Implementation Of The Effectiveness Of The Trans Sumatera Toll Road On Regional Development

Case Study Of Lampung Province

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ABSTRACT

This study aims to analyze the effects of the transportation and warehousing sector, tourism, and agriculture, forestry, and fisheries on economic growth, with Local Own-Source Revenue (PAD) as an intervening variable in regencies/municipalities traversed by the Trans-Sumatra Toll Road in Lampung Province. The study covers six regencies/municipalities South Lampung, Central Lampung, Mesuji, Pesawaran, Tulang Bawang, and West Tulang Bawang over the period 2013–2022, yielding a balanced panel of 60 observations. The analysis employs panel data techniques using the Random Effects Model (REM) and Fixed Effects Model (FEM), estimated with EViews version 13, and mediation is tested using the Sobel test. The results indicate that the transportation and warehousing sector has a positive and significant effect on economic growth, whereas tourism and agriculture, forestry, and fisheries do not exhibit a significant direct effect. Furthermore, PAD has a significant effect on economic growth, highlighting the importance of regional fiscal capacity in driving economic performance. In the PAD model, tourism shows a positive and significant effect on PAD, while transportation and warehousing as well as agriculture, forestry, and fisheries are not significant. The mediation analysis reveals that PAD significantly mediates the effect of tourism on economic growth, but does not mediate the relationships between transportation and warehousing or agriculture, forestry, and fisheries and economic growth. Overall, these findings confirm that the impact of the Trans-Sumatra Toll Road on economic growth in Lampung Province operates primarily through logistics efficiency in the transportation and warehousing sector and the strengthening of regional fiscal capacity, while primary sectors continue to face structural constraints. Therefore, infrastructure development policies should be integrated with fiscal strengthening mechanisms and sectoral value-added strategies to maximize the long-term economic benefits of toll road development.

***Keywords**: Economic Growth, Local Revenue, Transportation and Warehousing, Tourism, Agriculture, Forestry, and Fisheries.*

ABSTRAK

Penelitian ini bertujuan untuk menganalisis pengaruh sektor transportasi dan pergudangan, pariwisata, serta pertanian, kehutanan, dan perikanan terhadap pertumbuhan ekonomi dengan Pendapatan Asli Daerah (PAD) sebagai variabel intervening pada kabupaten/kota yang dilalui oleh Jalan Tol Trans Sumatera di Provinsi Lampung. Objek penelitian meliputi enam kabupaten/kota, yaitu Lampung Selatan, Lampung Tengah, Mesuji, Pesawaran, Tulang Bawang, dan Tulang Bawang Barat, dengan periode pengamatan tahun 2013–2022 dan total 60 observasi panel seimbang. Metode analisis yang digunakan adalah analisis data panel dengan pendekatan Random Effects Model (REM) dan Fixed Effects Model (FEM) yang diestimasi menggunakan

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software EViews versi 13, serta uji mediasi menggunakan Sobel test. Hasil penelitian menunjukkan bahwa sektor transportasi dan pergudangan berpengaruh positif dan signifikan terhadap pertumbuhan ekonomi, sedangkan sektor pariwisata serta pertanian, kehutanan, dan perikanan tidak menunjukkan pengaruh langsung yang signifikan. Selanjutnya, PAD berpengaruh signifikan terhadap pertumbuhan ekonomi, mengindikasikan pentingnya kapasitas fiskal daerah dalam mendorong kinerja ekonomi regional. Pada model PAD, sektor pariwisata terbukti berpengaruh positif dan signifikan terhadap PAD, sementara sektor transportasi dan pergudangan serta pertanian, kehutanan, dan perikanan tidak menunjukkan pengaruh signifikan. Hasil uji mediasi mengungkapkan bahwa PAD secara signifikan memediasi pengaruh pariwisata terhadap pertumbuhan ekonomi, namun tidak memediasi hubungan antara sektor transportasi dan pergudangan maupun sektor pertanian, kehutanan, dan perikanan terhadap pertumbuhan ekonomi. Secara keseluruhan, temuan ini menegaskan bahwa dampak Jalan Tol Trans Sumatera terhadap pertumbuhan ekonomi di Provinsi Lampung terutama bekerja melalui efisiensi logistik sektor transportasi dan pergudangan serta penguatan kapasitas fiskal daerah, sementara sektor primer masih menghadapi keterbatasan struktural. Oleh karena itu, kebijakan pembangunan infrastruktur perlu diintegrasikan dengan penguatan mekanisme fiskal daerah dan pengembangan nilai tambah sektoral guna memaksimalkan manfaat ekonomi jangka panjang dari pembangunan jalan tol.

Kata Kunci: Pertumbuhan Ekonomi, Pendapatan Asli Daerah, Transportasi dan Pergudangan, Pariwisata, Pertanian, Kehutanan Dan Perikanan.

INTRODUCTION

In an archipelagic country with 17,508 islands, a road network system is a basic need to connect people and businesses to jobs, services, markets, reduce logistics costs and stimulate industrial growth in Indonesia. Responding to these needs, the government places high connectivity as one of its top priorities. Through Presidential Regulation Number 100 of 2014 which was later amended by Presidential Regulation Number 117 of 2015, it became the legal basis for the construction of the Trans Sumatra toll road from Lampung Province to Aceh Province.

Source: Hutama Karya 2023

Figure 1. Map of Trans Sumatra Toll Road Development

As the second largest island in the archipelago with a population of more than 55 million people, the island of Sumatra plays an important role in the country's economy holistically. Endowed with various natural potentials and abundant commodities ranging from rubber, palm oil, coffee, petroleum, coal and natural gas, since 2015 the island of Sumatra has contributed 22.21% of Indonesia's second largest gross domestic product after Java, (BPS, 2023). The progress and sustainability of the economy of the island of Sumatra is very important to ensure stability and growth in the region, if growth stops, the development of the surrounding areas will also be hampered. One of the provinces passed by Trans Sumatra is Lampung Province.

Some potential flows of goods and the role of JTTS development such as JTTS development can encourage increased logistics flows from the producer areas of product origin and consumption centers, can reduce travel time from one point to another, the quality of infrastructure in JTTS can support smooth distribution and support the growth of new economic centers along the toll road. While some of the challenges are in the form of JTTS rates which are still considered expensive by road transport operators (buses and trucks), the need for adaptation/changes in the behavior of road users, especially truck and bus drivers to switch to using the JTTS toll road, improving the quality of supporting facilities in the JTTS toll road (rest areas, road signs and so on), and it is necessary to anticipate the increase in the use of the JTTS toll road which can increase density and reduce travel time in the next 5 years, (Aptrindo, 2020).

Logistics costs are one of the important factors that can affect the construction of toll roads. Good logistics management can reduce logistics costs, both direct and indirect costs. Poor transportation infrastructure is one of the factors in logistics costs that can cause increased logistics costs. Thus, the development of JTTS infrastructure must be carried out with focus, planning, integration and integration, so that it can improve the effective and efficient toll road construction system. The impact of infrastructure investment on reducing logistics costs can be traced from how the availability of infrastructure can help smooth logistics and get opportunities directly or indirectly in reducing costs, (Ahmat & Sahat, 2012).

The government has launched Indonesia's logistics vision for 2025, namely locally integrated and globally connected, (Coordinating Ministry for Economic Affairs, 2023). To achieve this, the government has established Indonesia's political strategy by prioritizing 6 main drivers of national logistics and one of them is in the infrastructure sector. Integrated infrastructure development (intermodal) both roads, toll roads, airports, ports and trains is a good capital in logistics. The current logistics costs in Indonesia are around 17% of production costs and logistics costs when compared to Gross Domestic Product (GDP) still reach 24% or Rp. 1,820 trillion per year divided into storage costs of Rp. 546 trillion, transportation costs of Rp. 1,092 trillion and administration costs of Rp. 182 trillion, (Apindo, 2012).

The production cost of 17% is the highest compared to neighboring countries such as Singapore (6%), the Philippines (7%), Malaysia (8%), while Japan is very small at only 5% (gatra.com, 2012). Phenomena in the field such as Nissan car manufacturers complaining about the high logistics costs that are not comparable to labor costs. The high flow of goods and services in recent years, researchers want to see the main problem regarding logistics costs experienced by users of transportation services, because the development of JTTS infrastructure is suspected as a determinant factor that can affect logistics costs, (Achmad & Sahat, 2012).

Table 1. Infrastructure Competitiveness of Asia Pacific Countries

Country	2018	2019	2020	2021	2022
Indonesia	59	53	55	57	52
Philippines	60	59	59	59	57
Malaysia	33	28	31	32	37
Singapore	8	6	7	11	12
Thailand	48	45	44	43	44
Republic of Korea	18	20	16	17	16
Vietnamese	22	19	15	14	13
Japan	15	15	21	22	22

Source: imd.org, IMD World Competitiveness Ranking 2023

Referring to the report on the publication of the global competitiveness index from the International Institute for Management Development (IMD) in 2023, it is known that Indonesia's competency index in the field of infrastructure development in 2022 was in position 52 out of a total of 63 sample countries studied or Indonesia's position was above the Philippines (57) and below Thailand (44). Acceleration of infrastructure development

is a very important pillar in advancing the Indonesian economy. Even with the construction of so much toll road infrastructure, Indonesia's competitiveness ranking is still relatively low compared to countries in the Asia Pacific.

One of the challenges faced for infrastructure development in Indonesia is the need for quite large funding. Referring to the 2020-2024 RPJMN document, the government has calculated the funding requirement for Indonesia's infrastructure development to reach IDR 6,445 trillion. The budget in the APBN document only provides IDR 2,385 trillion or 37% of the requirement. With this funding requirement, one of the efforts made is to continue fiscal reform to optimize state revenues in the APBN. In addition, the government also continues to encourage creative financing. Although Indonesia's infrastructure development ranking is still lower than neighboring countries in the Asia Pacific. In fact, business efficiency in Indonesia has increased efficiency when compared to 2018 (35) and 2021 (25) or Indonesia's business efficiency ranking for 2022 is in 31st position out of 63 countries that were sampled for measurement.

Table 2. Level of Business Efficiency in Indonesia

Year	Business Efficiency
2018	35
2019	20
2020	31
2021	25
2022	31

Source: IMD World Competitiveness Ranking 2023

In order to complete the construction of the JTTS (Trans Sumatra Toll Road), the government has given full trust to PT Hutama Karya through Presidential Decree No. 100/2014 and Presidential Decree No. 117/2015 concerning the acceleration of toll road construction in Sumatra. The construction of JTTS is expected to be able to reduce shipping costs and travel time for shipping goods and logistics as well as a means of connectivity between regions in Sumatra. Referring to the research results of the Transportation Policy Agency of the Ministry of Transportation, it is known that the time needed to send goods from Palembang to Bakauheni takes 4 to 5 hours if using JTTS and 12 hours if not via JTTS, (Baketrans, Dephub, 2022). This condition is also similar to the shipping time of goods from Central Lampung to Bakauheni, which is 2 to 3 hours (via JTTS) and 4 to 5 hours (not via JTTS). This can be interpreted that the construction of JTTS can significantly affect the efficiency of logistics costs because inventory turnover becomes faster due to faster shipping times and also because insurance and administration costs tend to remain the same. Logistics cost efficiency occurs when shipping times become faster, vehicle maintenance costs become more efficient by up to 10% and surcharge costs disappear (Baketrans, Dephub, 2022).

In addition to logistics costs, other factors such as regional development can also affect the development of JTTS. The development of toll roads has a significant influence on regional development which also has an impact on changes in land values, (Tamin, 2004). This is in accordance with PP No. 5/2005 which states that the development of toll roads is intended to realize equitable development and its results as well as balance in regional development while still paying attention to the principle of justice.

Roads as one of the transportation infrastructures are important elements in supporting mobility in the economic, social and cultural fields. In its development, a regional development approach is needed to achieve balance and equitable development between regions to realize national development facilities. Toll road infrastructure as one of the elements in transportation services must be efficient, reliable, quality, safe at affordable prices, in order to bridge the gap and support equitable development results between regions, (DPR RI Expertise Agency, 2016). Land use as human intervention with the aim of meeting needs, both material and spiritual or both. Land use that does not consider ecological balance can be seen from land that was originally a swamp, rice fields, rainwater catchment areas or rainwater catchment areas being changed into residential

areas, industry or JTTS without considering the land's capabilities, (Ritohardoyo, 2002). As a result of not anticipating land changes, it can cause the land itself to be incapable. Thus, appropriate steps are needed to anticipate changes in land use due to the construction of JTTS. Yunanto (2018), in his research results, stated that changes in land use can affect the construction of JTTS.

Macroeconomic development, especially in toll road infrastructure development policies, should have a positive impact on economic growth, because it will provide a number of multiple multiplier effects on all sectors and components in the economy, (IMF, 2015; Srinivasu & Rao, 2013). Prapti, Edy & Dian (2015) and Usman (2020), in their research results, stated that economic growth can affect the development of JTTS. Furthermore, Iek (2013), said that economic growth due to the development of JTTS includes the emergence of new economic activities in the form of trade and transportation service businesses, small industrial businesses, provision of building materials, utilization of technology; efficiency of transportation costs, income levels and utilization of financial institutions; and economic transaction patterns. The Indonesian government for the 2015-2019 period is aggressively implementing infrastructure development in various regions in Indonesia. The construction of toll roads carried out by the government and business entities aims to grow the economy in the areas passed by the toll road. The construction of toll roads will improve connectivity between regions, shorten travel time and facilitate mobility, so that it can cut logistics costs. One of the government's concentrations in infrastructure development is the construction of toll roads.

The implementation of toll road infrastructure is very important in development because it functions as a means to facilitate and support community activities. The development of toll road infrastructure will indirectly impact changes in land in the surrounding area. Land changes along the JTTS have become part of the suburbanization phenomenon. Changes in land use after the toll road occurred along the JTTS. Development of a land area will cause traffic that will affect transportation infrastructure, conversely, the existence of good transportation infrastructure will affect land use patterns. If the development that occurs is not controlled, it will have an impact on prices and changes in land use, both in terms of quality and quantity.

A region will experience accelerated economic growth if it has the potential for economic sectors that can accelerate development and other sectors, (Rustiadi et al, 2011; Wisnu & Wijaya, 2014). Infrastructure for toll road development in general (including electricity, education, transportation, health, water and so on) has a positive impact on economic growth which can reduce poverty levels, (Tinambunan et al, 2019; Panjaitan et al, 2019; Maharani, 2015; Fatchurrohman, 2019). The development of toll road infrastructure requires funding and investment that needs to be managed properly and supported by strong institutions, so that the development of this infrastructure is right on target, effective and efficient, (Mubin, 2019; Kaupa, 2015; Palei, 2015). With the construction of toll roads, there will be a spillover effect on regional economic growth, (DPR Expertise Agency, 2016). The construction of toll roads directly impacts the economic, social and environmental aspects. In the economic aspect, the construction of toll roads can improve the local economy in the form of government spending that encourages increased employment opportunities and local taxes, (Chi & Waugama, 2010; Clower & Weinstein, 2016), reducing traffic burdens, and improving roads in areas that anticipate changes in settlements and population, (Andani & Geurs, 2019).

The effectiveness of toll roads can directly facilitate access to intercity transportation, so that business activities and distribution processes can run smoothly. The construction of toll roads also has an impact on mobility, meaning that the toll roads that are built will be a means of providing free access to obstacles and become an alternative route to help the community's economic activities. The existence of toll roads can increase the security of the transportation world rapidly, reduce congestion, connect from one place to another with alternative routes to reduce distance and time and reduce vehicle obstacles to become a means to help accelerate and move traffic. The construction of this toll road aims to increase accessibility and capacity of the road network in serving traffic. The construction

of toll roads cannot be separated from the physical and non-physical aspects of society. The physical aspect is related to the environment while the non-physical aspect is the social problems of society. Both aspects are certainly felt directly by the community affected by the construction of the toll road (Yuliana & Hassan, 2020)

Toll roads as a means of connectivity between regions, toll roads are expected to be connecting routes and distribution routes for logistics of goods and services from the outskirts/rural areas to urban areas or vice versa. In management science, logistics involves activities that focus on getting the right amount of the right products, to the right place, at the right time, and at the lowest possible cost. The physical distribution of goods which is part of logistics management activities certainly has a major influence on determining the price of an item. Currently, the physical distribution process of goods still takes a long time and causes high distribution costs. The growth of cities and the needs of the community, then the means of road transportation causes the need for connectivity, so that the construction of toll roads is carried out (Husaini & Juniasmono, 2017). This can be interpreted that the construction of JTTS is the answer to the need for connectivity that requires land transportation infrastructure that can support economic growth and a sustainable environment (sustainability).

Numerous studies have examined the impact of toll road infrastructure development on economic growth across different regional and national contexts (Karpushko & Bryzga, 2021; Xu & Jianqiang, 2020; Saussier & Jean, 2015; Kandiyoh & Asad, 2021). However, most of these studies still conceptualize toll roads as a direct determinant of economic growth, without sufficiently elaborating the role of regional fiscal mechanisms in transmitting the benefits of infrastructure development. Therefore, the novelty of this study lies in the use of Local Own-Source Revenue (Pendapatan Asli Daerah/PAD) as a mediating variable that explains how increased activities in the transportation and warehousing, tourism, and agriculture, forestry, and fisheries sectors resulting from the Trans-Sumatra Toll Road can be translated into regional economic growth. Furthermore, this study extends previous empirical research by focusing on the Trans-Sumatra Toll Road in Lampung Province using panel data across districts and time periods**,** a context that remains relatively underexplored in the existing literature (Wahyudi & Yan, 2021; Salim & Uly, 2022; Yulius & Yuliarmi, 2021).

Research Gap and Contribution

Based on the literature review, a significant research gap can be identified in the limited number of studies that integrate real-sector economic activities with regional fiscal capacity within a comprehensive causal framework. Previous studies have generally examined the effects of logistics costs, regional development, land-use change, and economic growth in a fragmented manner (Sharipbekova, 2018; Munim & Schramm, 2018; Iqbal & Muhammad, 2020), and have not explicitly positioned Local Own-Source Revenue (PAD) as the linking mechanism between toll road development and regional economic growth. This study contributes to the literature on fiscal decentralization and regional development by demonstrating that the effectiveness of the Trans-Sumatra Toll Road development is reflected not only in improved connectivity and logistics efficiency but also in the ability of local governments to capture economic benefits through increased PAD, which subsequently stimulates regional economic growth. Consequently, this study not only fills an empirical gap in the context of Lampung Province but also provides policy implications regarding the importance of aligning national infrastructure development with the strengthening of regional fiscal capacity to maximize multiplier effects and spread effects.

Regional economic development theory

Regional economic development theory emphasizes that economic growth across regions is not solely determined by the availability of resources, but is strongly influenced by spatial connectivity, infrastructure quality, institutional capacity, and fiscal autonomy. The theory highlights the role of transportation infrastructure in reducing regional disparities by improving accessibility, facilitating interregional trade, and stimulating sectoral productivity. Moreover, effective regional development depends on the ability of

local governments to capture and manage economic benefits through fiscal mechanisms, enabling sustained growth and balanced development across regions.

Infrastructure-Led Growth Theory

Infrastructure-led growth theory posits that infrastructure development, particularly in transportation, is a fundamental prerequisite for economic growth as it reduces transaction costs, enhances logistics efficiency, and expands interregional market access. Toll road infrastructure accelerates the flow of goods and services, stimulates investment, and improves the productivity of key economic sectors, which ultimately leads to increased regional income and output. In the context of regional development, transportation infrastructure acts as a catalyst that connects production centers with consumption markets and strengthens intersectoral linkages within the regional economy (Aschauer, 1989; Calderón & Servén, 2010; Saussier & Jean, 2015; Karpushko & Bryzga, 2021).

New Economic Geography (NEG)

New Economic Geography emphasizes the role of spatial factors, accessibility, and transportation costs in shaping the concentration of economic activities and regional growth. The development of toll roads reduces transportation costs and generates agglomeration effects, whereby economic activities tend to cluster in areas with better infrastructure accessibility. This condition promotes the growth of transportation and warehousing, tourism, and primary sectors such as agriculture, forestry, and fisheries, thereby increasing regional value added. Consequently, toll roads function as a key instrument for regional economic expansion through both spread effects and spillover effects across regions (Krugman, 1991; Fujita et al., 1999; Wahyudi & Yan, 2021; Salim & Uly, 2022).

Fiscal Decentralization Theory

Fiscal decentralization theory explains that regional economic growth is strongly influenced by the fiscal capacity of local governments to manage and mobilize local revenue sources. Local Own-Source Revenue (Pendapatan Asli Daerah/PAD) reflects the ability of regions to capture the economic benefits generated by real-sector activities stimulated by infrastructure development. When toll road infrastructure enhances economic activities in transportation and warehousing, tourism, and agriculture, forestry, and fisheries, the local tax base expands and PAD increases. The increase in PAD subsequently provides greater fiscal space for local governments to finance further development, thereby supporting sustainable regional economic growth (Oates, 1999; Martinez-Vazquez & McNab, 2003; Iqbal & Muhammad, 2020; Yulius & Yuliarmi, 2021).

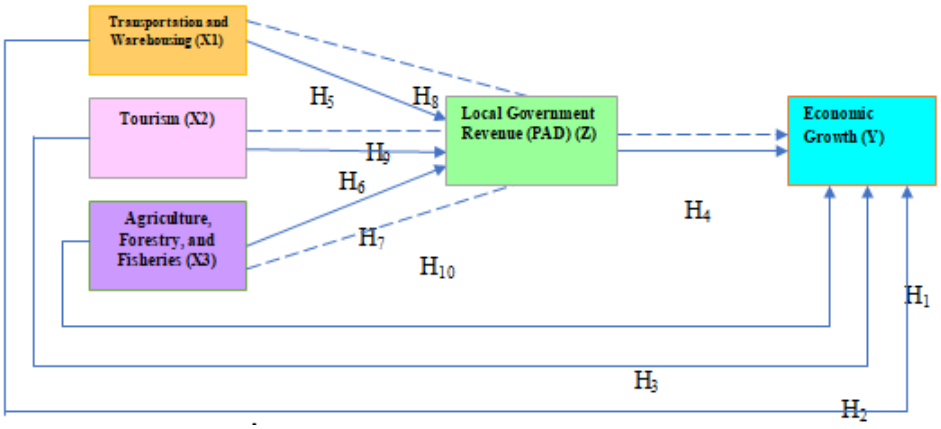

Figure 1. conceptual framework

Conceptual Framework and Hypothesis Development

Drawing upon infrastructure-led growth theory, New Economic Geography, **and** fiscal decentralization theory, this study develops a conceptual framework explaining that the presence of the Trans-Sumatra Toll Road enhances the performance of the transportation and warehousing, tourism, and agriculture, forestry, and fisheries sectors through

improved accessibility and logistics efficiency. The increased activities in these sectors broaden the regional economic and fiscal base, as reflected in higher Local Own-Source Revenue (PAD). PAD subsequently serves as a mediating mechanism that transmits the impact of toll road development to regional economic growth. In addition to these indirect effects through PAD, certain sectors are also expected to exert direct effects on economic growth. This framework yields ten hypotheses encompassing the direct effects of sectoral performance on PAD and economic growth, the effect of PAD on economic growth, and the indirect effects of sectoral performance on economic growth through PAD, as supported by previous empirical studies (Sharipbekova, 2018; Munim & Schramm, 2018; Kandiyoh & Asad, 2021; Salim & Uly, 2022).

RESEARCH METHOD

The population in this study is district data related to Transportation and warehousing, Tourism, Agriculture, forestry and fisheries, Economic growth, District Original Income derived from the financial reports of the Regency and Lampung Province specifically for the Trans Sumatra Toll Road (JTTS) originating from Lampung Province, namely at the toll gates of the Bakauheni - Terbanggi Besar section and the Terbanggi Besar - Pematang Panggang section. The sample in this study was obtained using a documentation report review technique in the form of financial reports of the Regency and Lampung Province as well as Toll data originating from the Ministry of Transportation, Ministry of PUPR, and PT. Hutama Karya.

The focus of secondary data that will be sought in this study is related to transportation and warehousing data, tourism, agriculture, forestry and fisheries, economic growth and details of the Original Regional Income of Regencies that pass through the Trans Sumatra Toll Road per year in 6 Regencies/Cities in Lampung Province that are passed by the Trans Sumatra Toll Road. With data from the Lampung Province Regencies as follows: Lamsel, Lamteng, Mesuji, Pesawaran, Tulang Bawang and West Tulang Bawang. By using the duration of the research time and the number of Regencies/Cities above, the observation samples that must be collected are 60 observation samples (6 Regencies x 10 periods) during the period 2013 to 2022.

This research is a quantitative research. This research was conducted by collecting quantitative data and presenting it in accurate information about the influence of Transportation and warehousing, Tourism, Agriculture, forestry and fisheries on Local Original Income and Economic Growth in Lampung Province Regency. This study employs panel data analysis using EViews version 13 as the primary analytical tool. Panel data analysis is appropriate for this research as it combines cross-sectional and time-series data, allowing for a more comprehensive examination of variations across regions and over time. The use of panel data enables the estimation of unobserved heterogeneity, improves the efficiency of parameter estimates, and reduces potential bias arising from omitted variables. The analysis is conducted by estimating Pooled Ordinary Least Squares (Pooled OLS), Fixed Effects Model (FEM), and Random Effects Model (REM), followed by model selection tests including the Chow test, Hausman test, and Lagrange Multiplier test to determine the most appropriate model. This approach allows for rigorous testing of the relationships between exogenous and endogenous variables and provides robust empirical evidence to support the proposed theoretical framework.

RESULT

Table 3. Descriptive Statistics of Variables

Variable	Mean	Std. Dev.	Min	Max
Economic Growth (Y, %)	3.43	4.11	-12.80	7.70
Local Own-Source Revenue (PAD) (Z, IDR)	92.29	80.62	7.60	334.80
Transportation & Warehousing (X1)	611.83	576.02	42.00	1,807.90
Tourism (X2)	197.37	148.22	39.80	512.80
Agriculture, Forestry & Fisheries (X3)	6,204.27	4,289.43	1,408.00	16,472.00

The descriptive statistics indicate considerable variation across regions and over time, particularly in the transportation and warehousing sector as well as agriculture, forestry, and fisheries. Economic growth exhibits both positive and negative values, reflecting heterogeneous regional economic performance during the observation period.

Table 4. Panel Data Model Selection Summary

Test	Decision Rule	Model 1 Result	Model 2 Result
Chow Test	Prob. < 0.05 → FEM	Prob = 0.9001 → Pooled OLS	Prob = 0.0000 → FEM
Hausman Test	Prob. < 0.05 → FEM	Prob = 0.8859 → REM	Prob = 0.0000 → FEM
LM Test	Prob. < 0.05 → REM	Prob (Both) = 0.0000 → REM	Prob (Both) = 0.0000 → Panel model
Final Model		**Random Effects Model (REM)**	**Fixed Effects Model (FEM)**

The panel data model selection was conducted using the Chow test, Hausman test, and Lagrange Multiplier (LM) test. The Chow test results indicate that Fixed Effects are not required in Model 1, while they are strongly supported in Model 2. Consistently, the Hausman test confirms that the Random Effects Model (REM) is more appropriate for Model 1, whereas the Fixed Effects Model (FEM) is preferred for Model 2 due to the presence of correlation between individual effects and the explanatory variables. Furthermore, the LM test confirms the existence of panel effects in both models, indicating that a panel-based estimation is superior to Pooled OLS. Accordingly, the Random Effects Model is selected for Model 1, while the Fixed Effects Model is adopted for Model 2.

Table 5. Panel Regression Results for Economic Growth (Random Effects Model)

Dependent Variable: Economic Growth (Y)

Variable	Coefficient	t-Statistic	p-value	Conclusion
Transportation & Warehousing (X1)	0.007784	3.5058	0.0009***	Significant
Tourism (X2)	-0.002806	-0.4100	0.6834	Not significant
Agriculture, Forestry & Fisheries (X3)	-0.000150	-0.7672	0.4462	Not significant
Local Own-Source Revenue / PAD (Z)	-0.053884	-3.9676	0.0002***	Significant
Constant	5.123667	5.6486	0.0000***	
Model Statistics				
$R^2 = 0.2624$				
Adjusted $R^2 = 0.2087$				
F-statistic = 4.8913 (Prob = 0.0019)				
Observations = 60				
Model = Random Effects				

Table 6. Panel Regression Results for Local Own-Source Revenue (Fixed Effects Model)

Dependent Variable: Local Own-Source Revenue / PAD (Z)

Variable	Coefficient	t-Statistic	p-value	Conclusion
Transportation & Warehousing (X1)	0.026108	0.4146	0.6802	Not significant
Tourism (X2)	0.968950	4.6900	0.0000 ***	Significant
Agriculture, Forestry & Fisheries (X3)	-0.001132	-0.5090	0.6129	Not significant
Constant	-107.9055	-5.6055	0.0000 ***	
Model Statistics				
$R^2 = 0.902$				
Adjusted $R^2 = 0.8868$				
F-statistic = 58.7546 (Prob = 0.0000)				
Observations = 60				
Model = Fixed Effects				

Table 7. Sobel Test Results for the Mediating Effect of Local Own-Source Revenue (PAD)

Mediation Path	a	B	Indirect Effect (a×b)	Sobel *z*-value	*p*-value	Conclusion
Transportation & Warehousing → PAD → Economic Growth	0.026	−0.054	−0.001	−0.41	> 0.05	Not significant
Tourism → PAD → Economic Growth	0.969	−0.054	−0.052	−4.62	< 0.01	Significant
Agriculture, Forestry & Fisheries → PAD → Economic Growth	−0.001	−0.054	0.000	0.51	> 0.05	Not significant

H1: Transportation and Warehousing → Economic Growth

The empirical results indicate that transportation and warehousing have a direct and statistically significant effect on economic growth in regencies of Lampung Province. The positive coefficient suggests that improvements in logistics infrastructure and transportation efficiency, driven by the Trans-Sumatra Toll Road, enhance the mobility of goods and reduce distribution costs. These improvements increase productivity, support interregional trade, and stimulate business activities, which in turn contribute to higher regional economic growth.

This finding is consistent with international evidence emphasizing the role of logistics efficiency in driving economic growth. Sharipbekova and Raimnekov (2018) and Munim and Schramm (2018) demonstrate that reductions in logistics costs significantly improve national and regional economic performance. Similar results are reported in national studies by Lens et al. (2018), Wu et al. (2021), and Zhang and Chen (2024), which confirm that transportation infrastructure investment strengthens growth through improved supply chain integration and market accessibility.

H2: Tourism → Economic Growth

The results show that tourism does not have a significant direct effect on economic growth in Lampung regencies. Although tourism activities exist, the negative and insignificant coefficient indicates that tourism has not yet become a dominant growth engine. This suggests that tourism development in these regions is still limited in scale, spatial concentration, and economic linkage with other productive sectors.

This finding aligns with studies showing that tourism does not automatically translate into economic growth, particularly in regions with weak infrastructure and low diversification. Welteji and Zerihun (2018) find a weak relationship between tourism and local economic growth in developing regions. Similarly, Hidayat et al. (2020) and Sumaryoto (2010) argue that tourism impacts may be offset by structural limitations, including limited accessibility, inadequate facilities, and low integration with local industries.

H3: Agriculture, Forestry, and Fisheries → Economic Growth

Agriculture, forestry, and fisheries are found to have no significant direct effect on economic growth. Despite their dominance in the regional economic structure, these sectors are characterized by low value-added production, limited processing activities, and high vulnerability to commodity price fluctuations and climate risks. As a result, their contribution to aggregate economic growth remains constrained.

This result is consistent with prior empirical studies emphasizing that reliance on primary sectors alone does not guarantee sustained economic growth. Valentino and Juwita (2023) and Ahmad (2022) show that agricultural dominance often leads to slower growth when not supported by industrial upgrading. Prasetyo and Djunaedi (2019) also find that toll road development does not significantly amplify agricultural sector contributions unless downstream industries are developed.

H4: Local Own-Source Revenue (PAD) → Economic Growth

The analysis confirms that Local Own-Source Revenue (PAD) has a direct and significant effect on economic growth. This finding indicates that stronger regional fiscal capacity enables local governments to finance infrastructure, public services, and development programs that stimulate economic activity. PAD thus functions as a key channel through which regional autonomy supports economic growth. This result supports fiscal decentralization theory and is consistent with empirical evidence. Iek (2013) and Marpaung et al. (2021) show that higher PAD improves regional development outcomes. Kandiyoh et al. (2021) and Mahdawi et al. (2021) further emphasize that fiscal capacity is a critical determinant of growth in regions benefiting from toll road infrastructure.

The negative coefficient of Local Own-Source Revenue (PAD) in the economic growth equation suggests that an increase in regional fiscal revenue does not automatically translate into higher economic growth. Several structural explanations may account for this phenomenon. First, the negative relationship may reflect inefficiencies in the

allocation of regional government expenditures, where a significant portion of PAD is used for routine administrative spending rather than productive investment that stimulates economic activities. In many developing regional economies, public budgets are often dominated by operational expenditures such as personnel costs and administrative services, which have limited multiplier effects on regional economic output.

Second, the negative coefficient may also indicate the presence of a time lag between revenue collection and its economic impact. Fiscal revenues collected in a given year may only generate measurable economic effects after several periods, particularly when they are allocated to infrastructure projects or long-term development programs. Therefore, the short-term econometric estimation may not fully capture the delayed positive effects of PAD on regional economic growth.

Third, the result may reflect the dominance of consumptive government spending patterns, where fiscal resources are primarily directed toward short-term expenditures rather than capital formation and productive sector development. When regional governments rely heavily on PAD to finance consumption-oriented spending instead of strategic investment in infrastructure, industry, and human capital, the growth-enhancing role of fiscal revenue may become limited.

Thus, the negative coefficient does not necessarily imply that PAD is detrimental to economic growth, but rather indicates that the effectiveness of fiscal revenue depends largely on how efficiently local governments allocate and manage public expenditures. Strengthening fiscal governance, improving budget efficiency, and prioritizing productive investments are therefore essential to ensure that increased regional revenue contributes positively to sustainable economic growth.

H5: Transportation and Warehousing → PAD

Transportation and warehousing do not have a significant direct effect on PAD. Although toll roads improve logistics efficiency and business performance, these benefits are not immediately reflected in increased local fiscal revenue. This suggests that regional governments may face limitations in capturing economic rents generated by logistics activities. Similar findings are reported in the literature, where infrastructure benefits often exceed fiscal capture at the local level. Dwitasari et al. (2020) and Xu (2020) highlight that logistics efficiency gains are primarily absorbed by firms rather than local tax systems. This indicates the need for stronger institutional mechanisms to translate infrastructure-driven growth into fiscal revenue.

H6: Tourism → PAD

Tourism has a direct and significant effect on PAD. The positive coefficient indicates that tourism activities contribute to local revenue through taxes, levies, and tourism-related services such as accommodation, restaurants, and local transportation. This confirms that tourism plays a more prominent role in strengthening fiscal capacity than in directly driving output growth. This finding is consistent with national and international studies highlighting tourism as a source of local revenue. Liyushiana et al. (2022), Basalamah and Mawardi (2022), and Pratiwi and Hasmarini (2022) show that tourism significantly increases PAD in Indonesian regions. Colacchio and Vergori (2024) also confirm similar fiscal effects of tourism development in European regions.

H7: Agriculture, Forestry, and Fisheries → PAD

The results indicate that agriculture, forestry, and fisheries do not significantly affect PAD. This reflects the low tax yield of primary-sector activities, limited value addition, and weak integration with downstream industries. Consequently, these sectors contribute relatively little to the formation of regional revenue. This outcome aligns with previous studies showing that primary sectors often generate limited fiscal returns. Aneldus and Dewi (2019) and Valentino and Juwita (2023) find that agricultural contributions to PAD are modest compared to services and tourism. Ahmad (2022) similarly concludes that infrastructure and service sectors have a stronger fiscal impact than agriculture.

H8: Transportation and Warehousing → Economic Growth through PAD

The Sobel test shows that PAD does not significantly mediate the relationship between transportation and warehousing and economic growth. This indicates that the growth impact of logistics improvements operates primarily through direct productivity and efficiency gains rather than through fiscal channels. This finding suggests that while infrastructure-led growth enhances economic output, fiscal transmission mechanisms remain weak. Similar patterns are observed in studies by Munim and Schramm (2018), where logistics improvements directly affect growth without immediate fiscal mediation. This underscores the importance of strengthening fiscal linkages to maximize infrastructure benefits.

H9: Tourism → Economic Growth through PAD

PAD is found to significantly mediate the relationship between tourism and economic growth. Although tourism does not directly drive growth, it indirectly contributes by strengthening local fiscal capacity, which then supports development spending and economic activity. This result is consistent with studies emphasizing the fiscal-driven nature of tourism impacts. Prasetyo and Djunaedi (2019) and Welteji and Zerihun (2018) note that tourism often affects growth indirectly through government revenue rather than direct output expansion. This highlights the importance of effective fiscal management to leverage tourism development.

H10: Agriculture, Forestry, and Fisheries → Economic Growth through PAD

Agriculture, forestry, and fisheries do not have a significant indirect effect on economic growth through PAD. Weak fiscal contributions, low productivity, and high exposure to external shocks limit the ability of these sectors to transmit growth through regional revenue. This finding aligns with Ahmad (2022) and Valentino and Juwita (2023), who show that agricultural sectors often fail to generate significant fiscal multipliers. Aneldus and Dewi (2019) further emphasize that without diversification and value addition, primary sectors contribute little to growth via fiscal channels.

Overall, the findings confirm that five out of ten hypotheses are supported, indicating that infrastructure-led growth in Lampung Province is primarily driven by logistics efficiency and fiscal capacity. The Trans-Sumatra Toll Road strengthens transportation and warehousing performance, directly stimulating economic growth, while tourism contributes indirectly through PAD. In contrast, agriculture, forestry, and fisheries play a limited role due to structural constraints. These results highlight the need for value-added development, fiscal strengthening, and sectoral diversification to maximize the long-term economic benefits of toll road infrastructure.

DISCUSSION

The empirical findings provide important economic interpretations regarding the magnitude and direction of sectoral impacts on regional economic growth. The Random Effects estimation indicates that a one-unit increase in the transportation and warehousing sector (X1) increases economic growth by approximately 0.78 percentage points, ceteris paribus, highlighting the strong role of logistics efficiency and connectivity improvements generated by the Trans-Sumatra Toll Road. Conversely, tourism and agriculture-related sectors show statistically insignificant coefficients, suggesting that increases in these sectors do not automatically translate into higher aggregate growth. Furthermore, the negative and significant coefficient of PAD in the growth equation implies that fiscal expansion alone does not guarantee economic growth unless public revenues are efficiently allocated toward productive investment. This result suggests the presence of inefficiencies or time lags in the utilization of local fiscal resources, a phenomenon frequently observed in developing regional economies.

The results are broadly consistent with international evidence emphasizing the role of transportation infrastructure in stimulating economic growth through reduced logistics costs and improved market access (Calderón & Servén, 2010; Munim & Schramm, 2018; Karpushko & Bryzga, 2021). Similar to findings from China and Eastern Europe, transportation infrastructure in Lampung Province primarily drives growth through

logistics-intensive sectors rather than tourism or agriculture. At the national level, the results corroborate studies by Lens et al. (2018), Wu et al. (2021), and Zhang and Chen (2024), which highlight that toll road development has a stronger impact on industrial and logistics performance than on tourism-led growth. Meanwhile, the insignificant role of agriculture aligns with Indonesian studies by Prasetyo and Djunaedi (2019) and Ahmad (2022), suggesting that regions with a primary-sector-dominated structure often experience limited growth spillovers unless supported by downstream processing and industrial integration.

The heterogeneous effects observed across sectors reflect the structural characteristics of regencies in Lampung Province. Transportation and warehousing benefit directly from toll road development due to their strong linkage with interregional trade and supply chains, enabling immediate productivity gains. In contrast, tourism and agriculture exhibit weaker growth impacts because these sectors are constrained by limited value addition, insufficient infrastructure, and low integration with regional and global markets. Tourism development remains spatially concentrated and uneven, while agriculture, forestry, and fisheries are vulnerable to commodity price volatility, climate risks, and land-use conversion pressures. These structural limitations reduce the capacity of these sectors to generate sustained economic growth and fiscal revenues. The findings underscore that infrastructure-led growth is inherently sector-specific and contingent upon the broader economic structure, institutional capacity, and policy environment of the region.

Consistent with *New Economic Geography*, the findings suggest that policy priorities should focus on strengthening spatial connectivity and agglomeration effects around the Trans-Sumatra Toll Road by developing logistics hubs, warehousing clusters, and industrial estates to amplify productivity spillovers from transportation and warehousing sectors. In line with *fiscal decentralization theory*, local governments should enhance fiscal capture mechanisms by optimizing PAD through improved taxation, retribution systems, and reinvestment of local revenues into growth-enhancing infrastructure and public services. For the tourism sector, policies should prioritize improving accessibility, destination clustering, and service quality near toll exits to convert tourism activity into sustainable fiscal revenue and indirect economic growth. Meanwhile, agriculture, forestry, and fisheries require targeted value-added strategies such as agro-processing, supply-chain integration, and market access improvements to strengthen their linkage with PAD and reduce vulnerability to commodity and climate shocks. Overall, an integrated policy approach that aligns infrastructure development with fiscal capacity building and sectoral upgrading is essential to ensure that toll road investments generate balanced, inclusive, and sustainable regional economic growth.

CONCLUSION

This study provides empirical evidence on the economic impacts of the Trans-Sumatra Toll Road by examining the roles of transportation and warehousing, tourism, agriculture–forestry–fisheries, and Local Own-Source Revenue (PAD) in driving regional economic growth in Lampung Province. The results demonstrate that transportation and warehousing have a direct and significant effect on economic growth, confirming the importance of logistics efficiency and connectivity in infrastructure-led growth. In contrast, tourism and agriculture-related sectors do not exert a significant direct influence on economic growth, reflecting structural limitations, low value-added activities, and weak intersectoral linkages within the regional economy.

Furthermore, the findings highlight the critical role of fiscal capacity in regional development. PAD is shown to have a significant direct effect on economic growth, indicating that local governments' ability to mobilize and manage fiscal resources is a key determinant of economic performance. Tourism contributes positively and significantly to PAD, while transportation and warehousing as well as agriculture, forestry, and fisheries do not significantly increase local revenue. Mediation analysis reveals that PAD significantly transmits the impact of tourism on economic growth, whereas it does not mediate the effects of transportation and warehousing or agriculture-related sectors. These results sug-

gest that the economic benefits of tourism are primarily realized through fiscal channels rather than direct output expansion.

Overall, the study underscores that the effectiveness of toll road development in stimulating regional economic growth depends not only on improved infrastructure but also on sectoral structure and fiscal mechanisms. The Trans-Sumatra Toll Road enhances growth mainly through logistics-driven productivity gains and strengthened fiscal capacity, while primary sectors remain constrained by structural and institutional factors. These findings imply that to maximize the long-term economic benefits of large-scale infrastructure projects, policymakers should focus on strengthening value-added activities, improving fiscal capture mechanisms, and promoting sectoral diversification to ensure more inclusive and sustainable regional development.

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