Financial Engineering and Risk Management (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/ferm.2025.080118
ISSN 2523-2576 Vol. 8 Num. 1

Analysis on the Impact and Effect of China's Foreign Direct Investment on Laos' Industrial Structure

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Keywords: Foreign Direct Investment (FDI); Laos; Industrial Structure; OLS Regression; China's Outbound Investment

Abstract: Laos is a key node nation in the "Belt and Road" program, and as such, foreign investment is crucial to its economic growth. Therefore, studying the impact of China's FDI in Laos on its industrial structure is of great practical significance. To this end, this paper studies the impact of China's foreign direct investment (FDI) in Laos on the proportion of Laos' primary, secondary and tertiary industries, and evaluates the specific effect of FDI on the upgrading of Laos' industrial structure while promoting economic growth. Based on the data on China's FDI flow to Laos from 2003 to 2023, the proportion of Laos' tertiary industry structure and GDP data, this paper uses the ordinary least squares (OLS) regression model to construct a quantitative analysis framework. First, through theoretical analysis, the main paths through which FDI affects the economic structure of Laos are sorted out, including capital investment, technology spillovers and market competition effects. Secondly, based on the OLS model, the econometric equations that affects the proportion of three industries: primary, secondary, and tertiary education are constructed, respectively, and SPSS is used for empirical analysis to quantify the specific impact of Chinese FDI on the industrial structure of Laos. The OLS regression results show that Chinese FDI has a significant negative impact on the proportion of the primary industry in Laos (LNPID1) (regression coefficient -0.096, $p<0.01$), that is, the inflow of foreign capital reduces the proportion of agriculture in the economy. It has a significant positive impact on the proportion of the secondary industry (LNSID) (regression coefficient 0.074, $p<0.01$), indicating that FDI has promoted the industrialization process in Laos. The impact on the proportion of the tertiary industry (LNTID3) is not significant ($p\approx0.053$), indicating that the driving effect of foreign investment in the service industry is weak. In addition, FDI is mainly concentrated in Vientiane and the economically developed areas along the Mekong River, while the driving effect on remote areas is limited, resulting in an uneven regional investment distribution.

1. Introduction

With the advancement of globalization and economic development, many developing countries have experienced significant changes in the process of industrial restructuring. The transformation of industrial structure not only reflects the stage characteristics of national economic development,

but is also closely related to resource allocation, policy orientation and changes in the international market. As a landlocked country in Indochina, the evolution of Laos' economic structure is one of the key factors in understanding its economic development process.

This paper aims to analyze the changes in Laos' economic structure, focusing on the changing trends of the primary, secondary and tertiary industries from 2003 to 2023 and the driving factors behind them. By reviewing the data on the proportion of industries in Laos, the inherent laws of the country's industrial transformation are revealed, and a reference is provided for the future direction of economic development. Changes in the industrial structure not only affect the economic growth model but also provide an important basis for the formulation of targeted policies. Therefore, an in-depth analysis of the transformation of Laos' industrial structure can provide useful experience and inspiration for other developing countries.

The structure of this paper is divided into five main parts. First, the background and purpose of the study are introduced, and the importance of industrial restructuring to economic development is explained. Secondly, the data sources and research methods are described in detail, and the OLS regression model is used to conduct an empirical analysis of Lao economic data. Next, the research results are presented, including the changing trends of the proportion of each industry and its impact on economic growth. Then, the main findings of the study are discussed and compared with relevant literature, further explaining the causes and effects of industrial restructuring. Finally, in addition to summarizing the research findings, the report offers policy suggestions and future research possibilities.

2. Related Work

In recent years, foreign direct investment (FDI) has played an important role in global economic development, environmental sustainability and industrial structure upgrading, and has attracted the attention of many scholars. Udemba et al. used structural mutation analysis, autoregressive distributed lag bounds test and Granger causality estimation to analyze the relationship between natural resources, foreign direct investment (FDI) and economic development in Norway. The estimation results show that natural resources and foreign direct investment are reducing pollution. Therefore, Norway's policies are expected to promote sustainable environmental development through resources and foreign direct investment [1]. Islam and Beloucif analyzed the motivational elements of FDI inflows into host countries through the SLR (Systematic Literature Review) method. The analysis results show that the size of the host country market is the most powerful determinant [2]. Kanval et al. explored the moderating effect of Foreign Direct Investment (FDI) on the impact of human capital on economic growth in Pakistan, and controlled for renewable energy, carbon emissions and urbanization factors. The results showed that the economic expansion of Pakistan was positively impacted by foreign direct investment, electricity from renewable sources, physical wealth, and skilled labor [3]. Raihan used time series information from 1990 to 2021 to examine how carbon dioxide (CO_2) emissions and foreign direct investment (FDI) affected Vietnamese economic growth. According to the study, Vietnam's GDP grew by 1.36% and 1.11% over the long run corresponding to each 1% rise in FDI and CO_2 emissions, respectively[4]. Camara investigated how foreign direct investment (FDI) affected revenue mobilization in developing nations. From 1996 to 2017, she analyzed data from 90 developing nations using the Generalized Method of Moments (GMM) approach. The findings demonstrated that FDI inflows considerably accelerated tax growth[5]. Song et al. used a nonlinear autoregressive distributed lag model and data from 1980 to 2021 to study and test the feasibility of the environmental Kuznets curve theory. The study's findings are contradictory and indicate an erratic connection between FDI, trade liberalization, prosperity, urbanization, utilization of energy, and production of CO2, N2O, CH4,

and carbon dioxide[6]. Tan et al. investigated how the advancement of the digital economy might encourage the modernization of the manufacturing industry, which in turn can support low-carbon environmentally friendly growth. According to the report, the growth of the Internet of Things can both directly and indirectly support low-carbon development objectives by encouraging the modernization of the industrial structure[7]. Luo et al. used principal component analysis (PCA) to evaluate the level of urban digital economic development and used the number of urban green patent applications to represent the level of green innovation. The study showed that the digital economy promotes openness in the economy increases opportunities for markets, maximizes industrial structure[8]. Kitole and Utouh studied and predicted the impact of FDI on Tanzania's industrialization and industrial performance. Vector autoregression and vector error correction models were used for time series analysis. According to the study, foreign direct investment (FDI) significantly influenced Tanzania's industrialization over the long run, whereas the exchange rate significantly influences the progress of industrialization in the short term[9]. Between 1975 and 2020, Eweade et al. investigated the unequal effects of globalization, fossil fuels, and foreign direct investment on Mexico's ecological footprint. The study discovered that whereas FDI helped environmental conditions and industrialization had no effect on the natural environment, economic development and the use of fossil fuels caused ecological degradation [10]. Voumik et al. investigated the connections between Australia's utilization of energy, the process of economic growth, opening up of trade, the rise of urbanization and foreign direct investment. The findings demonstrated a cointegration link between transparency in trade, urbanization, going growth in foreign direct investment, and energy consumption [11]. Although existing studies have widely explored the impact of FDI on economic growth, environmental sustainability and industrial structure upgrading, there are still deficiencies in the mechanism, long-term effects and regional differences of specific industrial structure adjustments in host countries.

3. Method

3.1 The Role of FDI in Laos' Economic Growth

The formation of foreign direct investment (FDI) policy can be analyzed through the "demand-supply" framework. Laos' economic development is relatively lagging and relies on foreign investment to drive economic growth, so the demand for FDI is very urgent. The Lao government has implemented a number of preferential measures to enhance the investment climate and draw in foreign money in order to encourage the influx of capital. At the same time, the entry of FDI has promoted Lao economic growth, allowing local governments to further promote policy optimization to create a more favorable investment environment. This interactive mechanism has promoted institutional reform while promoting Lao economic growth.

(1) Capital support

According to the theory of monopoly advantage, foreign enterprises usually have financial advantages. Direct investment in Laos can help make up for the lack of local construction funds. Historically, due to the influence of colonial rule and war, Laos' economy is relatively backward. Although it is rich in natural resources, it is not fully developed due to insufficient financial support. The entry of FDI provided sufficient funds to promote resource development and infrastructure construction.

(2) Technology and equipment upgrades

Based on their technological advantages, foreign companies set up enterprises in Laos and introduced advanced technology and equipment. The production equipment of FDI companies usually meets international market standards, allowing Laos' related industries to directly connect with the global market. Before FDI entered, Lao companies generally have outdated equipment,

backward technology, and lacked funds for upgrading and transformation. The entry of foreign capital effectively alleviates this problem and accelerates the modernization of Laos' industry.

3.2 Competitive Effects and Industrial Impacts of FDI

While FDI brings economic growth, it may also cause a "crowding-out effect". In order to attract foreign investment, many developing countries give it special treatment, such as land concessions, tax exemptions, etc., so that foreign-funded enterprises have advantages in cost control. This leads to foreign-funded enterprises occupying a dominant position in market competition, while local enterprises are at a disadvantage in the competition due to their weak technology, management, brand and financial strength, and may even be acquired or eliminated. In addition, foreign-funded enterprises often rely on the global supply chain, which makes some local enterprises only able to act as low-end suppliers and it is difficult to form independent brands and core competitiveness.

(1) FDI and global market expansion under the Belt and Road Initiative

Under the promotion of the Belt and Road Initiative, Laos' investment environment has been continuously improved, providing convenience for foreign investment. Multinational companies use their own technological advantages and Laos' natural resource advantages to produce cost-effective products and enter the international market with the help of the Belt and Road related trade policies. FDI has not only promoted the development of Laos' industry but also improved the competitiveness of its products in the global market.

(2) Regional distribution of FDI in Laos

Foreign investment in Laos is mainly concentrated in the economically developed city of Vientiane and the Mekong River region. These regions have complete infrastructure and a good investment environment, which attracts most FDI inflows. Other small and medium-sized towns, however, attract less foreign investment due to their backward infrastructure. Although the Lao government has introduced policies to encourage foreign investment in underdeveloped regions, FDI is still mainly concentrated in economically developed regions due to factors such as population density, market environment and investment costs.

3.3 Impact of FDI on Laos' import and export trade

FDI not only directly increases Laos' trade in goods but also indirectly promotes trade growth through the following ways:

Supply chain integration: Host country enterprises can establish long-term supply chains through foreign direct investment, and some enterprises gradually develop into international trade enterprises.

Technology spillover effect: Early FDI is mainly concentrated in labor-intensive industries, which led to Lao enterprises becoming low-value-added OEM factories and difficulty in increasing trade income. However, with the improvement of foreign investment quality and the optimization of host country policies, high-value-added enterprises have entered Laos, bringing more advanced production models and technologies, and promoting the competitiveness of Lao goods trade.

3.4 OLS Model Study on the Impact of Chinese FDI on Laos' Industrial Structure

$$Y_{it} = \beta_0 + \beta_1 FDI_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

Among them, Y_{it} represents the added value or proportion of a certain industry in Laos; FDI_{it} represents the FDI inflow from China to Laos; X_{it} is a control variable, such as labor, capital input, government policy, etc.; ε_{it} is a random error term.

This model can help analyze whether Chinese FDI has a significant impact on Laos' industrial upgrading and assess the impact of FDI on different industries (such as manufacturing, services, agriculture, etc.). Further adding panel data analysis can provide a deeper understanding of the differences in the impact of FDI at different times and regions, providing a basis for policy making.

4. Results and Discussion

4.1 Construction of OLS Model

Assumptions of the OLS model:

The OLS regression model needs to meet the following key assumptions:

Linear relationship assumption: There is a linear relationship between the dependent variable and the independent variable.

Independence assumption: The observations are independent of each other and there is no correlation between the error terms.

Homoscedasticity assumption: The error terms have the same variance (i.e. no heteroscedasticity).

Normality assumption: The error terms follow a normal distribution.

No multicollinearity: There is no high correlation between the independent variables.

4.2 Indicator Selection and Data Source

In order to construct an OLS regression model and conduct effective empirical analysis, it is first necessary to select appropriate indicators (variables) that can represent the influencing factors required in the study. Usually, the basis for indicator selection includes theoretical background, previous research results and data availability.

Main indicators selected:

In this study, the following main independent and dependent variables are selected:

Dependent variable (Y):

LNPID1: The logarithmic form of an economic indicator in a specific field (such as GDP, industrial production, etc.), indicating the trend of the dependent variable.

LNSID: The logarithmic form of another economic or social indicator, as the second dependent variable.

LNTID3: The third dependent variable, which may be an indicator related to environmental, industrial or social development.

Independent variable (X):

LNFDI: The logarithmic form of foreign direct investment, as a key independent variable, affects the change of the dependent variable. Foreign direct investment usually plays an important role in the economic growth, industrial structure and social development of a country or region.

4.3 Data Analysis

Data source: China's FDI flow to Laos comes from the Statistical Bulletin on China's Outward Direct Investment released by the Chinese government since 2003, of which the 2019 data is obtained through online news reports. Laos' GDP data comes from the World Bank database.

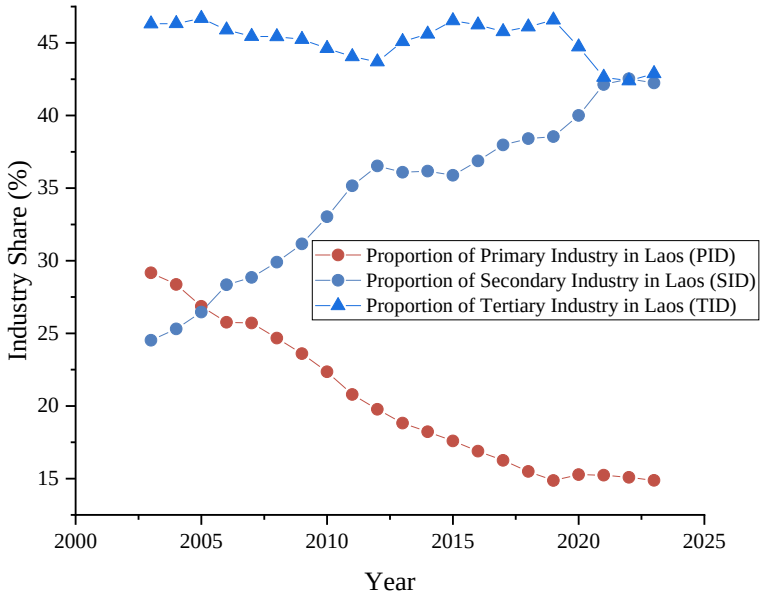

Figure 1. Linear comparison of the proportion of the three industries in Laos

According to the data on the proportion of the first, second and third industries in Laos provided in Figure 1, analyzing the trend of changes in its industrial structure can reveal the changing characteristics of the country's economic development.

The primary industry share (PID) has continued to decline over the past 20 years, from 29.17% in 2003 to 14.88% in 2023. This trend reflects the decreasing share of agriculture in the economy, which may be closely related to factors such as the accelerated industrialization process in Laos, the decline in agricultural output efficiency, and the migration of labor to cities. The secondary industry share (SID) has gradually increased from 24.52% in 2003 to 42.24% in 2023. This change shows that Laos' industrialization process has been significantly promoted, especially the increasing share of secondary industries such as manufacturing and construction. The growth of the secondary industry share was particularly significant between 2004 and 2008, reflecting the importance and policy promotion of industrialization in the Lao economy during this period.

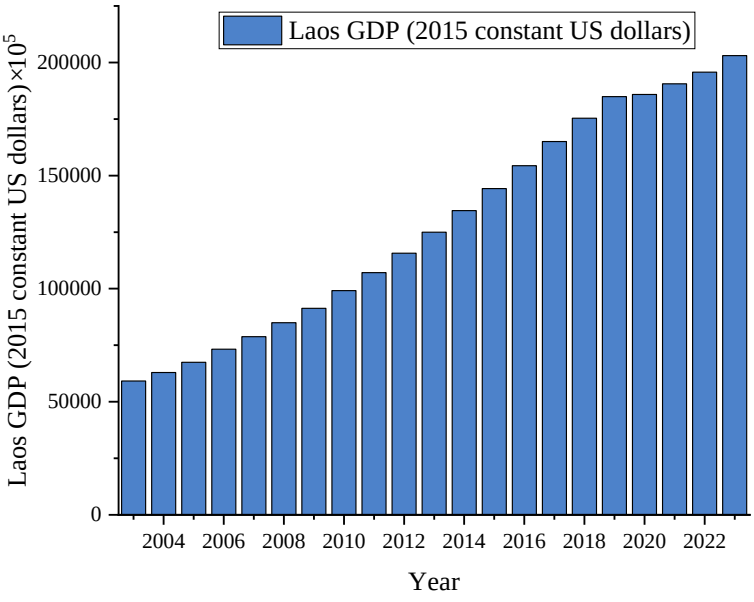

Figure 2. Laos GDP

Laos GDP shows a steady growth trend between 2003 and 2023, with an average annual growth of about 7.5%. According to the data, Laos GDP increases from US$59.185 billion in 2003 to US$203.037 billion in 2023, reflecting Laos' significant progress in economic development. In particular, the GDP growth rate accelerates significantly between 2011 and 2013, which may be closely related to the inflow of foreign capital and the promotion of large-scale infrastructure construction projects (as shown in Figure 2).

Under the influence of FDI, the proportion of manufacturing and service industries in Laos has gradually increased, especially in the early stage of FDI introduction, capital accumulation and technology transfer have played a positive role. According to regression analysis, there is a significant positive correlation between FDI inflow and GDP growth in Laos, and the contribution of FDI inflow to GDP growth has increased year by year. In particular, between 2014 and 2017, the impact of FDI on economic growth is more significant. During this period, FDI mainly flowed into the manufacturing and service sectors, promoting the development of related industries.

Further analysis shows that the contribution of FDI to Laos' economic growth varies in different years. After 2018, Laos' GDP growth slowed down, which may be related to global economic uncertainty, the gradual saturation of the domestic market, and the regional imbalance of FDI inflows. In particular, the GDP growth rate of rapidly developing regions such as the Mekong Economic Belt is relatively fast, while the growth of remote areas is relatively lagging, exposing the imbalance of FDI in regional distribution and industrial structure.

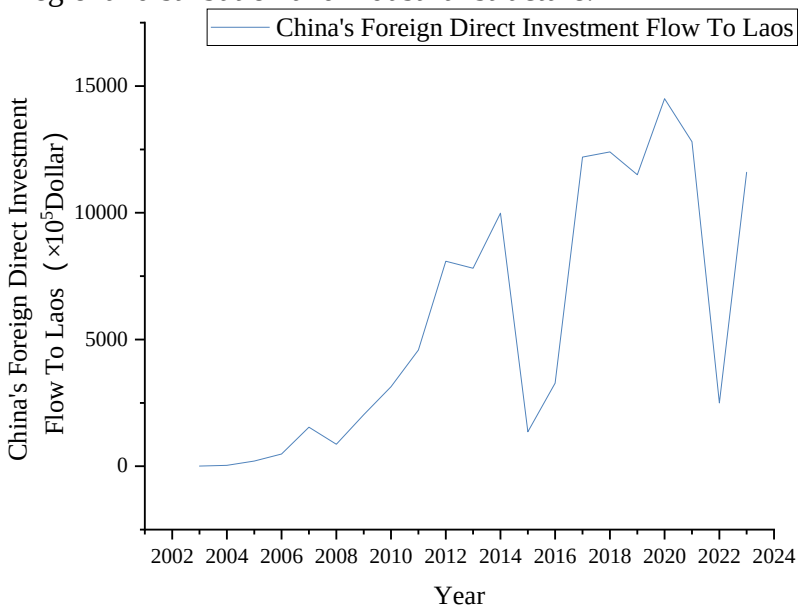

Figure 3. China's FDI flows to Laos

By analyzing the data of China's foreign direct investment (FDI) flows to Laos in Figure 3, we can observe that since 2003, China's FDI inflows to Laos have shown a significant growth trend. This change reflects the increasingly close economic relations between China and Laos and the strong driving force of Chinese capital on the Lao economy. Specifically, China's FDI to Laos is US$800,000 in 2003 and reached US$1.16 billion in 2023, a significant increase, reflecting the deepening of investment cooperation between the two countries. However, from 2015 to 2022, FDI inflows fluctuated, reaching only US$136 million in 2015, and then rebounded to US$328 million in 2016. In 2020 and 2021, China's FDI flows to Laos increased again, reaching US$1.45 billion and US$1.28 billion, respectively, which is closely related to the impact of the COVID-19 pandemic on the global economy and the Lao government's further improvement of the investment environment. In particular, in 2020, despite the spread of the global pandemic, China still

maintained a high level of FDI inflows, showing the resilience of China-Laos economic cooperation. In 2022, China's FDI to Laos plummeted to US$250 million, which may be related to global economic uncertainty, changes in the international trade environment, and saturation of the Lao domestic market. However, in 2023, FDI flows rebounded again to US$1.16 billion, indicating that China's investment in Laos has resumed growth and may involve large-scale infrastructure construction, mineral resource development and other projects.

Based on previous research, this paper uses the univariate OLS model to study the available data and establishes the following three models to test the effect of China's foreign direct investment in Laos on Laos' industrial structure.

Table 1. Regression Analysis of Equation 1

Coefficient [a]								
Model		Unstandardized coefficients		Standardized coefficient	t	Significance	Collinearity Statistics	
		B	Standard Error	Beta			Tolerance	VIF
1	(constant)	4.833	.297		16.295	.000		
	LNFDI	-.096	.015	-.821	-6.274	.000	1.000	1.000
a. Dependent variable: LNPID1								

According to the SPSS regression analysis results in Table 1, the regression model of Equation 1 is as follows:

$$\mathrm{LnPID} = 4.833 - 0.096\mathrm{LnFDI} \tag{2}$$

Among these, LNFDI has a coefficient of correlation of -0.096, meaning that LNPID1 will fall by 0.096 units for each unit rise in LNFDI. The t value of this coefficient is -6.274, and the corresponding significance level (p value) is 0.000, indicating that the impact of LNFDI on LNPID1 is noteworthy with a 99% degree of assurance. At the same time, the standardized regression coefficient Beta is -0.821, indicating that LNFDI has a strong negative impact on LNPID1. In addition, the collinearity statistics show that the variance inflation factor, also known as the VIF, and the tolerance range of the LNFDI are both 1.000, suggesting that variability is not an issue and that the model resistance evaluation has been highly robust. In summary, the regression model has good statistical significance, and LNFDI is an important negative variable affecting LNPID1.

The spss coefficient results of equation 2 are as follows:

Table 2. Regression Analysis of Equation 2

Coefficient [a]								
Model		Unstandardized coefficients		Standardized coefficient	t	Significance	Collinearity Statistics	
		B	Standard Error	Beta			Tolerance	VIF
1	(constant)	2.109	.176		12.001	.000		
	LNFDI	.074	.009	.881	8.130	.000	1.000	1.000
a. Dependent variable: LNSID								

The regression model of 2 equations is as follows, based on the SPSS regression assessment findings in Table 2:

$$\mathrm{LnSID} = 2.109 - 0.074\mathrm{LnFDI} \tag{3}$$

Among them, the regression coefficient of LNFDI is 0.074, indicating that for every unit increase in LNFDI, LNSID will increase by 0.074 units. The t value of this coefficient is 8.130, and

the corresponding significance level (p value) is 0.000, indicating that the impact of LNFDI on LNSID is significant at the 99% confidence level. LNFDI has a significant positive influence on LNSID, as evidenced by the standardized regression coefficient Beta of 0.881. Furthermore, the variance inflation factor (VIF) and the acceptable level of the LNFDI are both 1.000, according to the the collinearity statistics, suggesting that the regression algorithm is highly robust which means crossovers is not an issue. In summary, the regression model has strong statistical significance, and LNFDI is a key positive variable affecting LNSID.

The spss coefficient results of equation 3 are as follows:

Table 3. Regression Analysis of Equation 3

Coefficient [a]								
Model		Unstandardized coefficients		Standardized coefficient	t	Significance	Collinearity Statistics	
		B	Standard Error	Beta			Tolerance	VIF
1	(constant)	3.931	.059		66.679	.000		
	LNFDI	-.006	.003	-.428	-2.067	.053	1.000	1.000
a. Dependent variable: LNTID3								

According to the SPSS regression analysis results in Table 3, the regression model of Equation 3 is as follows:

$$\mathrm{LnTID} = 3.931 - 0.006\mathrm{LnFDI} \tag{4}$$

Among them, LNFDI's predictive value is -0.006, meaning that LNTID3 will drop by 0.006 units for each unit rise in LNFDI. This coefficient's value at the time of calculation is -2.067, and its related significance level (p value) is 0.053, which is near the 0.05 threshold, indicating that the impact of LNFDI on LNTID3 is close to significant, but not completely significant at the 95% confidence level. The standardized regression coefficient Beta is -0.428, indicating that LNTID3 is negatively impacted by LNFDI. Furthermore, the VIF, or variance inflation factor, and the tolerance range of the LNFDI are both 1.000, according to the collinearity statistics, suggesting that the regression framework is highly robust and that multiple linearity is not an issue. In summary, although the impact of LNFDI on LNTID3 is not completely significant at the 95% confidence level, the negative impact still has certain statistical significance, and the robustness of the regression model is good.

5. Conclusion

By examining changes in the percentage of primary, secondary, and tertiary industries in Laos from 2003 to 2023, this study demonstrates the general pattern of the nation's industrial structure transformation and its influencing elements. Data research indicates that during the past 20 years, Laos' economy has experienced substantial changes in its industrial structure, with the share of secondary and tertiary sectors steadily rising while the share of primary industry has been trending lower. Through the analysis of the changes in Laos' industrial structure, it can be seen that the key driving force of the country's economic transformation is the advancement of industrialization and the development of the service industry. With the effective allocation of resources and the continuous optimization of policies, Laos' industrial structure has played an important role in improving overall economic benefits, creating employment opportunities and enhancing international competitiveness. However, the industrial transformation process also faces some challenges, such as adaptability of the labor market, sustainability of resources and promotion of technological innovation. Laos' industrial structure transformation has made significant progress,

but it still needs further optimization. Policymakers should continue to promote the development of the secondary and tertiary industries, while strengthening the modernization of the primary industry, improving resource utilization efficiency, and promoting green development. In addition, strengthening education and training and technological innovation, improving the quality of the labor force and industrial added value will provide a solid foundation for the sustainable growth of the Lao economy.

Acknowledgement

Scientific Research Fund Project of Education Department of Yunnan Province: Evaluation and Research on the development level of Yunnan's industrial investment in Southeast Asian countries -- Based on the perspective of three industrial integration differences among five countries in the Lancang-Mekong River Basin (Project No. 2024.J0810).

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