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The Impact of the Blue Economy and Macroeconomics on Economic Growth in Indonesia

Afrila Eki Pradita[1], E.S Margianti[2], RR. Dharma Tintri Ediraras[3]
[1]Gunadarma University, Indonesia, afrila_pradita@staff.gunadarma.ac.id
[2]Gunadarma University, Indonesia, margianti@staff.gunadarma.ac.id
[3]Gunadarma University, Indonesia, dharmate@staff.gunadarma.ac.id

Corresponding Author: afrila_pradita@staff.gunadarma.ac.id[1]

Abstract: Indonesia's maritime sector contributes approximately 2.5% to the gross domestic product. Despite the country's vast marine territory, its potential remains underexplored and underutilized. This study aims to analyze the impact of the blue economy and macroeconomic factors on regional economic growth in Indonesia. The research object is the regional economic growth of provinces across Indonesia. The secondary data analyzed include inflation, investment, labor, the Human Development Index, total fisheries production, the fishermen and fish farmers' terms of trade, and regional gross domestic product from 2010 to 2023 across 32 provinces. The data were examined using descriptive statistical analysis and panel data regression methods. The results indicate that inflation, labor, the Human Development Index, and fisheries production volume significantly affect provincial regional economic growth.

Keywords: Blue Economy, Macroeconomic Factors, Regional Economic Growth

INTRODUCTION

The concept of the blue economy (Pauli, 2010) was first introduced in the book *The Blue Economy: 10 Years – 100 Innovations – 100 Million Jobs*. According to *The 2018 Annual Economic Report on the EU Blue Economy*, the blue economy encompasses all economic activities related to oceans, seas, and coastal areas. The logic applied in the blue economy concept is ecosystem-based, where ecosystems function efficiently by circulating nutrients and energy without generating waste to fulfill the basic needs of all contributors within the system. The blue economy holds significant potential for further development and utilization.

Indonesia is an archipelagic country consisting of 17,499 islands, with marine waters covering approximately 6,400,000 km², representing about 77% of the nation's total territorial area (Mulyadi et al., 2021). Indonesia's geographical position further supports the potential growth of the blue economy, as it lies between the continents of Asia and Australia and is bordered by the Indian and Pacific Oceans, forming a major crossroads for global transportation by air and sea. This condition signals strong opportunities for Indonesia to increase its gross domestic product through the utilization of the blue economy. However, this potential has not yet been matched by optimal resource management. The contribution of the

fisheries sector to national GDP from 2010 to 2023 has remained at approximately 2% annually. Additionally, in 2014, the Minister of Marine Affairs and Fisheries, Susi Pudjiastuti, highlighted the untapped potential for Non-Tax State Revenue (PNBP) amounting to IDR 25 trillion per year from fish and non-fish resources. Coastal and marine areas also account for about 70% of the nation's oil and gas resources (Rakhmindyarto & Sinulingga, 2012).

Optimizing fisheries production represents one of the key implementations of the blue economy. According to Statistics Indonesia (Badan Pusat Statistik, 2023), fish production refers to the total output obtained from capture fisheries or aquaculture activities involving fish, other aquatic animals, or aquatic plants harvested from natural fisheries resources or cultivation facilities, whether operated by fisheries companies or household enterprises. The Ministry of Marine Affairs and Fisheries classifies total fish production into three categories: aquaculture, marine capture fisheries, and inland open-water capture fisheries. Total fisheries production has been found to positively and significantly affect economic growth in member countries of the South Asian Association for Regional Cooperation (SAARC), including Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka, and the Maldives (Alharthi & Hanif, 2020).

Fisheries production is closely related to fish consumption. Indonesia is currently the world's second-largest producer of fisheries products after China (Dewi & Fatah, 2021). To meet market opportunities in Europe's marine and fisheries sector, Indonesia has strong export potential for tuna, shrimp, and lobster. However, the country still faces challenges; for instance, approximately 99% of Indonesian fishers are traditional fishers whose boats have relatively small tonnage and limited range. A long-term analysis conducted across 101 countries from 1970 to 2006 identified a long-run cointegration relationship between GDP and fish consumption (Jang & Chang, 2014).

Regional economic growth serves as a benchmark for development success and societal welfare within a region. Several factors influence regional economic growth. Santoso, Mopangga, and Saputra (2023) concluded that fisheries production in Gorontalo Province has a positive and significant effect on economic growth. Population size, provincial minimum wages, foreign direct investment, the Human Development Index, and farmers' terms of trade have also been shown to influence regional economic growth (Sari & Setyowati, 2023). According to Megondaru and Hasmarini (2022), economic growth on the island of Java is affected by inflation and human capital. Similar findings were reported by Widyastuti and Nugraha (2021), who found that economic growth in Java during the 2015–2016 period was influenced by investment, fisheries production, and labor. These studies suggest that economic growth is shaped by both macroeconomic factors and blue economy variables.

One indicator commonly used to measure regional economic growth is Gross Regional Domestic Product (GRDP), defined as the total value added generated by all business units within a region (Badan Pusat Statistik, 2024). Based on current price GDP data, in 2021 the agriculture, forestry, and fisheries sector contributed 13.28% to Indonesia's GDP, equivalent to IDR 2,253,836 billion.

Despite the growing literature on regional economic growth and fisheries development in Indonesia, several important gaps remain. First, most previous studies examine macroeconomic determinants and fisheries variables separately rather than integrating them into a unified empirical framework. Second, existing studies are generally limited to specific regions (e.g., Java or Bali) or shorter observation periods, thereby lacking long-term cross-provincial panel analysis. Third, limited attention has been given to examining how blue economy indicators interact simultaneously with macroeconomic variables in explaining regional economic growth within an archipelagic developing country context.

Therefore, this study contributes to the literature by integrating blue economy indicators—namely Fisheries Production Volume and Fishermen and Fish Farmers' Terms of

Trade—with key macroeconomic variables within a 14-year provincial panel dataset (2010–2023). By employing a fixed effect panel model across 32 provinces, this research provides a more comprehensive understanding of the blue economy–growth linkage and offers empirical evidence from Indonesia as a maritime developing country. This integrated approach expands previous empirical findings and strengthens the analytical foundation for regional blue economy policy formulation.

METHOD

This study employs an explanatory research design to analyze the impact of macroeconomic variables and blue economy indicators on regional economic growth across Indonesian provinces during the period 2010–2023. Regional economic growth is measured using the growth rate of Gross Regional Domestic Product (GRDP), which reflects the economic performance of each province in utilizing its available resources.

Although Indonesia currently consists of 38 provinces, this study includes 32 provinces due to data completeness constraints for the full observation period (2010–2023). Newly established provinces and provinces with incomplete time-series data were excluded to ensure data consistency and comparability across provinces. The final dataset therefore represents provinces with complete and reliable macroeconomic and fisheries data throughout the study period.

The initial dataset consisted of 448 observations (32 provinces × 14 years). However, due to several missing values in specific provincial-year records, the final estimation used 441 observations, resulting in an unbalanced panel structure. The use of an unbalanced panel does not invalidate the estimation results, as panel regression techniques can accommodate missing data while maintaining consistency and efficiency of estimators.

The sampling technique applied is purposive sampling, based on the availability and completeness of provincial-level data published by official institutions, including Statistics Indonesia (BPS) and Bank Indonesia. Secondary data were collected for the period 2010–2023.

The endogenous variable in this study is regional economic growth (GRDP growth rate). The exogenous variables consist of:

1. Inflation (I)
2. Investment (Inv), proxied by Domestic Investment (PMDN) growth
3. Labor (L), measured by the Labor Force Participation Rate (LFPR)
4. Human Development Index (HDI)
5. Fisheries Production Volume (FPV), measured as growth in capture and aquaculture production
6. Fishermen and Fish Farmers' Terms of Trade (FTT)

All variables are expressed in level or growth rate form as reported in official statistics and are not transformed into logarithmic form.

Model Specification

The panel regression model used in this study is specified as follows:

$$GRDPG_{it} = \alpha + \beta_1 Inflation_{it} + \beta_2 Investment_{it} + \beta_3 Labor_{it} + \beta_4 HDI_{it} + \beta_5 FPV_{it} + \beta_6 FTT_{it} + \mu_i + \varepsilon_{it}$$

where:

1. i represents province
2. t represents year (2010–2023)
3. μ_i captures province-specific fixed effects
4. ε_{it} is the error term

Panel data regression combines cross-sectional and time-series dimensions, enabling more efficient estimation and better control of unobserved heterogeneity across provinces.

Model Selection Procedure

To determine the most appropriate estimation model, three panel data approaches were considered:

1. Common Effect Model (CEM) using Ordinary Least Squares (OLS)
2. Fixed Effect Model (FEM) using Least Squares Dummy Variable (LSDV)
3. Random Effect Model (REM) using Generalized Least Squares (GLS)

The Chow test was conducted to compare the Common Effect Model and the Fixed Effect Model. The results indicated that the Fixed Effect Model was preferred. Subsequently, the Hausman test was applied to compare the Fixed Effect Model and the Random Effect Model. The Hausman test results supported the use of the Fixed Effect Model, indicating that the fixed effect estimator is consistent and appropriate for this dataset. Therefore, the Lagrange Multiplier test was not required.

The Fixed Effect Model is particularly suitable in this study because it controls for unobserved time-invariant provincial characteristics, such as geographical conditions, institutional differences, and structural economic composition, which may influence regional economic growth.

Econometric Considerations

Given the potential for reverse causality between economic growth and human development, this study acknowledges possible endogeneity concerns, particularly regarding the Human Development Index (HDI). Higher economic growth may improve human development outcomes, creating a two-way relationship. However, due to data limitations and the primary objective of examining structural provincial differences, the Fixed Effect Model is considered appropriate to mitigate omitted variable bias stemming from unobserved heterogeneity.

Future research may employ dynamic panel estimators, such as the Generalized Method of Moments (GMM), or instrumental variable approaches to address potential endogeneity issues more comprehensively.

In addition, the Durbin–Watson statistic was examined to assess potential autocorrelation. Although minor serial correlation may exist, the use of cross-section weighted estimation (PCSE) helps to improve robustness of standard errors.

RESULTS AND DISCUSSION

Labor, capital, technology, and entrepreneurship are four production factors that consistently form the foundation of economic growth discussions. Smith (1723–1790) and Schumpeter (1883–2005) introduced growth theories that are broadly categorized into three groups: classical growth theory, neoclassical growth theory, and endogenous growth theory. Classical growth theory posits that a country's economic growth will decline as population increases and resources become limited. This theory was later developed by George H. Bort (1960) into neoclassical theory, which emphasizes that regional growth is largely determined by a region's ability to enhance its production activities. Production is strongly influenced by labor mobility and capital mobility across regions. Neoclassical theory subsequently evolved into endogenous growth theory, which argues that growth is driven by internal economic factors rather than external forces. This perspective contrasts with the neoclassical model, which identifies external factors such as technological progress as the primary sources of economic growth.

The blue economy is a relatively new concept in sustainable development established by the United Nations, particularly under Goal 14—Life Below Water—which supports economic growth. Ahammed, Rana, Uddin, Majumder, and Shaha (2024) note that, theoretically, there is a causal relationship between macroeconomic indicators and the blue economy in influencing economic growth in both developed and developing countries. Several countries, particularly China, demonstrate that the blue economy significantly contributes to economic growth and welfare (Voyer et al., 2018; Burg et al., 2019; Ahammed et al., 2024). Positive macroeconomic indicators can serve as predictors of blue economy performance and encourage stronger competitiveness, thereby motivating the marine and fisheries sectors to improve their performance.

Within a strong and sustainable maritime development framework, Indonesia possesses considerable socio-economic potential. Many Asian and Australian countries share maritime boundaries with Indonesia, creating opportunities for blue economy expansion, as each coastal nation has the right to manage its coastal assets (Howard, 2018). Fisheries make substantial contributions to livelihoods in coastal regions. India produces approximately 1.2 million tons annually, while Myanmar produces around 1.1 million tons (Funge-Smith, Briggs, & Miao, 2012). Bangladesh, Sri Lanka, and Vietnam produce about 0.6 million tons, 0.12 million tons, and 0.16 million tons per year, respectively. Ensuring quality standards requires effective, efficient, and lawful coastal management, which can enhance supply and increase GDP (Bari, 2017). The convergence of the blue economy and marine ecosystems highlights the importance of ecosystem valuation in supporting coastal economic growth, addressing environmental challenges, and transforming scarce resources into abundant ones (Eikeset et al., 2018; Lillebø et al., 2017; Mulazzani et al., 2016).

Maritime transportation handles approximately 80% of the global trade volume and transported about 10 billion tons of goods in 2015. Phasing out outdated and unusable vessels is essential to ensure the success of ocean-based businesses and maintain the efficiency of global networks. Transportation serves as the backbone of global development. Although the coastlines of five ASEAN countries represent less than 2% of the world's total coastline, coastal regions account for around 40% of business activities within these countries and constitute a major part of their economic foundations. Asian coastal regions are particularly resource-rich, and the coastal tourism industry in the region has grown by approximately 8% annually. In 2014, Indonesia received a relatively high number of tourists in the region, while Bangladesh recorded the lowest (Adam, 2015).

Analyzing economic growth in Indonesia requires attention not only to the blue economy but also to macroeconomic factors. Macroeconomics examines the overall condition of an economy rather than focusing solely on individual producers or consumers. It evaluates the collective actions of consumers, businesses, governments, and financial institutions and their impact on the broader economy. The primary objective of macroeconomic analysis is to ensure balanced and sustainable economic performance while avoiding conditions that threaten stability. Three major short-term macroeconomic issues include inflation, unemployment, and balance of payments inequality (Priyono & Chandra, 2016). Understanding macroeconomics is therefore essential for enhancing national economic growth.

Inflation refers to a sustained increase in the general price level of goods and services over a certain period (Bank Indonesia, 2024). According to Keynes (1936), inflation occurs when certain groups within society—namely the government, entrepreneurs, and labor unions—seek to achieve living standards beyond the limits of available economic resources. Keynesian theory suggests that long-term changes in aggregate demand affect real output and employment.

Investment represents a commitment of money or other resources with the expectation of generating future returns (Bodie, Kane, & Marcus, 2019). Investments can take the form of

real assets or financial assets. Real assets include land, buildings, equipment, and knowledge used to produce goods or services that generate net economic benefits. Financial assets, such as stocks and bonds, do not directly expand an economy's productive capacity. Investment has been shown to influence Gross Regional Domestic Product in Bali Province during the 2010–2020 period (Sari & Setyowati, 2023). However, contrasting findings by Megondaru and Hasmarini (2022) suggest that investment does not significantly affect economic growth on the island of Java.

Another important macroeconomic factor is labor. According to Law of the Republic of Indonesia No. 13 of 2003, labor refers to any individual capable of performing work to produce goods and/or services for personal or societal needs. Workers are formally bound to employers through employment agreements. In this study, labor is measured using the regional labor force participation rate. Statistics Indonesia (2023) defines the labor force participation rate as the percentage of the labor force relative to the total working-age population, defined as individuals aged 15 years and above.

Beyond labor, human development is another critical factor in measuring economic growth. Human development forms part of the Sustainable Development Goals (SDGs), a global initiative designed by the United Nations to address poverty, protect the planet, and ensure prosperity and justice for all. Human development is commonly measured using the Human Development Index (HDI).

Megondaru and Hasmarini (2022) found that investment does not affect economic growth, whereas inflation has a positive effect. In contrast, Widyastuti and Nugraha (2021) reported that investment and fisheries production significantly influence economic growth, while labor has a negative effect. Mardyani and Yulianti (2020) found that fisheries output and labor positively affect economic growth, whereas fisheries investment has a negative impact.

Development across all sectors is a primary objective of Indonesian government policy, reflected in efforts to improve the welfare of the entire population. Indonesian society encompasses diverse professions, including farmers. The farmers' terms of trade serve as an indicator for measuring farmers' purchasing power.

The Farmers' Terms of Trade (FTT) is defined as the ratio between the price index received by farmers (It) and the price index paid by farmers (Ib). The former indicates producers' income, while the latter reflects farmers' consumption and production costs. The Fishermen and Fish Farmers' Terms of Trade (FTT) represents the equivalent measure within the fisheries subsector. Statistics Indonesia classifies the farmers' terms of trade into five subsectors: food crops, horticulture, estate crops, livestock, and fisheries (Statistics Indonesia, 2023).

The Fishermen and Fish Farmers' Terms of Trade also serves as a measure of welfare among fishers and aquaculture practitioners. When FTT > 100, it indicates that fishers experience a surplus relative to the costs incurred. Research by Sari and Setyowati (2023) concluded that fishermen's terms of trade have a positive but not significant effect on regional economic growth.

The Ministry of Marine Affairs and Fisheries categorizes aquaculture into three types: hatchery, grow-out, and ornamental fish cultivation. In this study, the fisheries production volume variable is measured by the growth rate of capture fisheries (marine capture and inland open-water capture) and aquaculture production (grow-out) across provinces during the 2010–2023 period. Alharthi and Hanif (2020) concluded that fisheries production makes a substantial contribution to economic growth. Similar findings have been reported by Rehman et al. (2019), ALshubiri (2018), Widyastuti and Nugraha (2021), Mardyani and Yulianti (2020), Udoh and Akpan (2019), Putri et al. (2021), and Santoso et al. (2023). Additionally, Sari and Setyowati (2023) found that farmers' terms of trade influence gross domestic product in Bali.

The research sample used in this study consists of 32 provinces in Indonesia. These provinces include Nanggroe Aceh Darussalam, North Sumatra, West Sumatra, Riau, Jambi, South Sumatra, Lampung, Bangka Belitung Islands, Riau Islands, West Java, Central Java, Special Region of Yogyakarta, East Java, Banten, Bali, West Nusa Tenggara, East Nusa Tenggara, West Kalimantan, Central Kalimantan, South Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi, Gorontalo, West Sulawesi, Maluku, North Maluku, Papua, Bengkulu, and West Papua.

Statistical analysis is necessary to examine the distribution of data for the variables used during the observation period.

Table 1. Descriptive Statistics of Variables

	INFLATION	INV	TK	IPM	VPP	NTNP	LPDRB
Mean	0,042759	7,734839	0,679848	0,689623	0,095711	1,039396	0,044556
Median	0,037050	0,200312	0,679450	0,693200	0,048007	1,044350	0,050350
Maximum	0,115800	1285,000	0,896700	0,810700	3,236821	1,272300	0,465600
Minimum	-0,000500	-0,999970	0,575400	0,544500	-0,767340	0,113498	-0,093400
Std. Dev.	0,024153	68,86629	0,039828	0,043136	0,337644	0,084773	0,044998
Skewness	0,719634	15,47180	0,734109	-0,285521	4,694325	-3,009646	4,084059
Kurtosis	2,792349	272,4402	4,874579	3,646942	38,41634	33,74514	37,61520
Observations	448	448	448	448	448	448	448

Source: EViews 13, processed data

Based on Table 1, the Inflation variable has a mean value of 0.042, a maximum value of 0.1158, and a minimum value of −0.0005. These results indicate that the average inflation rate from 2010 to 2023 was 4.2%, with the highest inflation occurring in West Sumatra Province in 2014 and the lowest in Maluku Province in 2017.

The Investment variable has a mean value of 7.734, a maximum value of 1.285, and a minimum value of −0.999. These findings suggest that the average growth of Domestic Investment (PMDN) during 2010–2023 was 773.4%, with the highest allocation recorded in the Bangka Belitung Islands Province in 2011 and the lowest in Maluku Province in the same year.

The Labor variable has a mean value of 0.679, a maximum value of 0.896, and a minimum value of 0.575. This indicates that the average provincial Labor Force Participation Rate (LFPR) from 2010 to 2023 was 67.9%. The highest LFPR, at 89.67%, occurred in West Java Province in 2010, while the lowest, at 57.54%, was recorded in Jambi Province in the same year.

The Human Development Index (HDI) variable shows a mean value of 0.6896, a maximum of 0.8107, and a minimum of 0.5445. The average HDI across Indonesian provinces during 2010–2023 was 68.96%. The highest HDI was observed in the Special Region of Yogyakarta in 2023 at 81.07%, while the lowest was recorded in Papua Province in 2010 at 54.45%.

The Fisheries Production Volume (FPV) variable has a mean value of 0.0957, a maximum value of 3.2368, and a minimum value of −0.7673. The average FPV growth from 2010 to 2023 was 9.57%. East Nusa Tenggara Province recorded the highest FPV in 2010, whereas the lowest was observed in the Special Region of Yogyakarta in 2019.

The Fishermen and Fish Farmers' Terms of Trade (FTT) variable has a mean value of 1.0393, a maximum of 1.2723, and a minimum of 0.1134. The average FTT during 2010–2023 was 103.93%. The highest welfare level among fishers and fish farmers was recorded in Maluku Province in 2013, while the lowest was observed in the Riau Islands Province in 2018.

The GRDP Growth Rate (GRDPG) variable has a mean value of 0.0445, a maximum value of 0.4656, and a minimum value of −0.0934. The average provincial regional economic

growth in Indonesia from 2010 to 2023 was 4.45%. The highest growth occurred in Papua Province in 2010, while the lowest was recorded in Bali Province in 2020.

Model selection testing is necessary in panel data regression analysis to determine the most appropriate model. Three alternative models are commonly used: the fixed effect model with the Least Squares Dummy Variable (LSDV) approach, the random effect model with the Generalized Least Squares (GLS) approach, and the common effect model with the Ordinary Least Squares (OLS) approach. The Chow test, Hausman test, and Lagrange Multiplier (LM) test were employed to identify the best-fitting model. Based on the results of the Chow and Hausman tests, consistent findings indicated that the fixed effect model was the most appropriate; therefore, the Lagrange Multiplier test was not required.

The testing of the impact of exogenous variables on the endogenous variable is presented in Table 2 below.

Table 2. Model Testing Results

Dependent Variable: LPDRB
Method: Panel EGLS (Cross-section weights)
Date: 11/25/24 Time: 22:05
Sample: 2010 2023
Periods included: 14
Cross-sections included: 32
Total panel (unbalanced) observations: 441
Linear estimation after one-step weighting matrix
Cross-section weights (PCSE) standard errors & covariance (no d.f. correction)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0,287304	0,042832	-6,707705	0,0000
I	0,428235	0,041720	10,26457	0,0000
Inv	0,000704	0,000565	1,246261	0,2134
TK	-0,080903	0,038649	-2,093265	0,0370
IPM	0,515234	0,049808	10,34446	0,0000
VPP	0,007635	0,003749	2,036530	0,0424
NTNP	0,013966	0,010122	1,379816	0,1684

Effects Specification
Cross-section fixed (dummy variables)

Weighted Statistics			
R-squared	0,368208	Mean dependent var	0,082052
Adjusted R-squared	0,310202	S.D. dependent var	0,049482
S.E. of regression	0,038829	Sum squared resid	0,607614
F-statistic	6,347778	Durbin-Watson stat	1,531543
Prob(F-statistic)	0,000000		

Source: EViews 13, processed data

The partial test results are presented in Table 2. The inflation variable produces a coefficient of 0.428235. The positive regression coefficient indicates that inflation has a direct

relationship with the GRDP growth rate (GRDPG). The probability value for inflation is 0.0000, which is lower than the significance level of α = 0.05; therefore, inflation significantly affects GRDPG. The findings suggest that a one-unit increase in inflation, assuming other variables remain constant, leads to an increase in GRDP of 0.428235. Descriptive statistics for the 2010–2023 period indicate relatively stable inflation growth. Although certain regions experienced high inflation—such as West Sumatra in 2014—the government was generally able to control inflation at the aggregate level. These results are consistent with the study by Megondaru and Hasmarini (2022).

The investment variable yields a coefficient of 0.000704. The positive regression coefficient implies that investment moves in the same direction as GRDPG. However, the probability value is 0.2134, which exceeds the significance level of α = 0.05, indicating that investment does not significantly affect GRDPG. This suggests that domestic investment (PMDN) allocations have not been optimally absorbed for provincial development; thus, higher PMDN does not necessarily translate into regional economic growth in Indonesia. This finding contrasts with Widyastuti and Nugraha (2021), who concluded that investment has a significant positive effect on GRDP.

For the labor variable (L), the coefficient is −0.080903. The negative sign indicates an inverse relationship with GRDPG. The probability value of 0.0370 is below α = 0.05, confirming that labor significantly affects GRDPG. The results show that a one-unit increase in labor—proxied by the Labor Force Participation Rate (LFPR)—while holding other variables constant, results in a decline in GRDP of −0.080903. This finding suggests that increases in LFPR have not been accompanied by optimal job absorption, leading to higher unemployment and subsequently lower GRDP. These results align with Widyastuti and Nugraha (2021), who reported a negative effect of labor on GRDP growth.

The Human Development Index (HDI) variable produces a coefficient of 0.515234, indicating a positive relationship with GRDPG. The probability value of 0.0000 is below α = 0.05, demonstrating that HDI significantly affects GRDPG. The findings indicate that a one-unit increase in HDI, assuming other variables remain constant, increases GRDP by 0.515234. This suggests that consistent government efforts to improve public health, expand access to healthcare facilities, enhance educational quality, and manage household expenditures can contribute to higher regional economic growth. This result is consistent with Sari and Setyowati (2023), who found that HDI has a significant positive effect on GRDP.

The Fisheries Production Volume (FPV) variable has a coefficient of 0.007635, indicating a positive relationship with GRDPG. The probability value is 0.0424, which is lower than α = 0.05, confirming that FPV significantly affects GRDPG. A one-unit increase in FPV, holding other variables constant, raises regional economic growth by 0.007635. However, this increase remains relatively small, suggesting that fishers and fish farmers have not yet optimized fisheries production. Production activities are largely limited to selling raw fish or processing them into basic food products, with minimal development of value-added derivatives. Examples of such derivatives include fish milk, a high-protein and nutritious processed product.

In aquaculture, seaweed is the dominant commodity. In 2023, seaweed enlargement production reached 9,753,410.49 tons, surpassing commodities such as tilapia and catfish. Aquaculture entrepreneurs should further optimize seaweed production by developing derivative products such as biostimulants, bioplastics, animal feed, alternative proteins, pharmaceuticals, and even textiles. Enhancing both capture and aquaculture fisheries through technological innovation would increase the value added of fisheries output. Higher value-added products can raise selling prices and boost the income of fishers and fish farmers, ultimately contributing to GRDP growth. These findings are consistent with studies by Santoso

et al. (2023), Widyastuti and Nugraha (2021), Mardyani and Yulianti (2020), Alharthi and Hanif (2020), and Alshubiri (2018).

The Fishermen and Fish Farmers' Terms of Trade (FTT) variable produces a coefficient of 0.013966, indicating a positive relationship with GRDPG. However, the probability value of 0.1684 exceeds $\alpha = 0.05$, meaning that FTT does not significantly affect GRDPG. Fisheries production in this study refers to the total fish captured in marine and inland waters as well as aquaculture enlargement output, all measured in tons. When fishers and fish farmers increase production, production costs also rise, including expenses for seeds, fertilizers or medicines, transportation, rental fees, capital goods, and wages. If production volume and costs increase without a corresponding rise in sales, this condition will not contribute to GRDP growth. Regional economic growth is therefore not determined by FTT, as the surplus received by fishers remains relatively low. Between 2010 and 2023, the average FTT was approximately 103%, indicating a surplus of only about 3%, which is insufficient to significantly influence regional economic growth. This result aligns with Sari and Setyowati (2023), who concluded that farmers' terms of trade have a positive but insignificant effect.

From a broader economic perspective, the insignificant effect of FTT suggests that improvements in micro-level welfare indicators do not automatically translate into macro-level growth. Although FTT reflects the purchasing power and relative income position of fishers and aquaculture farmers, its contribution to aggregate regional output depends on the scale of production, the degree of value added, and the strength of backward and forward linkages within the fisheries sector. When fisheries activities remain small-scale and concentrated in primary production, multiplier effects on regional economic growth tend to be limited.

The result also indicates a weak transmission mechanism between welfare improvement and structural economic transformation. In the context of endogenous growth theory, income gains contribute to growth when they stimulate productivity enhancement, capital accumulation, and technological upgrading. However, if the surplus received by fishers is minimal and primarily used for short-term consumption rather than productive reinvestment, the long-run growth impact becomes marginal. This may explain why FTT does not significantly affect GRDP growth despite being an important welfare indicator.

Furthermore, the limited role of FTT may reflect structural inefficiencies in the fisheries value chain. Market access constraints, price volatility, dependence on intermediaries, and limited processing capacity reduce the potential for fishers' income improvements to generate broader economic spillovers. Without integration into higher value-added processing industries—such as cold storage, packaging, marine biotechnology, and export-oriented processing—income gains remain localized and insufficient to significantly influence provincial GDP growth.

The findings also highlight that the blue economy's contribution to regional growth depends not only on production volume but also on industrial upgrading. While Fisheries Production Volume shows a significant effect, the relatively small magnitude of its coefficient and the insignificance of FTT together indicate that Indonesia's fisheries sector is still predominantly resource-based rather than innovation-driven. Structural transformation toward higher productivity and technology-intensive marine industries is therefore essential to strengthen the blue economy–growth linkage.

Overall, these results suggest that welfare-oriented indicators such as FTT are necessary but not sufficient conditions for regional economic growth. Sustainable growth requires the integration of welfare improvement, productivity enhancement, and value-added expansion within the fisheries sector. Without structural upgrading and stronger economic linkages, improvements in fishermen's terms of trade will have only a limited macroeconomic impact.

The regression equation that can be formulated from the model is as follows:

$LPDRB_{it} = -0{,}287304 + 0{,}428235I_{it} + 0{,}000704Inv_{it} – 0{,}080903TK_{it} + 0{,}515234IPM_{it} + 0{,}007635VPP_{it} + 0{,}013966NTNP_{it}$

Blue Economy as a New Driver for Regional Economic Growth aligns with the United Nations Sustainable Development Goals (SDGs). The blue economy embodies SDG 14, which aims to conserve and sustainably use the oceans, seas, and marine resources for sustainable development. Inductively, the results of this study are generalizable to all provinces in Indonesia. However, deductive or province-specific analyses with time-series data remain limited due to data availability and the roadmap for the blue economy in Indonesia, except in case studies.

Law No. 32 of 2014 concerning Marine Affairs stipulates that the Central and Regional Governments, within their respective authorities, are responsible for marine management to enhance public welfare through the utilization and management of marine resources according to the principles of the blue economy. This blue economy approach aims to improve sustainable marine management, conserve marine and coastal resources, and protect their ecosystems. The optimization of value-added fisheries production still faces several challenges, including the limited fleet of fishing vessels and fishing gear, low investment in the fisheries sector, the need for fiscal policy support from the government, limited human resources employed in the domestic fisheries industry, and suboptimal capacity of fishers to use fishing equipment effectively.

Macro-economic and blue economy variables simultaneously have a significant impact (adjusted $R^2 = 31.02\%$), and partially, all variables act as predictors except investment and the Fishermen and Fish Farmers' Terms of Trade (FTT), with the Human Development Index (HDI) being the most dominant variable. Based on this explanation, other variables still need to be studied as predictors for macroeconomic indicators, such as money supply, interest rates, Rupiah/USD exchange rate, taxes, fish and seafood consumption, and fiscal policy incentives. Meanwhile, other blue economy variables, such as marine tourism, fleet size, water area coverage, logistics, and maritime transport, have not yet been included in the blue economy indicators.

CONCLUSION

This study examines the simultaneous impact of macroeconomic variables and blue economy indicators on regional economic growth across 32 Indonesian provinces during the 2010–2023 period using a fixed effect panel regression model. The findings reveal that macroeconomic and blue economy variables jointly influence regional growth, although the explanatory power of the model remains moderate.

Partially, Inflation, Labor, Human Development Index (HDI), and Fisheries Production Volume significantly affect GRDP growth. The positive impact of inflation reflects Indonesia's relatively stable and moderate inflation environment during the study period. The negative coefficient of labor suggests potential structural mismatches or diminishing marginal productivity, indicating that increases in labor participation must be accompanied by productivity enhancement. The strong positive effect of HDI supports endogenous growth theory, confirming that human capital development plays a central role in sustaining regional economic expansion. Meanwhile, Fisheries Production Volume positively affects growth, though its relatively small coefficient indicates that the structural contribution of the fisheries sector remains limited.

Investment and the Fishermen and Fish Farmers' Terms of Trade (FTT) do not show significant effects. This finding suggests that increases in domestic investment have not consistently translated into productive regional output expansion, and improvements in fishermen's welfare have not yet generated substantial macroeconomic spillover effects. The

insignificance of FTT highlights the limited transmission from micro-level welfare improvements to broader regional growth, likely due to low value-added processing and structural inefficiencies within the fisheries value chain.

Theoretically, this study contributes to the literature by integrating macroeconomic determinants and blue economy indicators within a unified provincial panel framework in an archipelagic developing country context. The findings reinforce endogenous growth arguments emphasizing human capital, while also highlighting the constrained structural role of resource-based sectors without industrial upgrading.

From a policy perspective, strengthening Indonesia's blue economy requires more than increasing production volume. Strategic efforts should focus on enhancing value-added processing, technological modernization, logistics efficiency, and integration into higher-value marine supply chains. At the same time, sustained investment in education, health, and human capital development appears to offer the strongest leverage for regional growth. Future research may consider dynamic panel approaches or additional structural variables—such as marine tourism, maritime logistics, fiscal transfers, and technological adoption—to further explore the blue economy–growth linkage.

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