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Infrastructure, Human Capital, And Local Revenue As Determinants of Economic Growth in North Maluku Province

Liong Finox Konu[1], Teddy Ch. Leasiwal[2], Jopie Tamtelahitu[3]
Postgraduate Program, Department of Economics,
Pattimura University, Ambon
Email: konuliongfinox@gmail.com

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Abstract

North Maluku Province has recorded positive economic growth in recent years; however, this progress has been accompanied by substantial regional disparities in development across regencies/cities. These regional disparities are reflected in unequal infrastructure provision, variations in the quality of human capital, and uneven contributions of Local Own-Source Revenue (Pendapatan Asli Daerah, PAD), all of which constrain the acceleration of inclusive regional economic growth. This study aims to examine the effects of infrastructure, human capital, and PAD on economic growth in North Maluku Province. This quantitative study utilized panel data from 10 regencies/cities over the period of 2021-2024. The data was analyzed using panel data regression analysis with a Fixed Effect Model. The findings indicate that infrastructure, human capital, and PAD each have a positive and statistically significant effect on economic growth in North Maluku Province. Nevertheless, the magnitude of these effects varies considerably across regions. Areas with a strong mining base and relatively well-developed infrastructure exhibit higher contributions to economic growth compared to regions that rely primarily on trade and agriculture and are characterized by lower human capital quality. Based on these results, this study recommends the implementation of integrated and equitable development policies, including more targeted infrastructure investment, improved access to and quality of education to strengthen human capital, and the optimization of local economic potential to enhance PAD. Such measures are essential to promote more inclusive and balanced economic growth across all regions of North Maluku Province.

INTRODUCTION

Economic activity within a region is closely linked to the availability and quality of supporting infrastructure. Adequate infrastructure services can increase both the intensity and efficiency of economic activities, which in turn contribute to improvements in regional welfare. The rate of economic growth is influenced by a range of supporting factors, particularly infrastructure, human capital, and Local Own-Source Revenue (Pendapatan Asli Daerah, PAD) (Oppier et al., 2023). In recent years, the interaction of these factors has become increasingly evident in North Maluku Province.

Developments in infrastructure across North Maluku Province reveal notable spatial differences. Budget allocations for road infrastructure indicate that, among 10 regencies/cities, the largest average absorption rates are found in South Halmahera Regency (13.59%), followed by Central Halmahera Regency (12.10%). The relatively high allocation in these two regions reflects their strategic economic potential and strong demand for infrastructure support. Both areas function as key industrial zones, with economic activities centered on mining, agriculture, forestry, fisheries, and tourism. These sectors play a significant role in driving regional economic growth.

In contrast, Ternate City and Tidore Islands City record the lowest average infrastructure budget absorption, ranging from 4.64% to 6.21%. This lower allocation does not necessarily indicate limited economic activity; rather, it reflects the fact that physical infrastructure development in these urban areas has been largely completed over a longer period. Current spending is, therefore, focused mainly on maintenance and rehabilitation to sustain connectivity across service and trade sectors that support provincial economic growth.

Infrastructure development oriented toward industrial sectors inevitably highlights the importance of human capital as a key driver of regional economic activity. Human capital represents the quality of the labor force, particularly in terms of skills and productivity. In principle, higher labor quality enhances productivity within industrial activities, thereby strengthening regional economic growth. This relationship underscores the complementary role of infrastructure and human capital in supporting industrialization.

In North Maluku Province, human capital development, as reflected by the education index, also shows considerable variation across regions. Ternate City records the highest education index at 82.34%, followed by Tidore Islands City (71.86%) and Central Halmahera Regency (65.63%). These three regions consistently demonstrate higher education outcomes compared to other regencies/cities in the province. Conversely, the lowest education index values are observed in Morotai Island Regency (59.14%) and Taliabu Island Regency (59.89%). These figures indicate relatively limited human capital quality, particularly in terms of educational attainment and access. As a result, targeted policy interventions are required to improve educational facilities, increase average years of schooling, and enhance workforce skills, especially to support productive activities in industrial sectors and regional economic development.

Beyond infrastructure and human capital, PAD represents another critical factor influencing economic growth in North Maluku Province. Data show that the average contribution of regency/city-level PAD to provincial PAD over recent years is approximately 10%. Among the ten regions, South Halmahera Regency records the highest contribution (15.90%), followed by Central Halmahera Regency (12.54%) and North Halmahera Regency (11%). Regions with PAD contributions above 10% tend to exhibit stronger sectoral growth and higher capacity to generate PAD. This performance is largely driven by natural resource-based activities and industrialization, particularly in mining areas such as the nickel mining zones (Mining Business Permit Area (Wilayah Izin Usaha Pertambangan), WIUP) in Central Halmahera, South Halmahera, as well as North Halmahera. These regions benefit from comparative advantages in mining, agriculture, and tourism, supported by processing industries and relatively stronger human capital, which together enhance productivity and PAD generation.

In contrast, regions with PAD contributions below 10%, such as Taliabu Island Regency (6.31%), rely primarily on agricultural and trade commodities, including cloves, nutmeg, and copra. Economic activities in these areas are characterized by lower levels of human capital quality, which constrains productivity and revenue generation (Rumau et al., 2022). Consequently, PAD in such regions is largely derived from taxes and retributions rather than from value-added industrial activities, unlike regions endowed with stronger natural resource bases.

Overall, all regencies/cities contribute positively to provincial PAD. If these contributions continue to increase in the long term, they can help maintain regional economic stability, as reflected in economic growth rates. On average, the highest economic growth is recorded in Central Halmahera Regency (82.51%), followed by South Halmahera Regency (19.33%) and East Halmahera Regency (8.64%). These figures contrast sharply with regions experiencing growth rates

below 5%, with the lowest growth observed in Sula Islands Regency (1.64%). Despite these substantial regional disparities, North Maluku Province, as a whole, recorded an average economic growth rate of 12.70%, significantly exceeding the national average of around 3%. This performance highlights the strategic role of North Maluku Province's economic base sectors in supporting national economic dynamics.

Nevertheless, sustained positive growth must be accompanied by careful attention to regional disparities. In recent years, development gaps across regencies/cities have affected their respective contributions to provincial economic growth. Several regions, such as Morotai Island Regency, Taliabu Island Regency, and Sula Islands Regency, exhibit relatively adequate infrastructure absorption but face constraints related to limited natural resource potential and insufficiently skilled human resources to support industrial activities. These conditions contribute to unequal PAD generation and economic growth outcomes. In contrast, mining-based regions, such as South Halmahera Regency, North Halmahera Regency, and East Halmahera Regency, demonstrate progressively stronger contributions to PAD and economic growth due to their abundant natural resources.

Regions oriented toward services, trade, agriculture, and tourism, such as Ternate City and Tidore Islands City, function as hubs of intersectoral connectivity at the provincial level. Although their infrastructure budget allocations are relatively small, these areas already possess well-established supporting infrastructure, including roads, irrigation systems, and educational facilities. Current expenditures are therefore directed toward revitalization efforts aimed at improving infrastructure quality, strengthening human capital, and enhancing productivity in labor-intensive sectors that generate added values for provincial economic growth.

From a broader perspective, the relationships among infrastructure, human capital, and PAD across regencies/cities play a crucial role in shaping regional economic growth. These three factors are theoretically interconnected through both forward and backward linkages. According to Chenery and Clark (1992), as cited in Koylal et al. (2024), positive economic growth is strongly influenced by intersectoral linkages, where inputs from one sector generate positive output effects in other sectors. In this context, the development of supporting sectors that serve as central drivers of economic activity becomes essential. Accordingly, the integrated development of infrastructure, human capital, and PAD is vital for addressing regional disparities and promoting sustainable economic growth in North Maluku Province.

For these reasons, this study aims to examine the effects of infrastructure, human capital, and PAD on economic growth in North Maluku Province, with the expectation of contributing both theoretically and practically. Theoretically, the findings are intended to strengthen empirical evidence on regional economic growth models, particularly in resource-based and archipelagic regions, by emphasizing the role of intersectoral linkages and regional heterogeneity. Practically, the results are expected to provide policy-relevant insights for local governments in formulating more integrated and equitable development strategies, including infrastructure investment prioritization, human capital enhancement, and the optimization of local revenue sources to support sustainable growth, reduce interregional disparities, and improve regional economic resilience.

METHODS

This study employed a quantitative research design. The data utilized was secondary data consisting of time-series and cross-sectional data. The data was obtained from the Statistics Indonesia of North Maluku Province, consisting of data on infrastructure development, human capital, PAD, and economic growth of 10 regencies/cities in North Maluku Province over the period of 2021-2024.

Descriptive Analysis

In this study, descriptive analysis was utilized to illustrate trends and patterns in the variables under study. The data are presented in the form of tables, figures, and summary statistics to provide an initial overview of developments across regions and over time. This approach follows the descriptive statistical framework outlined by Kuncoro (2018).

Panel Data Regression Analysis

In this study, the empirical model was developed based on the Solow-Swan economic growth framework as adapted by Ramdhani (2022). In its general form, the panel data regression model can be expressed as follows:

$$\mathbf{Yit = \alpha it + \beta 1X1it + \beta 2X2it + \ldots. BnXnit + enit}$$

Note:

Y	= Dependent variable
X1, X2	= Independent variable
α	= Constant
β1, β2, … Bn	= Regression coefficient
it	= Cross-sectional unit of time period
e	= Error term

Based on the variables examined in this study, the model can be specified as follows:

$$\mathbf{PEit = \alpha it + \beta 1INFit1 + \beta 2MMit2 + \beta 3PADit3 + eit}$$

Note:

α	= Constant
PE	= Economic growth
INF	= Infrastructure
MM	= Human capital
PAD	= Local Own-Source Revenue (PAD)
β1, β2, β3	= Regression coefficient
it	= Cross-sectional unit of time period
e	= Error term

To account for differences in measurement scales and to improve the statistical properties of the model, the variables were transformed using natural logartihms. The log-linear panel regression model is specified as follows:

$$\mathbf{PEit = \beta 0it + \beta 1LNINFit1 + \beta 2LNMMit2 + \beta 3LNPADit3 + eit}$$

Note:

β0	= Constant
PE	= Economic growth
INF	= Infrastructure
MM	= Human capital
PAD	= Local Own-Source Revenue (PAD)
β1, β2, β3	= Regression coefficient
it	= Cross-sectional unit of time period
LN	= Natural logarithm

e = Error term

RESULTS AND DISCUSSION

Model Selection

Model selection in econometric analysis is a critical and iterative process aimed at identifying the most appropriate specification by balancing simplicity (the principle of parsimony) and goodness of fit. The objective is to obtain unbiased estimates, valid statistical inference, and reliable predictions. In this study, model selection began with a strong theoretical foundation derived from economic growth theory, followed by statistical evaluation using significance tests and information criteria. The selected model was further assessed through econometric diagnostics, including tests for heteroskedasticity and autocorrelation, to ensure that the underlying assumptions of the panel regression are satisfied. This comprehensive approach would help to minimize the risk of data mining and address the bias-variance trade-off by integrating theoretical reasoning with empirical evidence and the overall objectives of the analysis. The model selection of this study is depicted in the following Table 1:

Table 1. Panel Data Model Selection

No.	Model	Test	F-Statistic	Prob.	Description
1.	Common Effect	OLS	2.758506	0.057 (> 0.05)	Not satisfied
2.	Fixed Effect	Chow	3.904806	0.003 (< 0.05)	Satisfied
3.	Random Effects	Hausmant	0.593898	0.897 (> 0.05)	Not satisfied

Source: Eviews output (processed data, 2025)

Based on the estimation results, the Chow test indicates that the Fixed Effect Model is the most appropriate specification for this study.

Panel Data Regression

Table 2. Results of Panel Data Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-821.4447	195.5616	-4.200440	0.0003
LNINF?	2.936807	1.368434	2.146108	0.0418
LNMM?	115.3959	34.50908	3.343928	0.0026
LNPAD?	14.21403	4.407131	3.225235	0.0035

R-squared	0.930616
Adjusted R-squared	0.897312
S.E. of regression	17.68910
F-statistic	27.94286
Prob. (F-statistic)	0.000000

Source: Eviews output (processed data, 2025)

Based on the results of panel data regression presented in Table 2, the estimated econometric model can be expressed in the following mathematical form:

$$PEit = \beta 0it + \beta 1LNINFit1 + \beta 2LNMMit2 + \beta 3LNPADit3 + eit$$

The estimation results yield the following regression equation:

$$PEit = 821.44 – 2.936LNINFit1 + 115.39LNMMit2 + 14.214LNPADit3 + eit$$

DISCUSSION

The Effect of Infrastructure on Economic Growth in North Maluku Province

The empirical results indicate that the infrastructure variable has a positive and statistically significant effect on economic growth in North Maluku Province. The estimated regression coefficient for infrastructure is 2.93, with a t-statistic of 2.146 and a p-value below 0.05, confirming that improvements in infrastructure contribute to higher economic growth. Although the magnitude of this effect suggests that the acceleration of growth remains relatively slow, infrastructure development continues to exert a gradual and positive influence over time. This finding implies that infrastructure investment policies should be implemented progressively and sustained over the long term. Such an approach is particularly important given the persistent development disparities across the ten regencies/cities in North Maluku Province.

Evidence from the empirical findings and the observed regional conditions suggests that infrastructure development in North Maluku Province has not been evenly aligned with the distribution of natural resource potential. Several regions endowed with abundant natural resources still lack adequate supporting infrastructure, while other areas with relatively well-developed infrastructure have not been able to manage their natural resources optimally. A clear illustration of this imbalance can be found on Obi Island in South Halmahera Regency. Despite its significant nickel reserves and its designation as part of a National Strategic Project, the region continues to face limitations in basic infrastructure provision. This paradox reflects broader development disparities that stem not only from challenging geographical conditions, but also from public policies that have yet to be sufficiently focused and well targeted in addressing infrastructure needs.

From a theoretical perspective, the relatively slow transmission of infrastructure development effects to economic growth suggests that the functional role of public investment has not been fully optimized. Brilyawan (2021) argued that infrastructure development, as a form of physical capital investment, plays a crucial role in accelerating economic growth by supporting economic activities and strengthening connectivity across sectors. Infrastructure facilitates linkages among production, distribution, and consumption processes, thereby enhancing the efficiency of goods and services flows within a given period. When these functions are not fully realized, the growth-enhancing potential of infrastructure investment tends to unfold gradually rather than rapidly.

This view is also consistent with the findings of Aulia Sari (2024) who emphasized that the positive relationship between infrastructure and economic growth depends heavily on the productivity of government investment decisions. In other words, the effectiveness of infrastructure development is closely linked to how well public policies translate budget allocations into productive physical capital. Stronger policy commitment and more strategic planning in infrastructure development can, therefore, act as a catalyst for sectoral expansion and, ultimately, higher economic growth.

Based on the above explanations, the observed infrastructure-related disparities in North Maluku Province over recent years can be attributed to development policies that continue to face significant geographical constraints, particularly in island-based regions across Halmahera Regency. These areas still require substantial improvements in basic facilities, including roads,

dams, ports, housing, airports, and industrial facilities. The availability of such infrastructure is essential to support regional economic activities, enable more efficient and sustainable exploitation of natural resources, and strengthen the foundations for balanced economic growth across North Maluku Province.

The Effect of Human Capital on Economic Growth in North Maluku Province

The estimation results show that human capital has a positive and statistically significant effect on economic growth in North Maluku Province. The regression coefficient for human capital is 115.39, with a t-statistic of 3.343 and a p-value below 0.05. These results indicate that improvements in human capital contribute positively to economic growth. However, the empirical evidence also suggests that this positive contribution has not yet been fully realized in structural terms. In practice, the existing quality of human resources remains insufficient to meet the labor absorption needs of key economic sectors. While human capital is theoretically expected to enhance per capita output and overall economic performance, its current impact in North Maluku Province appears constrained by these structural limitations.

Field observations and supporting data reveal that the disparities in human capital development are largely driven by unequal access to education across regencies/cities. Several regions continue to record education index values below 70%, indicating limited educational attainment. Moreover, the Human Development Index (HDI) for North Maluku Province, although categorized as relatively moderate at 68.86%, still reflects substantial gaps in access to education, health services, and adequate income. These disparities serve as key indicators of labor quality and productivity, which in turn affect regional economic performance. Despite the province's abundant natural resource endowment, the lack of highly skilled and professional human resources, both in terms of labor capacity and land ownership in resource management, has limited the optimal utilization of these economic potentials.

From a theoretical standpoint, this condition is consistent with the Solow-Swan growth model (1956), which emphasized human capital as a critical determinant of economic growth. In North Maluku Province, the relatively low contribution of human capital can be attributed to the limited capacity of the workforce to adopt and develop modern production technologies. Production activities in many areas remain largely traditional, reducing labor productivity and competitiveness. As a consequence, employment in industrial sectors tends to be dominated by workers from outside the region or by foreign labor, rather than by the local workforce. In this context, this pattern directly affects per capita output and income growth.

Another similar explanation is provided by Romer (1990), particularly through the concept of "school enrollment rates". Unequal access to education leads to disparities in human capital accumulation, which ultimately affect the ability of workers to generate value added across economic sectors. This disparity is clearly reflected in HDI variations among the regencies/cities. Of the ten regions in North Maluku Province, only two (Ternate City and Tidore Islands City) record HDI levels above 70%, even surpassing the national average. The relatively high HDI in these two urban areas is supported by well-developed educational and health infrastructure, as well as their historical role as administrative and trade centers in the province. Nevertheless, despite stronger human capital indicators, their economic growth rates remain lower than those of mining-based regions that generate substantial regional revenue and exhibit lower poverty rates. This contrast underscores the critical importance of education access in shaping quality human resources as productive labor and in influencing economic growth outcomes.

These findings are in line with an earlier research by Ramadhani (2022), which emphasized that human capital should not be viewed merely as an output-related factor, but rather as a long-term investment within regional economic development models. In this context, government policy plays a central role in fostering economic growth by ensuring broad access to quality education and health services, as well as by supporting adequate income and wage levels that enhance labor productivity.

Based on the above explanations, the empirical evidence suggests that the disparities in human capital in North Maluku Province, particularly as measured by workforce quality, are closely linked to variations in educational attainment quality and the effectiveness of government policies in job creation. Addressing these challenges is essential for strengthening the role of human capital as a driver of economic growth and for achieving more balanced and sustainable development across the province.

The Effect of PAD on Economic Growth in North Maluku Province

The regression results indicate that PAD has a positive and statistically significant effect on economic growth in North Maluku Province. The estimated coefficient for PAD is 14.214, with a t-statistic of 3.225 and a p-value below 0.05. This finding confirms that increases in PAD contribute cumulatively to regional economic growth. From a descriptive perspective, the highest PAD levels are observed in regencies endowed with substantial natural resource potential, particularly in mining-based areas such as Central Halmahera Regence, East Halmahera Regency, and South Halmahera Regency. In contrast, regions whose economic base relies more heavily on trade, agriculture, and tourism include Ternate City, Tidore Islands City, Taliabu Island Regency, Sula Islands Regency, and Morotai Island Regency. These differences in revenue generation reflect variations in the availability and utilization of base economic sectors across regions.

Despite relatively strong PAD performance in certain areas, its contribution to provincial economic growth remains uneven. This imbalance is largely attributable to structural disparities in regional economic bases at the regency/city levels. An analysis based on the Klassen typology illustrates that the highest contributions to economic growth are concentrated in mining-oriented regions, particularly Central Halmahera Regency, which is classified as a fast-growing and rapidly developing region in terms of both economic growth and per capita income. By contrast, several regions are categorized as developed but under pressure, such as Ternate City, South Halmahera Regency, and East Halmahera Regency, while others remain relatively lagging, including West Halmahera Regency, North Halmahera Regency, Tidore Islands City, Sula Islands Regency, Taliabu Island Regency, and Morotai Island Regency. These classifications highlight differences in sectoral bases and their capacity to generate PAD.

From a theoretical perspective, variations in regional revenue are closely linked to differences in natural resource management and fiscal capacity, as outlined in the amended Law No. 23 of 2014 on regional government, which defines PAD sources as including local taxes, retributions, revenues from natural resource management, and other legitimate local income. This view is reinforced by Mailindra (2023), who argued that the level of PAD in a given period is largely determined by the ability of local governments to manage and optimize their economic base potential. Such management must account for ongoing structural shifts in the economy, including changes in business activities, income levels, and infrastructure accessibility, in order to remain sustainable.

The findings of this study are consistent with previous researches by Tumangken (2018)

and Mailindra (2023), both of which concluded that regional revenue has a consistently positive impact on economic growth. In this context, higher PAD reflects more effective utilization of base sectors, which not only increases local revenue, but also stimulates broader economic growth.

Based on the above explanations, the findings suggest that relatively high levels of PAD in North Maluku Province are largely the outcome of successful local government policies in managing natural resource potential in an efficient and effective manner. When local governments are able to provide adequate public services and a supportive environment for economic activities in key sectors, such as industry, mining, trade, agriculture, and tourism, the regional economic growth is more likely to accelerate and reach its full potential.

CONCLUSION

The findings of this study confirm that infrastructure, human capital, and PAD have positive and statistically significant effects on economic growth in North Maluku Province. Nevertheless, this study is subject to several limitations. First, this study was limited to a relatively short research period (2021–2024) and second, this study relied exclusively on secondary data. This made the analysis might not fully capture long-term structural changes or institutional factors influencing regional growth. Future research is therefore recommended to extend the study period, include a broader set of explanatory variables, and apply more advanced analytical approaches to better capture interregional relationships and long-run growth processes and enrich the understanding of regional economic growth in North Maluku Province and other regions.

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