemingly like clockwork. The promise of growth and prosperity becomes tantalizingly tangible. However, the reality is nuanced, often marked by variations across countries, sectors, and localities. The realization of FDI's full potential hinges not merely on its influx but also on astute policy frameworks and robust national strategies.

In the heart of Southeast Asia, the Lao People's Democratic Republic (Lao PDR) embarked on a remarkable journey of transformation. In 1986, it boldly transitioned from a centralized planning economy to a market-driven mechanism, fostering collaborations with countries worldwide and laying the groundwork for foreign investments. The initial steps bore fruit, yet a dearth of incentive investment policies and the absence of robust investor protection laws cast a pall over FDI inflows, leaving them relatively modest.

In 1989, the government took a pivotal step by proposing an investment promotion law. The subsequent

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decade witnessed a resplendent surge in FDI inflows, catapulting from a meager $30 million in 2001 to a staggering $1.16 billion in 2011. The heralded harbors of investment were China, Vietnam, and Thailand, collectively contributing a formidable 83.15% of the total FDI inflow. The sectors of agriculture, services, industry, and mining reaped the lion's share of these investments.

Though Laos has undoubtedly made significant strides, the path to full economic fruition remains uneven. The total FDI inflows, while robust, accounted for a modest 26.5% of the GDP in 2011. A stark lack of diversification in FDI sources and an unsettling concentration of investments in sectors like hydropower and mining challenge the Lao government's vision of balanced and sustainable growth.

Building upon a rich tapestry of prior empirical research, numerous studies (Agrawal *et al.*, 2011; Li *et al*., 2005; Ang, 2009; Flexner, 2000; Alfaro, 2003; Anwar *et al*., 2003; Mutascu *et al*., 2011; Agbo, 2012; Imoudu, 2012; Koojaroenprasit, 2012; Sisombat, 2008) have unraveled the intricate determinants of economic growth. FDI, financial development, technology transfer, export dynamics, exchange rates, and investments in human capital have emerged as the lynchpins of prosperity in various economic contexts. Conversely, empirical evidence from studies such as Abdul *et al*., (2007) and Agrawal *et al*., (2011) underscores that over-reliance on specific sectors, insufficient infrastructure development, and uninviting investment legislation can cast a pall over economic progress.

Surprisingly, some research has yielded paradoxical results, challenging conventional wisdom. Studies like Blomstrom *et al*., (1992), Liu *et al*., (2002), and Suvannaphakdy (2013) have probed the impact of trade openness on GDP growth and, intriguingly, have unearthed negative correlations. This dissonance in findings underscores the multifaceted nature of economic growth determinants, illustrating that a one-size-fits-all approach may not suffice.

While the international landscape is strewn with empirical studies, the Lao context has been somewhat underrepresented, with few studies delving into factors like financial development and labour force dynamics in the context of economic growth. As such, our research takes a distinctive approach. We harness a plethora of variables, expressing them in terms of ratios and percentages over specific time intervals. Our primary objectives are twofold:

Firstly, we aim to scrutinize the intricate interplay between FDI, trade openness, labour force dynamics, financial development, and economic growth within the unique context of Laos. By drawing upon empirical insights, we hope to untangle the threads that bind these factors, shedding light on their intricate relationships.

Secondly, our study strives to serve as a compass for the Lao government and related institutions, offering a roadmap for bolstering FDI, enhancing trade openness, optimizing labour force participation, and fostering financial development within the Lao PDR. In doing so, we aspire to not only highlight the key opportunities and prospects for economic advancement but also pinpoint the major constraints and challenges that confront the nation in its quest for sustainable development.

Finally, we embark on a journey of discovery, navigating the complex terrain of economic growth determinants in Laos. Through meticulous analysis and empirical rigor, we endeavour to contribute valuable insights to the policy arena, empowering decision-makers with the knowledge needed to chart a course toward a more prosperous and equitable future for the Lao People's Democratic Republic.

2. LITERATURE REVIEW

2.1 The Theory of Economic Growth

The quest to understand the dynamics of economic growth has been a central concern in the field of economics, with various theories and models seeking to elucidate the factors at play. In this review, we explore key theoretical frameworks that have contributed to our comprehension of economic growth.

Neoclassical Growth Model: The neoclassical model, as epitomized by Robert M. Solow (1956) and James Tobin (1969), lays the foundation for our understanding of economic growth. Solow's seminal work emphasized the pivotal role of labor productivity growth, propelled by technological advancements and scientific breakthroughs, as the linchpin of economic growth.

Keynesian Economics Theory: John Maynard Keynes's theory of effective demand reshaped our understanding of economic growth. Keynes argued that government intervention, through factors such as increased government spending, could directly contribute to national income and stimulate consumption as employment rates rise. Harrod (1939), Domar (1946), and Kaldor (1955) incorporated Keynesian insights into their models, viewing economic growth through the lens of aggregate supply factors.

Ramsey Model: Frank Ramsey's work (1928) on the optimal level of savings introduced the notion that savings rates are endogenously determined by consumer preferences. This model underscores the significance of savings, investments, technology, and capital goods in driving economic development. Investment in capital goods is posited as a catalyst for productivity gains and, consequently, economic growth.

Endogenous Technological Change: A paradigm shift occurred as economists began to consider technological change as an endogenous factor. This approach, grounded in rational consumer choices, examines the role of technological advancements in determining the rate of growth in consumption and production per unit of labor and capital. It emphasizes that technological innovation is not a random occurrence but a result of deliberate choices.

These foundational economic growth theories have provided essential insights into the drivers of economic development. However, it is crucial to recognize that each model offers a distinct perspective and set of assumptions. In the context of our study on the causal nexus between foreign direct investment, trade openness, labor force, financial development, and economic growth in Laos, we draw upon elements from these theories to inform our analytical framework. By considering the interplay of these factors within the unique context of Laos, we aim to contribute to the broader discourse on economic growth and provide insights that can inform policy and decision-making in the Lao People's Democratic Republic.

2.2. Foreign Direct Investment and Economic Growth

The literature on the relationship between foreign direct investment (FDI) and economic growth has been inspired by both advances in endogenous growth theory and the practical imperative of informing policymaking. A variety of studies from different contexts shed light on this intricate relationship: Duttaray *et al*., (2008) conducted a study encompassing 66 developing countries to explore the causal relationship between FDI and economic growth. Their findings indicated that FDI influenced growth in 29 of these countries, but there was no evidence of a reciprocal effect, with growth failing to impact FDI. Wang and Wong (2009) examined data from 12 Asian countries over the 1987 to 1997 period to discern the influence of FDI on economic growth. Contrary to predictions from endogenous growth theory, they noted that using total FDI could obscure its effects, leading to ambiguous results. The study revealed that FDI had a positive impact on economic growth in the manufacturing sector but not in non-manufacturing sectors. Gui-Diby (2014) delved into the impact of FDI on economic growth across 50 African countries between 1980 and 2009. Employing the system Generalized method-of-moments (GMM) estimator, the research demonstrated that FDI inflows significantly influenced economic growth in the African region during the examined period. Pegkas (2015) explored the relationship between FDI stock and economic growth in Eurozone countries from 2002 to 2012. Using panel data estimations and advanced econometric techniques like Full Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS), the study found a long-run positive association between FDI stock and economic growth. The author emphasized the importance of macroeconomic stability and reducing market distortions to attract FDI. Sunde (2017) expanded the empirical literature by investigating the impact of both exports and FDI inflows on economic growth in South Africa. Using the Bound estimation method and data spanning from 1990 to 2014, the research highlighted the positive influence of both FDI inflows and exports on economic growth. The findings also supported the FDI-led growth and export-led growth hypotheses. Abdul Rahim Ridzuan (2017) extended the analysis to include trade openness (TO). Covering the period from 1970 to 2013, the study revealed that TO had a significant and positive impact on economic growth. Employing the Autoregressive Distributed Lag (ARDL) estimation technique, the research emphasized the importance of trade openness in promoting economic growth.

These studies collectively contribute to the understanding of the complex relationship between FDI, exports, trade openness, and economic growth. They offer valuable insights for policymakers seeking to harness the potential benefits of FDI and international trade for economic development.

2. 3. Trade openness, FDI and Economic Growth

Trade openness and FDI represent two critical facets of a nation's engagement with the international marketplace. These alternative modes of international business participation offer varying avenues for economic development. Understanding their interplay and influence on economic growth is paramount in the realm of economic theory and policymaking.

The Positive Nexus Between Trade Openness and FDI: The literature resounds with evidence showcasing the symbiotic relationship between trade openness and FDI. Several scholars have examined this relationship and arrived at noteworthy conclusions. Petri (2012) emphasizes the positive association between trade openness and FDI. FDI, often geared toward exports and import-substitution, thrives in environments characterized by robust trade openness. Increased trade openness not only attracts FDI but also augments its contribution to the host nation's economy. Jeffrey A *et al*., (1999) highlight the role of trade in enhancing skills and technological advancements. Export-oriented industries are particularly adept at importing and applying superior technology and innovations. This process fosters competition, leading to innovation, and spurs the adoption of capital-intensive manufacturing facilities. Asiedu (2002) observes that the share of trade openness in a nation's GDP serves as a common metric to gauge the degree of openness. Empirical evidence suggests a positive correlation between trade volume and FDI. This insight underscores the importance of expanding trade to attract more FDI.

Varied Outcomes and Causality: While the positive relationship between trade openness and FDI is well-established, the direction and extent of causality can

be complex and context-dependent. Some studies, like those of Balasubramanyam V.N (1996), Lipsey (2000), and Karbasi *et al*., (2005), confirm the mutually reinforcing relationship between trade and FDI, where greater trade openness spurs more FDI inflows. Contrary to prevailing wisdom, Blomstrom *et al*., (1992) argue that FDI positively impacts only higher-income developing countries, while its benefits are limited in low-income nations. Liu *et al*., (2002) and Belloumi (2014) contend that FDI is not always the primary driver of economic growth and that a negative relationship between trade and FDI can exist.

However, Ramzan & Kiani (2012) find that trade openness and inward FDI are opportunities for economic development, demonstrating that a strong relationship between the two can foster economic growth.

The literature offers a nuanced perspective on the complex interplay between trade openness, FDI, and economic growth. While a positive association prevails, the outcomes vary across nations and over time, reflecting the intricate dynamics at play. Policymakers must consider these nuances when formulating strategies to leverage the potential of trade and FDI for economic development.

3. METHODOLOGY

3.1 Data Sources:

The study explores the relationship between foreign direct investment (FDI), trade openness (TO), labor force (LAB), financial development (FD), and economic growth in Lao PDR using annual time series data spanning from 2000 to 2018. The data for this research has been sourced from reputable international databases, including the World Development Indicator (WDI) for various variables and the International Monetary Fund (IMF) for trade openness and financial development data.

Variables:

Gross Domestic Product Growth Rate (GR): This variable serves as a proxy for economic growth and is calculated based on the annual real GDP growth rate data from 2000 to 2018. The source of this data is the World Development Indicator (WDI 2019).

Foreign Direct Investment (FDI): FDI inflows into Lao PDR are measured in real terms, providing a comprehensive understanding of the impact of foreign investment. The FDI data covers the period from 2000 to 2018 and is sourced from the World Development Indicator (WDI 2019).

Trade Openness (TO): This variable is computed as the sum of total imports and exports as a percentage of GDP for the years 2000 to 2018. The data used for this variable is extracted from the International Monetary Fund (IMF).

Financial Development (FD): Financial development is proxied by the ratio of money supplied (M2) to GDP. Annual data from 2000 to 2018 for this variable is obtained from the International Monetary Fund (IMF).

Labor (LAB): The labor variable represents the size of the total labor force in Lao PDR for each year spanning from 2000 to 2018. The data on the labor force is collected from the World Development Indicator (WDI 2019).

Data Analysis:

The analysis of the causal nexus between FDI, trade openness, labor force, financial development, and economic growth in Lao PDR will be conducted using advanced econometric techniques. Specifically, we will employ the Autoregressive Distributed Lag (ARDL) co-integration approach. This method is well-suited for analyzing the long-term relationships between variables in a time series framework and can account for potential endogeneity issues.

Hypothesis Testing:

To examine the causal relationships among the variables, we will conduct a series of statistical tests, including unit root tests such as the Augmented Dickey-Fuller (ADF) test, to ensure the stationarity of the time series data. We will also employ the ARDL co-integration approach to assess the long-term relationships between the variables and determine the direction of causality.

Interpretation of Results:

The results of our analysis will provide insights into the causal linkages between FDI, trade openness, labor force, financial development, and economic growth in Lao PDR. We will assess the significance and strength of these relationships, shedding light on the key drivers of economic growth in the country.

Conclusion:

The methodology employed in this study is designed to rigorously examine the complex relationships among the selected variables, offering valuable insights into the dynamics of economic growth in Lao PDR and informing policy recommendations for the government and related institutions.

3.2. Description variables

The table indicates information in detail for each variable including the average value or Mean; Median, the amount of Maximum, Minimum, standard deviations, and the number of data observations between the periods 2000 and 2018. The descriptive statistic among the dependent and independent variables shown in the table applies in the next step of the investigation. The data have been summarized and converted into the different units of estimation in the form of percentages of GDP, FD, LAB, FDI, and TO.

Table 1: Description of Variables

Table	GR (Percentage)	LAB (Percentage)	FDI (Percentage)	TR (Percentage)	FD (Percentage)
Mean	0.0716	0.6484	0.0449	0.9878	33.5947
Median	0.0727	0.64	0.0542	0.9674	30.4
Maximum	0.0862	0.7	0.1005	4.5824	53.1
Minimum	0.0575	0.6	0.0025	-1.0877	17.4
Std. Dev.	0.0092	0.0314	0.0283	1.5240	14.1992
Observations	19	19	19	19	19

Source: Author estimation

3.3 Research methodology

The econometric methodology in this part of the study is proceeding in three stages. First, this study required to examine the stationary of all series to avoid the problem of spurious regression. Thus, the most appropriate to apply for the first step could be the unit root tests developed by Augment Dicky-Fuller (ADF) by Engle & Granger (Engle, Granger, Engle, & Grangeri, 1987). The next step of this element is to use the suitable lag length to cointegrate the correlation among variables. The lag length is chosen criteria according to Akaike Information Criterion (AIC) and Schwartz Information Criterion (SIC). After the relationship between variables is confirmed, the next steps are to estimate the coefficient of the long-run and short-run relationship this point shows that FDI and Trade openness lead to sustainable economic growth. Lastly, the diagnostic test of stability for all models has been employed to confirm that the models are arranged very strongly to estimate the association between dependent and independent variables.

3.3.1 Model specification

Numerous previous studies have pointed to FDI, trade openness, and the most extensive application to examine the effect of FDI inflows; trade openness on growth is an aggregate production function (APF). The beginning spot is to employ the well-known standard growth model which total factor productivity (FTP) indicates the real GDP, labor force, and capital stock (Solow, 1956), followed by a new theory of endogenous growth model (Arrow, 1972) and, later extended by (Lucas, 1988). There are empirical studies have been explored in various articles by production function frameworks including Constant & Yaoxing, 2010; Farshid *et al*., 2009; Frimpong, 2007; Herzer, Nowak-Lehmann, & Siliverstovs, 2006; Kohpaiboon, 2003); Hussain & Haque, 2016). The approach used in this research follows Belloumi (2014).

Following the previous economic theories and works of literature, several factors influence economic growth, which depends on particular countries over different periods. The main factors that influence economic growth are various such as trade openness, GDP; total labor force; gross fixed capital formation; FDI; secondary school enrolment rate; and financial development, and the proposed econometric models are introduced in this section. All variables are transformed into log-linear form (LN) and thus the estimated results from these models represent elasticity. According to Abdul Rahim Ridzuan (2017), modeling the log-log model specification will provide efficient results by reducing the sharpness in time series data compared with the simple linear-linear specification.

Model of Economic Growth A standard augmented Cobb-Douglas production function framework with FDI as an additional variable along with capital and labor was introduced as in the following equation:

$$Y_t = f(K, L, FDI, FD, TO) \quad \ldots\ldots (1)$$

Where Y is real output, K is capital, L is labor and FDI is foreign direct investment inflows. Following Grossman and Elhanan (1991) and Barro and Sala-I-Martin (1995), this production's function has been extended according to the new growth theory also known as the endogenous growth model introduced by Lucas (1988), Romer (1986), and Rebelo (1991). The endogenous growth theories show that the long-run growth of a country is not only inclined by the volume of physical investment but also hangs on the efficiency of utilizing investment. Equation (1) above is log and extended by including other important variables as shown in Equation below By gathering all factors influencing economic growth from the previous discussion, the Lao economic growth function can be written as:

$$LNGR_t = \beta_0 + \beta_1 LNLAB_t + \beta_2 LNFDI_t + \beta_3 LNTO_t + \beta_6 LNFD_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots (2)$$

Where GR is real gross domestic product growth; LAB is total labor force participation as a percent; FDI is foreign direct investment inflows as a percentage of GDP; TO is the sum of export and import over GDP and FD is financial development proxy by money supplied, M2 over GDP. LAB is introduced in the model to control the additional determinant of growth, GDP to reduce the problem of omitted variable bias. Domestic investment. Next, FDI highlighted by Sahoo and Mathiyazhagan (2003) is added as it can potentially bring a positive impact on Lao's economic growth. Meanwhile. Trade openness (TO) is expected to have a positive effect as stated by Balasubramanyam *et al*., (1996). We also added financial development (FD) to act as another control variable and it is also expected to have a positive impact on growth especially for advanced

countries like Singapore. The error correction model (ECM) form of the ARDL model that contains both the short-run and long-run dynamics for a model of economic growth is shown as follows:

$\Delta LNGR_t = \beta_0 + \lambda_0 LNGR_{t-1} + \lambda_1 LNLAB_{t-1} + \lambda_2 LNFDI_{t-1} + \lambda_3 LNTO_{t-1} + \lambda_4 LNFD_{t-1} + \sum_{i=1}^{p} \omega_i \Delta LNGR_{t-i} + q \sum i=0\ \gamma i \Delta LNLAB_{t-i} + s \sum i=0\ \pi i \Delta LNFD\ I_{t-ii} + u \sum i=0\ \zeta i \Delta LNTO_{t-i} + v \sum i=0\ \psi i \Delta LNFD_{t-i} + \mu_t$ …….. (3)

Where Δ is the first difference operator and μt is the white-noise disturbance term. Residuals for all the ECM models should be serially uncorrelated and the models should be stable. The above final model for economic growth can be viewed as an ARDL or Bound of order (p, q, r, s, t, u, v).

3.3.2 ARDL Co-integration

To analyze the association between FDI, trade openness and economic growth is to investigate the short-run and long-run dynamic interactions between the variable of interest. In this part, the research uses the technique of autoregressive distributed lag (ARDL) co-integration procedure or bounds testing which was created by (Pesaran, Shin, & Smith, 2001). The primary of bounds tests is to indicate and compare the measured F-statistic and bounds critical statistics such as lower critical bound and upper analytical bound testing. The beginning point of F-statistic mensuration starts with the rest of the minimum lag length and then builds the lag level step by step which seeks the most suitable for the lag of order in the form of OLS. According to the procedure introduced, it proceeds to be adopted for three reasons as follows:

First, the bounds testing method is manageable. On the other hand, according to Johansen and Juselius (Johansen, S. & Juselius, 1990), the other multivariate co-integration methods allow the co-integration of the correlation to be measured by the OLS once the lag order of the model is recognized. Another advantage is that the ARDL approach is relatively more effective and suitable for the kinds of small and finite sample data. The third significant positive is that using the ARDL model can obtain unbiased estimates of the long-run model (Harris and Sollis (Harris, R. and Sollis, 2003). The form of Autoregressive Distributed Lag (ARDL) can be written as below:

$$\Delta LnGR_t = \alpha_1 + \sum_{i=1}^{p} b_1 \Delta LGR_{t-i} + \sum_{i=1}^{p} b_2 \Delta LnFD_{t-i} + \sum_{t-1}^{p} b_3 \Delta Ln\ LAB_{t-i} + \sum_{i=1}^{p} b_4 \Delta LnFDI_{t-i} + \sum_{t=1}^{p} b_5 \Delta LnTO_{t-i} + \theta_1 \Delta LnGR_{t-1} + \theta_2 \Delta LCP_{t-1} + \theta_3 \Delta LnLAB_{t-1} + \theta_4 \Delta LnFDI_{t-1} + \theta_5 \Delta TO_{t-1} + \mu_{2t} \ldots\ldots\ldots\ldots\ldots (4)$$

$$\Delta LnFD_t = \alpha_2 + \sum_{i=1}^{p} b_6 \Delta LnFD_{t-i} + \sum_{i=1}^{p} b_7 \Delta LnGR_{t-i} + \sum_{t-1}^{p} b_8 \Delta Ln\ LAB_{t-i} + \sum_{i=1}^{p} b_9 \Delta LnFDI_{t-i} + \sum_{t=1}^{p} b_{10} \Delta LnTO_{t-i} + \theta_6 \Delta LnGR_{t-1} + \theta_7 \Delta LnFD_{t-1} + \theta_8 \Delta LnLAB_{t-1} + \theta_9 \Delta LnFDI_{t-1} + \theta_{10} \Delta TO_{t-1} + \mu_{2t} \ldots\ldots\ldots\ldots\ldots (5)$$

$$\Delta LnLAB_t = \alpha_3 + \sum_{i=1}^{p} b_{11}\, \Delta LnLAB_{t-i} + \sum_{i=1}^{p} b_{12} \Delta LnGR_{t-i} + \sum_{t-1}^{p} b_{13} \Delta L\, nFD_{t-i} + \sum_{i=1}^{p} b_{14} \Delta LnFDI_{t-i} + \sum_{t=1}^{p} b_{15} \Delta LnTO_{t-i} + \theta_{11} \Delta LnGR_{t-1} + \theta_{12} \Delta LnFD_{t-1} + \theta_{13} \Delta LnLAB_{t-1} + \theta_{14} \Delta LFDI_{t-1} + \theta_{15} \Delta TO_{t-1} + \mu_{3t} \ldots\ldots\ldots\ldots\ldots (6)$$

$$\Delta LnFDI_t = \alpha_4 + \sum_{i=1}^{p} b_{16}\, \Delta LnFDI_{t-i} + \sum_{i=1}^{p} b_{17} \Delta LnGR_{t-i} + \sum_{t-1}^{p} b_{18} \Delta Ln\, FD_{t-i} + \sum_{i=1}^{p} b_{19} \Delta LnLAB_{t-i} + \sum_{t=1}^{p} b_{20} \Delta LnTO_{t-i} + \theta_{16} \Delta LnGR_{t-1} + \theta_{17} \Delta LnCP_{t-1} + \theta_{18} \Delta LnLAB_{t-1} + \theta_{19} \Delta LnFDI_{t-1} + \theta_{20} \Delta TO_{t-1} + \mu_{4t} \ldots\ldots\ldots\ldots\ldots (7)$$

$$\Delta LnTO_t = \alpha_5 + \sum_{i=1}^{p} b_{21}\, \Delta LnFDI_{t-i} + \sum_{i=1}^{p} b_{22} \Delta LnGR_{t-i} + \sum_{t-1}^{p} b_{23} \Delta Ln\, FD_{t-i} + \sum_{i=1}^{p} b_{24} \Delta LnLAB_{t-i} + \sum_{t=1}^{p} b_{25} \Delta LnTO_{t-i} + \theta_{21} \Delta LnGR_{t-1} + \theta_{22} \Delta LnFD_{t-1} + \theta_{23} \Delta LnLAB_{t-1} + \theta_{24} \Delta LnFDI_{t-1} + \theta_{25} \Delta TO_{t-1} + \mu_{5t} \ldots\ldots\ldots\ldots\ldots (8)$$

Where:

Δ: is first different

α_o: is defined as intercept.

p: is lthe ag length

b: is defined as short-run coefficients.

$\emptyset$:: is defined as long-run coefficients.

μ: is error term.

t: is tthe ime period.

The first step of the ARDL bounds testing is to estimate the equation (6)-(8) y the ordinary least squares (OLS). The estimation of five equations tests for the long-run relationship between variables through F-test which combine significance of coefficients of the lagged levels among variables. The null hypothesis of no cointegration can be written by:

$H_0: \theta_{j1} = \theta j_2 = \theta_{j3} = \theta j_4 = \theta j_5 = 0$ No long-run relationship or no cointegration

Against alternative hypothesis

$H_1: \theta_{j1} \# \theta_{j2} \# \theta_{j3} \# \theta_{j4} \# \theta_{j5} \# 0.$ Long-run relationship or cointegration

The null hypothesis of no-cointegration will rejected when the values of F-test statistic is bigger than the upper bound value, and it is not rejected if the F-test statistic is smaller than the lower bound value. Otherwise, the cointegration test is inclusive. The second step is to estimate long-run coefficient base on appropriate lag selection for each model.

3.3.3 Long-run relationship

According to the ARDL approach, the next stage is to estimate the long-run and short-run

relationship models. For the long-run relationship is particularly depends on the Ordinary Least Square equation (OLS), and the lag length criterion illustrates in equation (11) by using the model ARDL(2,0,1,0,0) for the dependent variable GR respectively. The bound-the testing procedure determines the model as below.

$$LnGR_t = \pi_1 + \sum_{i=1}^{n} \gamma_1 LnGR_{t-i} + \sum_{i=1}^{n} \gamma_2 LnFD_{t-i} + \sum_{t-1}^{n} \gamma_3 Ln\,LAB_{t-i} + \sum_{i=1}^{n} \gamma_4 LnFDI_{t-i} + \sum_{t=1}^{n} \gamma_5 LnTO_{t-i} + \varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (9)$$

$$LnFDI_t = \pi_1 + \sum_{i=1}^{n} \gamma_1 LnGR_{t-i} + \sum_{i=1}^{n} \gamma_2 LnFD_{t-i} + \sum_{t-1}^{n} \gamma_3 Ln\,LAB_{t-i} + \sum_{i=1}^{n} \gamma_4 LnFDI_{t-i} + \sum_{t=1}^{n} \gamma_5 LnTO_{t-i} + \varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (10)$$

$$LnTO_t = \pi_1 + \sum_{i=1}^{n} \gamma_1 LnGR_{t-i} + \sum_{i=1}^{n} \gamma_2 LnFD_{t-i} + \sum_{t-1}^{n} \gamma_3 Ln\,LAB_{t-i} + \sum_{i=1}^{n} \gamma_4 LnFDI_{t-i} + \sum_{t=1}^{n} \gamma_5 LnTO_{t-i} + \varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots\ldots (11)$$

Where:

π: is intercept.

γ: is coefficient.

ε: is error term.

3.3.4 Short-run relationship

The lag length order is the essential component to create the estimation accuracy to highlight the relationship between variables in the short-run. To achieve the short-run relationship between the impact of foreign direct investment and trade openness on economic growth, the Error Correction Model (ECM) is the most appropriate to use, and a model based on the bounds tests method has been developed to consider the proper lag order and time trend t for all variables. The Error Correction Model (ECM) measure a short-run on the relationship between variable can be written as below:

$$\Delta LnGR_t = \delta_1 + \sum_{i=1}^{p} \sigma_1 \Delta LnGR_{t-i} + \sum_{i=1}^{p} \sigma_2 \Delta LnFD_{t-i} + \sum_{t-1}^{p} \sigma_3 \Delta Ln\,LAB_{t-i} + \sum_{i=1}^{p} \sigma_4 \Delta LnFDI_{t-i} + \sum_{t=1}^{p} \sigma_5 \Delta LnTO_{t-i} + ECT_{-1}\varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots (12)$$

$$\Delta LnFDI_t = \delta_1 + \sum_{i=1}^{p} \sigma_1 \Delta LnGR_{t-i} + \sum_{i=1}^{p} \sigma_2 \Delta LnFD_{t-i} + \sum_{t-1}^{p} \sigma_3 \Delta Ln\,LAB_{t-i} + \sum_{i=1}^{p} \sigma_4 \Delta LnFDI_{t-i} + \sum_{t=1}^{p} \sigma_5 \Delta LnTO_{t-i} + ECT_{-1}\varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots (13)$$

$$\Delta LnTO_t = \delta_1 + \sum_{i=1}^{p} \sigma_1 \Delta LnGR_{t-i} + \sum_{i=1}^{p} \sigma_2 \Delta LnFD_{t-i} + \sum_{t-1}^{p} \sigma_3 \Delta Ln\,LAB_{t-i} + \sum_{i=1}^{p} \sigma_4 \Delta LnFDI_{t-i} + \sum_{t=1}^{p} \sigma_5 \Delta LnTO_{t-i} + ECT_{-1}\varepsilon_{1t} \quad \ldots\ldots\ldots\ldots\ldots (14)$$

Where:

δ: is intercept.

σ: is coefficient.

ε: is error term

4. RESULT OF RESEARCH

4.1. *Empirical researches*

4.1.1 Unit root testing

To check the bounds tests is to test whether the variables are stationary or have the Unit root or not. The critical value of bounds testing introduced by (Pesaran, Shin, & Smith,2001) according to the amount in consideration is integrated with level I(0) or first difference I(1), but not in order I(2). However, the joined of the F-statistic is not appropriate to approve the relationship between variables. Thus, it requires checking the stability of all variables for the unit root test. Since time series are being used for analysis, it is believed that most of them are not stationary. The non-stationary data will Lead to the spurious regression. Therefore, it is necessary to check the stationary for all variables. This study employed the Augment Dickey-Fuller (ADF) for unit root testing (Engle *et al*., 1987). The unit root testing result is shown in Table 2, which indicates that: the variable GR, LAB, FDI, and FD are stationary at first difference I (1), in trend, trend, and intercept, but TO is stationary at the level I (0).

Therefore, based on the result of the unit root test mixture it justifies applying to the Autoregressive distributed lag ARDL model rather than the maximum likelihood framework of cointegration. ARDL model by Anon (2001) presents to solve the non-stationary problem in time series data, ARDL is applicable if all variable is stationary at the level of I(0) or purely at the first difference I(1) or the combination of both I(0) and I(1) but not I(2). Moreover, the ARDL model applies to a small sample size.

Table 2: Estimation result of unit root test

Regressor	Level		First Difference	
	Intercept	***Trend & intercept***	***Trend***	***Trend & intercept***
LNGR	-1.6236	-0.6428	-3.9884***	-4.0271**
LNLAB	-1.8516	-3.1876	-7.5963***	-5.6931***
LNFDI	-1.4629	-3.5386*	-3.3397**	-4.5538**
LNTO	-3.7994**	-4.2860**	-7.0137***	-6.8130***
LNFD	-0.4412	-2.5861	-2.8662*	-2.7556

*Note: *,**and *** are significant levels at 10, 5% and 1% respectively.*
Source: Estimation by Eview-10

4.1.2 ARDL for Co-integration and ARDL bounds testing approach

The null hypothesis of no-co-integration will be rejected when the values of the F-test statistic are bigger than the upper bound value, and it is not rejected if the F-test statistic is smaller than the lower bound value. Otherwise, the co-integration test is inclusive. The second step is to estimate the long-run coefficient based on the appropriate lag selection for each model. Calculate the F-statistic for each model represented in Table 3 ARDL bounds testing approach and significant F-statistic.

Table 3: Result of Co-integration and ARDL bound test

Models	Lower bounds(I0)	Upper bounds(I1)	F-statistics	Results
LNGR/LNLAB, LNFDI, LNTO,LNFD	3.29	4.37	10.8794***	Co-integration
LNLAB/LNGR, LNFDI, LNTO,LNFD	3.29	4.37	9.9324***	Co-integration
LNFDI/LNLAB, LNGR, LNTO,LNFD	3.29	4.37	186.90***	Co-integration
LNTO/LNLAB, LNFDI, LNGR,LNFD	3.29	4.37	50.0407***	Co-integration
LNFD/LNLAB, LNFDI, LNTO,LNGR	3.29	4.37	4.5022***	Co-integration

*Note: ** and *** is significant level at 5% and 1% respectively. Source: Estimation by Eview-10*

4.1.3 Empirical result of the long-run Model of Economic Growth.

To examine the long-run relationship between the selected variables, we estimated coefficients using the ARDL(2,2,2,2,2) model for GDP growth (GR), ARDL(2,2,2,2,2) for Foreign Direct Investment (FDI), and ARDL(2,2,2,2,2) for Trade Openness (TO). The coefficients estimate of the long-run relationship for GDP growth reveals significant contributors to economic growth in Lao PDR: Capital Investment (FDI): The coefficient indicates a statistically significant positive relationship between capital investment and GDP growth at a 5% significance level. An increase in capital investment by 1% results in a 5% increase in GDP growth. Labor Force (LAB): The number of laborers in the country also significantly contributes to economic growth in the long-run relationship, with a 1% increase in the labor force leading to a 1% increase in GDP growth.

The association between FDI and GDP growth is positive and statistically significant. An increase in FDI inflows by 1% efficiently encourages growth in the country, contributing to aggregate demand for local products and services as well as job creation. Specifically, the estimation of the long-run relationship between FDI and GDP growth suggests that a 1% growth in FDI in Lao PDR will increase GDP growth by 0.3197% with statistical significance at the 5% level. This result aligns with numerous empirical studies, including Saibu (2014) in Sub-Saharan Africa, Darrat & Sarkar (2009) in Turkey, Adhikary (2012) in Bangladesh, Belloumi (2014) in Tunisia, and Constant & Yaoxing (2010) in Cote d'Ivoire.

Trade openness exhibits a negative and significant relationship with GDP growth. This result is consistent with previous empirical studies, including Blomstrom *et al*., (1992), Liu *et al*., (2002), E. Borensztein, J. De Gregorio (1998), de Mello (1999), Lipsey (2000), Belloumi (2014), and Suvannaphakdy (2013). The negative relationship suggests that, in the case of Laos, which is a developing country with a trade deficit, increased trade openness does not support economic growth due to a higher level of imports than exports.

Interestingly, when FDI is an independent variable, trade openness demonstrates a positive and significant relationship. An increase in the degree of trade openness at the 5% significance level leads to a 0.2567% increase in FDI flows into Lao PDR. This finding aligns with prior research, suggesting a positive relationship between trade openness and FDI inflows.

Financial development, proxied by money supplied (M2) over GDP, does not show significant support for trade openness as an independent variable.

These results offer valuable insights into the complex relationships among FDI, trade openness, labor force, financial development, and economic growth in Lao PDR. Policymakers must carefully consider these findings when developing strategies to promote economic growth, attract FDI, and balance trade openness in the country.

Table 4: Estimate Long-run Elasticity

Regressor	LNGR (ARDL) (2,2,2,2,2)	LNFDI (ARDL) (2,2,2,1,2)	LNTO (ARDL) (2,2,2,2,2)
LNGR	-	3.2424***	-10.4858**
LNLAB	9.9430**	-31.742***	106.7825**
LNFDI	0.3197***	-	3.4198**
LNTO	-0.0954***	0.2567***	-
LNFD	0.3661*	-1.3287***	4.0458
C	1.5572	-4.1989***	16.9407**

*Note: All ARDL model are based on the Akaike Information Criterion (AIC). *,**and *** are significant levels at 10, 5% and 1% respectively*

4.1.4. Empirical result of the short-run Model of Economic Growth.

The short-run relationship which is represented in equation (12)-(14) Table (5), the negative sign of error correction term (ECT(-1)) or speed adjustment found in equation (12)-(14) where ΔLNGR, ΔLNFDI, and ΔLNTO is dependent variable at 1% level of significance. It confirms the short-run dynamic is running from labor force, financial development, Trade openness, and FDI to the economic growth in Lao PDR.

Table 5: Estimate of short-run Elasticity

Regressor	**DLNGR**	**DLNFDI**	**DLNTO**
	(ARDL(2,2,2,2,2)	**(ARDL(2,2,2,1,2)**	**(ARDL(2,2,2,2,2)**
D(LNGR)	-	1.704563***	-10.4351***
D(LNGR(-1))	0.389099**	-1.19707***	5.368393**
D(LNLAB)	1.713827*	-5.3298***	20.49157**
D(LNLAB(-1))	-4.51475**	6.753848**	-60.4665**
D(LNFDI)	0.489192***	-	5.585674***
D(LNFDI(-1))	0.046343**	-0.088368***	0.48996**
D(LNTO)	-0.08503***	0.15681***	-
D(LNTO(-1))	0.010051*	-	0.121582*
D(LNFD)	0.027988	-0.12022	0.083767
D(LNFD(-1))	1.516036**	-3.02157***	16.95346***
CointEq(-1)*	-2.01685***	-1.30222***	-2.21284***

*Note: Δ is the first difference, *,**and *** are significant levels at 10, 5% and 1% respectively.*

4.1.5 Diagnostic

There are numerous advantages to using the ARDL model if compared to other econometrics frameworks. However, it is indispensable to check the diagnosis during the estimation to make a confirmation that we have a good result and there is no big problem with the measurement of the model. Further, the diagnostic methods chiefly involved Author-correlation, Normality, and Heteroscedasticity from the considered p-value. Furthermore, to make the estimated model more robust and proper for implementation, it requires to be checked the stability of coefficients by applying Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) with more than 90% level of significance.

One more important step of the econometric analysis is to diagnose the perfectness and stability of the designed model to make the model more reliable implementation. This empirical study employs different diagnostics and stability tests to ensure the robustness of the estimations, including serial correlation, residual distribution, and heteroscedasticity. The stability of the coefficients can be checked through Cumulative Sum (CUSUM) and Cumulative Sum of Square (CUSUMSQ) given by Brown, R., Durbin, J., & Evans, (1975).

The diagnostic test of stability for all models has been employed to confirm that the above models fit very well to estimate the relationship between dependent and independent variables. All models pass all diagnostic tests against serial correlation (Durbin Watson test and Breusch-Godfrey test), heteroskedasticity (White heteroskedasticity test), and Normality test (Jarque-Bera test). The diagnostic analysis reveals no evidence of misspecification or autocorrelation. The study of parameter stability by the cumulative sum of recursive residual (CUSUM) and the CUSUM of the square (CUSUMSQ) also indicates that no severe problem was identified.

The diagnostic tests and stability assessments conducted in this empirical study strengthen the reliability and robustness of the estimated models. These results provide confidence in the relationships between the dependent and independent variables, supporting the validity of the findings.

Table 6: Diagnostic tests

ARDL (2,2,2,2,2)		
Diagnostic	Statistic-Value	Probability
R-squared	0.9811	-
Durbin-Watson	1.2615	-
Auto-Correlation	F(1,1)	0.5777
Normality	0.7481	0.6879
Heteroscedasticity	F(14,2)	0.5313

Source: estimated by E-view 10

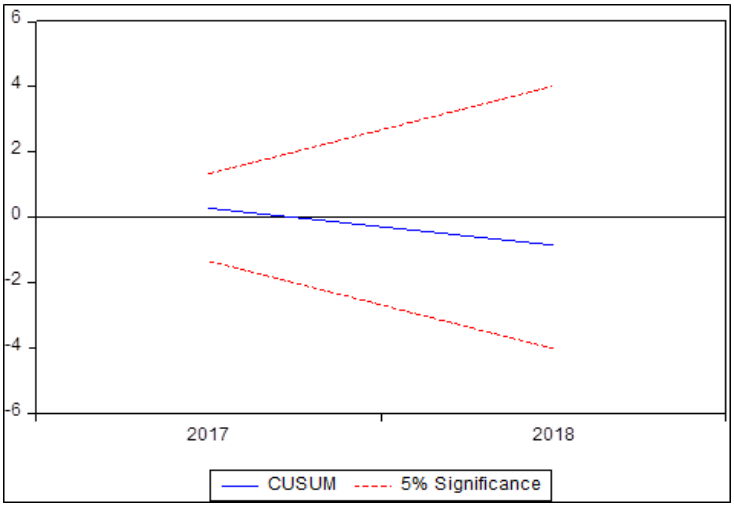

Figure 1: CUSUM test

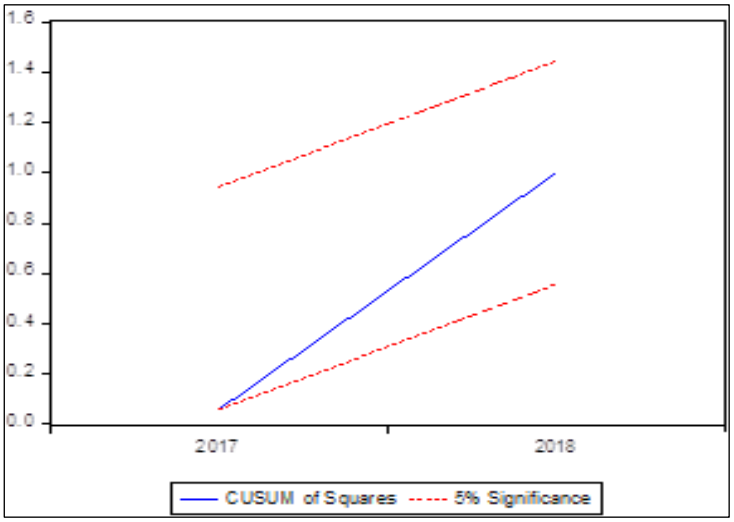

Figure 2: CUSUMSQ tests

5. CONCLUSION

5.1. Conclusion of the research

The results of the analysis provide valuable insights into the relationships between various economic factors and economic growth in Lao PDR. Here is a summary of the key findings:

The study highlights the importance of financial development, labor force growth, and FDI inflows as drivers of economic growth in Lao PDR. However, the country's trade balance, characterized by a trade deficit, may contribute to a negative relationship between trade openness and economic growth. Additionally, the complementary relationship between trade openness and FDI suggests the potential benefits of policies that encourage both trade liberalization and foreign investment.

The short-run relationship analysis suggests that there are dynamic interactions between labor force, financial development, trade openness, FDI, and economic growth in Lao PDR. The ARDL model, along with comprehensive diagnostic tests, provides confidence in the robustness and reliability of the estimated relationships. These findings contribute to a better understanding of the short-run dynamics of economic growth in the country and can inform policymakers in their decision-making processes.

Furthermore, the robustness of the model and the comprehensive diagnostic tests affirm the reliability of these results, making them a valuable resource for future research and policy planning in the region.

5.2. Recommendation for the policy maker

Policymakers in Laos can draw several policy implications from these results. They may consider enhancing policies that attract FDI, promoting labor force development, and addressing trade balance issues. Additionally, fostering a synergy between trade openness and foreign investment can be a strategic approach to maximizing economic growth potential.

The findings of this study offer valuable insights into the complex dynamics of economic growth in Laos. They highlight the roles of investment, labor

force development, FDI, and trade openness in driving short-run economic growth. These insights can guide policymakers in formulating strategies that promote economic development while addressing the challenges and opportunities presented by Laos' unique economic landscape.

The results show that dynamics of economic growth in Laos, emphasizing the importance of investments, labor force development, FDI attraction, and trade policies. The complexities of trade openness underscore the need for well-calibrated policies that consider the interplay between trade and investment. These findings can guide policymakers and researchers in their efforts to promote sustainable economic development in Laos and similar developing economies.

The short-run relationship analysis suggests that there are dynamic interactions between labor force, financial development, trade openness, FDI, and economic growth in Lao PDR. The ARDL model, along with comprehensive diagnostic tests, provides confidence in the robustness and reliability of the estimated relationships. These findings contribute to a better understanding of the short-run dynamics of economic growth in the country and can inform policymakers in their decision-making processes.

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