**SPECIAL ECONOMIC ZONES AND LOCAL ECONOMIC DEVELOPMENT: AN INDONESIA PERSPECTIVE**

**ABSTRAK**

This study aims to analyze the determinants of economic growth in regencies/municipalities that host Special Economic Zones (SEZs) in Indonesia, using data from 14 SEZs spread across various regions. The variables analyzed include road infrastructure, investment, Regional Original Revenue (PAD), Labor Force Participation Rate (LFPR), and Human Development Index (HDI). The results show that road infrastructure, investment, LFPR, and HDI do not have a significant effect on economic growth in the short term, but have a significant effect in the long term. Meanwhile, PAD has a positive and significant effect on economic growth in both the short and long term. These findings highlight the importance of long-term development and PAD optimization in driving economic growth in SEZ regions.

**Keywords: Economic Growth, Special Economic Zones (SEZs), Road Infrastructure, Investment, Regional Original Revenue (PAD), Labor Force Participation Rate (LFPR), Human Development Index (HDI)**

1. **INTRODUCTION**

Comprehensive and sustainable development in Indonesia is a primary goal of the government and a shared hope among all Indonesians. The development process involves various stages and components designed to enhance social, economic, and environmental well-being. This process includes integrated planning, implementation, monitoring, and evaluation aligned with national development policies and strategies. Indonesia’s development agenda is in line with the programs and initiatives of the United Nations. The Sustainable Development Goals (SDGs) are a global initiative established by the United Nations with the aim of promoting sustainable social, economic, and environmental development worldwide. The SDGs began in 2015 as part of the 2030 Agenda for Sustainable Development, succeeding and continuing the commitments of the Millennium Development Goals (MDGs), which ended in 2015 (Nawir & Sinjai, 2022).

The implementation of the SDGs in Indonesia is part of a national effort to achieve sustainable development by involving various sectors and stakeholders. Indonesia has adopted and integrated the SDGs into national development policies, planning, and implementation. There are 17 main SDG goals, covering various aspects of sustainable development, one of which is the development of industry, innovation, and infrastructure. Building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation are programs that are being pursued and applied, particularly in Indonesia. One of the key objectives of SDG implementation in Indonesia is to promote inclusive and sustainable economic growth. The SDGs assist Indonesia in formulating and implementing development strategies that not only focus on economic growth but also ensure that such growth benefits all levels of society and does not harm the environment (Sampurna, 2022).

Economic growth remains one of the key indicators of a country's success in managing its resources, both human (HR) and natural (NR). According to Solow (1956), economic growth is driven by human production activities, capital accumulation, and the use of modern technology in generating output. His theory suggests that population growth can have both positive and negative impacts, and therefore must be leveraged as a productive resource. The productive use of resources aligns with Indonesia's government programs aimed at achieving economic reform. Economic reform refers to concrete actions taken by the government by targeting economic policy instruments to influence the behavior of public and private economic agents in the hope of increasing sustainable demand and controlling inflation in the national economy or increasing productive investment to achieve national economic growth and job creation targets (Bakoup, 2013).

One of the Indonesian government's strategies to accelerate economic reform is the establishment of Special Economic Zones (SEZs). SEZs are a strategic government policy aimed at developing centers of economic growth, ensuring equitable national economic distribution, supporting industrialization, and increasing employment in Indonesia. SEZs are also designated areas equipped with top-tier facilities and incentives offered to both domestic and international investors (National Council for Special Economic Zones, 2022). They are created to foster a conducive economic environment for investment, exports, and trade activities to boost economic growth as part of broader economic reform. SEZs reflect the government’s commitment to accelerating the utilization of each region’s potential resources.

However, SEZs in Indonesia face various challenges that hinder their full potential (Aggarwal, 2022). Inadequate infrastructure, particularly in remote areas, increases operational costs and reduces accessibility for investors. Bureaucratic and regulatory complexities—despite reforms like the Omnibus Law—still slow down licensing processes. A shortage of skilled labor outside Java forces companies to bring in workers from other regions or allocate extra investment for training. Competition from neighboring countries such as Vietnam, Thailand, and Malaysia, which offer more attractive policies and facilities, also poses significant challenges. Additionally, weak integration with local industries limits SEZs' impact on the domestic economy, and environmental risks like pollution and deforestation further complicate their development. Long-term sustainability is another concern, as some projects have failed to expand or maintain consistent operations, reducing SEZs' overall contribution to economic growth.

The competition among Special Economic Zones (SEZs) in Southeast Asia is quite intense, particularly between Indonesia, Malaysia, and Thailand. Indonesia currently has the highest number of SEZs in the region, with a total of 20 zones spread across various areas. These SEZs cover key sectors such as manufacturing, tourism, and mining. Malaysia, in contrast, has five major SEZs or economic corridors. These zones, known as Economic Corridors or Special Economic Zones, mainly focus on regional development and specific industrial sectors.

One of the main goals of SEZ development in Indonesia is to boost regional economic growth (Afriyana et al., 2023). Through SEZs, Indonesia aims to strengthen local economies by attracting investment, creating job opportunities, and utilizing local resource potential. The Indonesian government is working to reduce the gap between developed and underdeveloped regions by establishing SEZs in areas that have potential but are less developed. This initiative is expected to promote more equitable economic distribution and enhance overall national welfare.

The economic growth of regencies/municipalities hosting SEZs in Indonesia demonstrates interesting dynamics that warrant deeper analysis. Some regions have experienced significant economic growth after the COVID-19 pandemic in 2020, such as East Kutai Regency, which saw a sharp increase from -3.08% in 2020 to 7.71% in 2023. However, not all areas followed the same pattern. Pandeglang Regency, for example, experienced improvement in 2021 and 2022, but then saw its economic growth decline to 2.53% in 2023. This suggests the presence of structural issues or suboptimal policy implementation, despite the SEZ's role in promoting growth.

The economic slowdown in Pandeglang Regency to 2.53% in 2023, despite earlier improvements, may be due to several factors. One key issue is the limited diversification of the local economy—Pandeglang remains heavily reliant on the tourism sector, which is vulnerable to global economic fluctuations and shifting travel trends. In addition, the implementation of the Tanjung Lesung SEZ has not been fully optimized in terms of supporting infrastructure, investment promotion, or integration with the local community. Other contributing factors include limited accessibility and transportation, which reduce the attractiveness of the SEZ to investors. These combined issues hinder the full potential of the SEZ to drive sustainable economic growth in Pandeglang (Rokhman et al., 2024).

Another significant issue is the economic fluctuation seen in several regions. For instance, Denpasar City experienced a sharp contraction of -9.44% in 2020 but rebounded to 5.69% in 2023. The high dependency on a single sector, such as tourism in Denpasar, magnified the pandemic’s negative impact and posed challenges to economic diversification. Other regions, such as Morotai Island Regency, showed relatively stagnant growth, increasing only from 2.01% in 2020 to 2.48% in 2023, despite the operation of the Special Economic Zone (SEZ). This indicates that efforts to simplify economic regulations in the region have not had a significant impact on the regional economy.

One of the main objectives behind the establishment of Special Economic Zones (SEZs) is to create a new investment ecosystem that attracts both domestic and foreign investors. Expanding these zones through investment is crucial to ensure sustainable development in line with the intended goals of SEZs. Investment in SEZs is important for several reasons. SEZs are areas governed by policies and regulations that differ from those in surrounding regions, with the aim of promoting economic growth and attracting investment (Katarzyna and Elżbieta, 2023). These zones are often developed in economically underdeveloped areas. Investment in SEZs can boost local economic growth, create jobs, and improve infrastructure. Typically, SEZs offer a range of incentives such as tax breaks, streamlined licensing procedures, and more flexible regulations to attract investors, making them appealing locations for companies to operate and invest.

Investing in SEZs can also enhance a region’s competitiveness, both nationally and internationally. This is because SEZs often focus on strategic sectors such as technology, manufacturing, or tourism. Many SEZs are specifically designed to foster innovation and the adoption of high technology. Investment in these zones can accelerate the uptake of new technologies and increase productivity. Additionally, investment in SEZs is frequently accompanied by the development or enhancement of infrastructure such as transportation, energy, and telecommunications. High-quality infrastructure improves operational efficiency and enhances the attractiveness of SEZs to investors.

Based on research conducted by Diantari and Wirathi (2023) and Suryade et al. (2022), investment is identified as one of the primary variables influencing economic growth in the respective SEZ locations examined. Its impact is evident across multiple dimensions, including job creation, infrastructure enhancement, and industrial sector development. Investment within SEZs frequently involves large-scale projects such as factories, resorts, or business centers, which generate direct employment opportunities. Furthermore, investment stimulates indirect employment through supply chains, support services, and related sectors. By leveraging available policies and incentives, SEZs have the potential to become dynamic and sustainable economic growth hubs—facilitating labor absorption, improving infrastructure both in quality and quantity, encouraging industrial diversification, and increasing regional revenues.

In contrast, a study conducted by Wu et al. (2021) in one Chinese city revealed that investment did not exhibit a statistically significant effect on economic growth. While investment is generally expected to have a positive impact on economic expansion, these findings illustrate that under certain circumstances, investment can have negligible or even detrimental effects. One of the main constraints identified was the lack of infrastructure, which hampers productivity and reduces the effectiveness of investment, thus reducing its potential to stimulate economic growth. This discrepancy underscores the need for context-sensitive policy implementation and highlights that the success of investment-driven development strategies in SEZs is highly dependent on complementary factors, particularly robust infrastructure and an efficient institutional framework. These findings imply that investment in infrastructure is a crucial investment. Infrastructure investment can be a sustainable investment that will impact other sectors. Infrastructure development serves as a fundamental foundation for long-term investment programs. This development involves private and public participation to ensure that all surrounding elements benefit sustainably. According to Paksi (2020), infrastructure development policies should not only aim to increase output value but also ensure equitable distribution.

Infrastructure is a fundamental pillar of the development process. Sustainable development can only be achieved with the support of various components, one of which is the availability of infrastructure facilities. Adequate infrastructure contributes positively to the sustainability of community life, as seen through improved welfare, income distribution, and the fulfillment of basic societal needs. According to Government Regulation of the Republic of Indonesia No. 2 of 2011 on the Implementation of SEZs, Article 29 states that regions designated as SEZs are given three years to commence operations and development, which includes land acquisition and physical infrastructure development. This includes the construction of capital goods as well as supporting infrastructure and facilities.

Infrastructure within SEZs plays a vital role in supporting all types of activities, particularly economic activities. It also acts as a trigger to attract both domestic and foreign investment. According to Tarigan (2019), infrastructure refers to physical systems such as transportation, irrigation, drainage, buildings, and other public facilities that fulfill basic human needs within social and economic contexts. Therefore, the status of a region as an SEZ must be supported by adequate facilities and infrastructure. Mankiw (2013) explains that labor becomes more productive when equipped with proper tools, referring to physical capital as the equipment and infrastructure used to produce goods and services. Similarly, Todaro and Smith (2013) highlight that the level of infrastructure availability in a country or region is a critical factor that determines the speed and scale of economic development.

Research conducted by Qureshi and Farooq (2020) and Tarigan (2019) found a positive and significant relationship between increasing road length and a region's economic performance. Continuously improving and expanding road infrastructure is a key factor contributing positively to economic development, thereby increasing regional competitiveness in the national economy and enhancing national competitiveness in the global economy. The government plays a crucial role in stimulating economic activity by improving distribution channels through road construction and expansion. However, Zhang and Cheng (2023) found that road length had no significant impact on economic growth in the United Kingdom (UK). Their research showed that improving road conditions, not road length, improves the distribution of goods and services, which in turn facilitates regional economic activity and contributes to GDP. The transfer of district/city status to Special Economic Zones (SEZs) is expected to boost one important aspect of regional development: Regional Original Income (PAD).

As SEZs, regions receive several incentives, such as simplified licensing processes, certain tax exemptions, and substantial infrastructure investment. These incentives attract domestic and foreign investors, thereby boosting economic activity. With the growth in investment volume and business activity, local governments generate revenue from various taxes and levies, including hotel, restaurant, entertainment, and motor vehicle taxes, which are used to support business operations in the Special Economic Zones (SEZs). Furthermore, increased trade and export volumes from SEZs also contribute to regional revenues.

In addition to tax revenue, SEZs also create new employment opportunities for the local population, which in turn increases purchasing power and domestic consumption. This rise in consumption can stimulate the Micro, Small, and Medium Enterprises (MSME) sector, which serves as the backbone of regional economies. The growth of local economic activity also contributes directly to Regional Original Revenue (PAD) through market levies and income generated from the utilization of regional assets. With effective management strategies, SEZs function not only as centers of economic growth but also as sustainable sources of regional income, thereby strengthening the financial independence of local governments (Hadisantoso et al., 2023).

A study by Hamzah & Nasir (2023) found a positive and significant relationship between PAD and economic growth. PAD can positively and significantly influence economic growth if it is managed efficiently and directed toward supporting productive activities. PAD funds can be used to build infrastructure that facilitates economic activities, such as roads, ports, and industrial zones, enhancing the distribution of goods and services. Additionally, PAD can be allocated to community empowerment programs such as skills training, capital assistance for MSMEs, and the provision of quality public facilities. This indicates that PAD-sourced investments not only increase regional competitiveness but also drive the growth of strategic sectors. The multiplier effect of increased local economic activity, through higher consumption, job creation, and investment, strengthens the overall regional economy. Moreover, investment in SEZs can enhance employment opportunities and increase the Labor Force Participation Rate (LFPR).

The Labor Force Participation Rate (LFPR) is an indicator that shows the percentage of the working-age population (aged 15 and above) that is economically active, either employed or actively seeking work, compared to the total working-age population in a given area (BPS, 2023). LFPR plays a crucial role in the success of SEZs in Indonesia, as it reflects the extent to which the local population is involved in economic activities within the zone. SEZs are designed to attract investment, create employment, and stimulate economic growth, making a high LFPR a key indicator of the strategy's success. Active participation of the local workforce facilitates skills and technology transfer, boosts productivity, and reduces unemployment. Moreover, labor involvement in SEZs helps drive growth in supporting sectors such as transportation, logistics, and services. An increase in LFPR not only enhances the sustainability of SEZs but also supports broader local economic development.

esearch by Hidayati et al. (2023) and Nadhilla (2023) shows a positive and significant relationship between the Labor Force Participation Rate (LFPR) and economic growth. A higher LFPR means more people are engaged in productive activities, boosting the production of goods and services and increasing regional and national output. It also raises employment and income levels, which enhances purchasing power and stimulates domestic consumption, one of the main drivers of economic growth. Policies that promote education, job training, and employment creation can help sustain this positive cycle. Converting conventional regions into Special Economic Zones (SEZs) aims not only to support sustainable economic development but also to improve human resource quality.

Human capital quality is reflected in the Human Development Index (HDI), which includes health, education, and standard of living. SEZs contribute to improving HDI through job creation, investment, and infrastructure development, such as health and education facilities. In turn, a high HDI attracts more investors by signaling a skilled and productive workforce. This creates a mutually reinforcing relationship, SEZs help enhance HDI, while strong human development supports the success and sustainability of SEZs.

Maulidiyah and Mohammad (2024) found a positive and significant link between the Human Development Index (HDI) and economic growth. Higher HDI, reflecting better health, education, and living standards, leads to a more productive and competitive workforce, which boosts economic output and domestic consumption. This relationship is mutually reinforcing: economic growth increases government resources to invest in human development, while improved HDI further drives sustainable economic growth.

1. **LITERATURE REVIEW, HYPOTHESIS DEVELOPMENT, AND RESEARCH METHODS**

**Neoclassical Economic Growth Theory**

The neoclassical growth theory, developed by Robert M. Solow and T. W. Swan, is an improvement of earlier classical theories. According to this theory, economic growth depends on the availability of production factors such as labor, capital accumulation, and the level of technological advancement. The analysis is based on classical assumptions that the economy operates at full employment and full utilization of production factors.

This model explains that the technology used determines the level of output produced from given amounts of capital and labor. Presented in the form of the Cobb-Douglas production function, the neoclassical growth model emphasizes the roles of capital, labor, and technology. According to Solow, population growth and technological progress—though still considered exogenous—play key roles. The production function is formulated as:

**Y = F(K, L × E)**

Where F is a function and E represents labor efficiency. The term L × E measures effective labor, accounting for both the number of workers (L) and their productivity (E). This function shows that total output (Y) depends on the capital input (K) and effective labor (L × E). An increase in labor efficiency (E) alongside a growing labor force (L) enhances economic output (Mankiw, 2004). While this model can drive temporary economic growth, long-term sustainable growth depends on technological progress. Thus, Solow’s model underlines the importance of investment in the accumulation of physical capital as a key driver of growth.

**Investment**

Investment refers to the flow of expenditures that adds to the stock of physical capital—in other words, it is the amount spent by businesses to increase their capital stock over a specific period (Isma et al., 2018). Investment involves capital spending aimed at acquiring capital goods to enhance the production capacity of goods and services, which is expected to boost economic performance in the future.

According to Mankiw (2003), investment consists of goods purchased for future use. This investment is categorized into three types: business fixed investment, residential investment, and inventory investment. Business fixed investment includes facilities and equipment used by companies in production; residential investment involves the purchase of new homes, either for own occupation or rental; and inventory investment includes goods stored by companies, such as raw materials, supplies, semi-finished goods, and finished products. Investment is a key driver of economic growth, as it contributes to increased growth rates and income levels (Malau et al., 2019).

**Infrastructure**

Infrastructure refers to the physical facilities developed or required by public agencies to fulfill governmental functions, including the provision of water, electricity, waste management, transportation, and other services that support economic and social objectives. Infrastructure systems serve as the primary backbone supporting social functions and economic systems in everyday life. According to Kodoatie (2003), infrastructure can be defined as the basic facilities, structures, equipment, and installations built and required for the functioning of a society's social and economic systems.

Based on Presidential Regulation No. 42 of 2005 on the Committee for the Acceleration of Infrastructure Provision, the types of infrastructure managed by the government include: transportation infrastructure, road infrastructure, irrigation systems, drinking water and sanitation infrastructure, telematics infrastructure, electricity infrastructure, and oil and gas transport infrastructure. These are categorized as basic infrastructure due to their essential role in serving the general public, which requires government regulation and provision.

The development of road infrastructure significantly contributes to economic growth in both rural and urban areas. Roads are vital for ensuring the smooth flow of goods, services, people, money, and information between market zones, thus accelerating economic activity. Wahyuni (2009) highlights that poor road conditions hinder resource allocation, disrupt the distribution of production factors, and slow industrial and service development, ultimately affecting income levels.

**Labor Force Participation Rate (LFPR)**

The Labor Force Participation Rate (LFPR) is a key indicator in economic and labor market analysis. It reflects the proportion of the working-age population actively engaged in the labor market, either as employed individuals or as job seekers. According to Statistics Indonesia (BPS, 2023), LFPR is calculated by comparing the number of labor force participants to the total working-age population, expressed as a percentage. This indicator provides insights into the level of labor force engagement within the economy, serving as a basis for understanding labor market dynamics and formulating policies that promote productivity and welfare.

Several factors influence LFPR, including educational attainment, economic conditions, cultural norms, and government policies. Higher education levels often correlate positively with labor force participation, as individuals with better skills are more likely to find employment. Additionally, government initiatives—such as job training programs and entrepreneurship support—play a vital role in enhancing LFPR. Becker (1993) emphasized that investment in human capital, particularly in education and training, can increase both labor force participation and overall labor productivity.

**Human Development Index (HDI)**

The Human Development Index (HDI) is a composite indicator used to measure human development achievements across three basic dimensions: a long and healthy life, knowledge, and a decent standard of living. Introduced by the United Nations Development Programme (UNDP), HDI provides a comprehensive picture of the quality of life of populations across countries. The health dimension is measured by life expectancy at birth, the education dimension by mean years of schooling and expected years of schooling, and the standard of living by Gross National Income (GNI) per capita (UNDP, 2023).

HDI plays a crucial role in assessing the success of development efforts in a region or country. In the Indonesian context, Statistics Indonesia (BPS) adopts the UNDP methodology to calculate HDI at both national and regional levels. An increase in HDI is often associated with the success of development programs in the health, education, and economic sectors. However, disparities in HDI achievements across regions remain a significant challenge. Urban areas tend to have higher HDI values than rural areas due to better access to healthcare, education, and economic opportunities (BPS, 2022).

**Local Own-Source Revenue (PAD)**

Local Own-Source Revenue (Pendapatan Asli Daerah or PAD) is a key component of regional financial structure, reflecting a region’s ability to generate economic resources to fund its development needs. According to Law Number 33 of 2004 on Fiscal Balance between the Central and Regional Governments, PAD consists of regional taxes, regional levies (retributions), profits from regionally owned enterprises, and other legitimate income. The main function of PAD is to support regional fiscal independence by reducing reliance on central government transfers (Mardiasmo, 2020).

As an indicator of fiscal autonomy, PAD demonstrates the extent to which a region can manage local resources to drive economic development and improve public welfare. Regional taxes—such as hotel, restaurant, and motor vehicle taxes—are primary contributors to PAD through direct public participation. Meanwhile, retributions are collected for specific services or permits issued by the local government. The greater the PAD, the more flexibility the region has to set development priorities based on its local needs and potential (Halim, 2019).

Research Methods

This research is a quantitative study using secondary data. Secondary data refers to data that has been processed and published by institutions related to the research topic. The data used in this study is panel data, combining time series data for the period 2020–2023 and cross-sectional data from 14 regencies/cities that are designated as Special Economic Zones.

The study employs dynamic panel data regression using the FD GMM (First Differences Generalized Method of Moments) approach, processed using the E-Views 12 program. Model estimation testing with the Generalized Method of Moments (GMM) method in Stata is conducted to address issues of endogeneity, heteroskedasticity, and serial correlation in the regression model. The use of Stata generally includes defining dependent and independent variables, determining valid instruments, and selecting the appropriate type of GMM, such as Difference GMM (using differenced levels as instruments) or System GMM (combining difference and level equations). After estimation, instrument validity and model assumptions are tested using the Hansen/Sargan test for instrument validity and the Arellano-Bond test for serial correlation. These tests ensure that the instruments used are valid and that the estimation model provides consistent and efficient results.

1. **RESULT AND DISCUSSION**

**Descriptive Statistical Analysis Results**

Descriptive analysis is a statistical method used to describe, summarize, or present data in a simplified form that is easier to understand, without making generalizations or inferences about a broader population. The main objective of descriptive analysis is to provide a general overview of the characteristics of the data being studied. The following are the results of the descriptive analysis in this study.

**Table 1. Result of Descriptive Analysis**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Observations** | **Mean** | **Standard Deviation** | **Minimum** | **Maximum** |
| Economic Growth (PE) | 56 | 2.75 | 3.33 | -6.67 | 7.71 |
| Road Infrastructure (IJ) | 56 | 624.14 | 399.84 | 182 | 1,669.00 |
| Investment (INV) (in million Indonesian Rupiah) | 56 | 77,536.09 | 109,720.00 | 814 | 556,448.00 |
| Local Own-Source Revenue (PAD) | 56 | 80.83 | 13.48 | 44.76 | 123.57 |
| Labor Force Participation Rate (LFPR/TPAK) (%) | 56 | 69.05 | 5.02 | 55.43 | 80.26 |
| Human Development Index (HDI/IPM) | 56 | 73.35 | 4.81 | 62.39 | 83.71 |

The descriptive analysis results for the variables in this study provide an overview of the determinants of economic growth in regencies/cities that host Special Economic Zones (SEZs) in Indonesia. The Economic Growth (PE) variable has an average value of 2.75 with a standard deviation of 3.33. The minimum and maximum values are -6.67 and 7.71, respectively, indicating significant variation in economic growth rates across the research locations, with some areas experiencing economic contraction.

The Road Infrastructure (IJ) variable shows an average road length of 624.14 kilometers with a standard deviation of 399.84 kilometers. The minimum length is 182 kilometers, while the maximum reaches 1,669 kilometers, highlighting a considerable gap in road infrastructure availability between regencies/cities. Meanwhile, the Investment (INV) variable records an average of IDR 77,536.09 billion with a substantial standard deviation of (Indonesian Rupiah) IDR 109,720 billion. The minimum investment value is IDR 814 billion, and the maximum is IDR 556,448 billion, reflecting significant disparities in investment absorption across regions.

Other variables, such as Local Own-Source Revenue (PAD), have an average of 80.83 percent, with a minimum of 44.76 percent and a maximum of 123.57 percent, indicating that while fiscal capacity varies, it is relatively more stable compared to other variables. The Labor Force Participation Rate (LFPR/TPAK) averages 69.05% with a standard deviation of 5.02%, suggesting relatively consistent participation levels across different areas. Finally, the Human Development Index (HDI/IPM) averages 73.35, with a minimum of 62.39 and a maximum of 83.71, indicating varying levels of human development across regions, though generally at a moderately high level. These findings offer an initial picture of the economic and social disparities across the SEZ locations in Indonesia.

**Research Results Using FD-GMM (First-Difference Generalized Method of Moments)**

FD-GMM (First-Difference Generalized Method of Moments) is an econometric estimation method used to address endogeneity issues in dynamic panel regression models. FD-GMM is developed based on the GMM (Generalized Method of Moments) approach and utilizes data transformation to eliminate fixed effects that may bias estimation results. The following presents the FD-GMM estimation results.

The FD-GMM estimation results in Table 2 show that the variable L1.PE (the lag of economic growth) has a coefficient of 0.297, which is statistically significant at the 95% confidence level (p = 0.048). This indicates that economic growth in the previous period has a positive contribution to current economic growth. Specifically, a one-unit increase in L1.PE is expected to increase current economic growth by 0.297 percentage points.

**Table 2. Result of FD-GMM**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **Std. Error** | **z** | **P > z** | **[95% Conf. Interval]** |
| L1.PE | 0.297 | 0.15 | 1.97 | 0.048 | 0.002 – 0.591 |
| LIJ | -36.193 | 24.869 | -1.46 | 0.146 | -84.935 – 12.550 |
| LINV | -0.156 | 0.484 | -0.32 | 0.747 | -1.104 – 0.792 |
| PAD | 0.036 | 0.008 | 4.3 | 0 | 0.020 – 0.053 |
| TPAK | -0.05 | 0.125 | -0.4 | 0.688 | -0.296 – 0.195 |
| IPM | 0.178 | 0.444 | 0.4 | 0.689 | -0.693 – 1.048 |
| \_cons | 218.808 | 160.12 | 1.37 | 0.17 | -95.020 – 532.637 |

The variable Local Own-Source Revenue (PAD) also has a positive and significant effect on economic growth, with a coefficient of 0.036 (p = 0.000). This indicates that a 1% increase in PAD can boost economic growth by 0.036%, highlighting the importance of regional fiscal contributions to local economic development. However, other variables such as Road Infrastructure (LIJ), Investment (LINV), Labor Force Participation Rate (LFPR), and Human Development Index (HDI) did not show a statistically significant effect on economic growth (p > 0.05). This may suggest that the relationship between these variables and economic growth could be influenced by other unobserved factors not captured in this model.

**Table 3. Result of Sargan FDGMM**

|  |  |
| --- | --- |
| **Result Sargan Test** | **Prob.** |
| 2,641 | 0,292 |

The Sargan test results in Table 3. show that the Sargan test value is 2.641 with a probability (p-value) of 0.292. Since the p-value is greater than the commonly used significance level of 0.05, the null hypothesis (H₀), which states that the instruments used are valid, cannot be rejected. This indicates that the instruments used in the FD-GMM estimation are considered valid and uncorrelated with the error term, thereby satisfying the assumption of instrument exogeneity. Therefore, the estimated FD-GMM model can be considered appropriate for further analysis.

**Consistency Test of FD-GMM**

The purpose of the FD-GMM consistency test is to ensure that the GMM estimator used produces consistent parameter estimates. Consistency in FD-GMM depends on the validity of the instruments used and the absence of serial correlation in the error term. To test for consistency, the Arellano-Bond serial correlation test is typically conducted, which evaluates whether there is serial correlation in the differenced error term. The null hypothesis (H₀) of this test is that there is no second-order serial correlation (AR(2)) in the error term. If the p-value for the AR(2) test is greater than the significance level, the null hypothesis is accepted, indicating no serial correlation and confirming the consistency of the estimation. If this test is passed, the FD-GMM results can be considered reliable for interpretation.

**Table 4. Result of FDGMM Consistency Test**

|  |  |  |
| --- | --- | --- |
| **Ordo** | **Hasil Nilai Arellano Bond** | **P-*Value*** |
| 1 | -0,02729 | 0,9782 |

The FD-GMM consistency test results in Table 4 show that the Arellano-Bond test statistic for first-order serial correlation (AR(1)) is -0.02729 with a p-value of 0.9782. Since the p-value is much greater than the commonly used significance level (0.05), the null hypothesis (H₀), which states that there is no first-order serial correlation, cannot be rejected. This indicates that there is no serial correlation in the first-differenced residuals. The FD-GMM estimation is therefore considered consistent, fulfills an important assumption of the model, and can be used for further analysis.

**Unbiasedness Test of FD-GMM**

The unbiasedness test of FD-GMM can be conducted by comparing the coefficient value of the lagged dependent variable obtained from FD-GMM with the results from the Fixed Effect Model (FEM) and Pooled Least Squares (PLS). FD-GMM is designed to address potential bias in the estimation of dynamic panel models, particularly when the lagged dependent variable is used as a predictor. Such bias often occurs in FEM (typically downward) and PLS (typically upward) due to the correlation between the lagged dependent variable and the error term.

If the coefficient of the lagged dependent variable estimated using FD-GMM falls between the FEM and PLS estimates, this indicates that the FD-GMM estimate is unbiased and more reliable. This comparison serves as an additional validation of the FD-GMM results under the assumption that the method provides efficient and consistent estimates. The following presents the results of the Unbiasedness Test of FD-GMM.

**Table 5 Result of Unbiasedness Test of FD-GMM**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **FDGMM** | **FEM** | **PLS** |
| L1.PE | 0,29663952\* | 0,27883908\* | 0,23687822\*\*\* |

Based on Table 5, the coefficient value of the lagged dependent variable in the FD-GMM model is 0.29663952, which is higher than the lagged dependent variable in the Fixed Effect Model (FEM) at 0.27883908. Therefore, the model using FD-GMM does not meet the assumption of unbiasedness and cannot be continued. The estimation in this study is thus continued using the SYS-GMM method.

**Research Findings Using SYS-GMM**

**Validity Test of SYS-GMM**

The validity test of SYS-GMM (System Generalized Method of Moments) aims to ensure that the instruments used in the estimation satisfy the assumption of exogeneity, so that the model can generate consistent and efficient estimates. Instrument validity is tested using the Sargan or Hansen test, which evaluates the null hypothesis (H₀) that the instruments are valid—meaning they are uncorrelated with the error term. If the p-value of the Sargan or Hansen test is greater than the significance level (e.g., 0.05), the null hypothesis is accepted, and the instruments are considered valid.

In addition, validity can be further supported by verifying that no serial correlation exists in the differenced residuals using the Arellano-Bond test. This test assesses whether residuals from the dynamic panel model exhibit autocorrelation, which could undermine the consistency of GMM estimators. A non-significant result in the Arellano-Bond test for second-order autocorrelation (AR(2)) indicates that the residuals are free from serial correlation. These validation results are crucial to support the reliability of the SYS-GMM estimation in dynamic panel data analysis.

**Table 6. Result of Sargan SYS-GMM Test**

|  |  |
| --- | --- |
| **Sargan Test Value** | **Prob.** |
| 6,119 | 0,191 |

The validity test results of the SYS-GMM presented in Table 6. indicate that the Sargan test value is 6.119 with a probability (p-value) of 0.191. Since the p-value is greater than the commonly used significance level of 0.05, the null hypothesis (H₀)—which states that the instruments used are valid—cannot be rejected. This implies that the instruments used in the SYS-GMM estimation are considered valid, as they are not correlated with the error term, thereby meeting the assumption of instrument exogeneity. Therefore, the SYS-GMM estimation results can be regarded as reliable and appropriate for further interpretation and analysis.

**Consistency Test of SYS-GMM**

The consistency test of SYS-GMM aims to ensure that the model estimation produces consistent parameter values. The consistency of SYS-GMM relies on two main aspects: the validity of the instruments used, which can be tested using the Hansen or Sargan test, and the absence of serial correlation in the error term. If the instruments are valid (i.e., not correlated with the error term), and there is no second-order serial correlation in the first-differenced residuals (as indicated by the Arellano-Bond AR(2) test), then the SYS-GMM estimation is considered consistent. These tests are crucial to confirm that the estimated model is statistically sound and that the conclusions drawn from the analysis can be trusted.

**Table 7. Results of the SYS-GMM Consistency Test**

|  |  |  |
| --- | --- | --- |
| **Ordo** | **Arellano Bond Value** | **P-*Value*** |
| 1 | 0,01327 | 0,9894 |

The results of the SYS-GMM consistency test in Table 7 show that the Arellano-Bond test for first-order serial correlation (AR(1)) has a value of 0.01327 with a p-value of 0.9894. Since the p-value is greater than the commonly used significance level of 0.05, the null hypothesis (H₀), which states that there is no serial correlation in the differenced residuals, cannot be rejected. This indicates that there is no first-order serial correlation in the differenced residuals. These results suggest that the SYS-GMM estimation is consistent, making it reliable and appropriate for further analysis.

**Unbiasedness Test of SYS-GMM**

The unbiasedness test of SYS-GMM is conducted by comparing the coefficient value of the lagged dependent variable obtained from the SYS-GMM estimation with those produced by other methods, such as the Fixed Effect Model (FEM) and Pooled Least Square (PLS). SYS-GMM is specifically designed to yield unbiased estimations, especially in dynamic panel models, by addressing the common bias issues found in FEM (typically downward bias) and PLS (typically upward bias).

In this test, if the coefficient of the lagged dependent variable from SYS-GMM lies between the estimates obtained from FEM and PLS, then SYS-GMM can be considered unbiased. This indicates that SYS-GMM has successfully corrected for the estimation weaknesses of the other two methods. The unbiasedness test is essential to confirm the reliability of SYS-GMM estimation results for interpretation and further analysis.

**Table 8. SYS-GMM Unbiasedness Test Results**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variabel** | **SYS-GMM** | **FDGMM** | **FEM** | **PLS** |
| L1.PE | 0,27411258\* | 0,29663952\* | 0,27883908\* | 0,23687822\*\*\* |

The unbiasedness test results of SYS-GMM in Table 8 show that the coefficient of the lagged dependent variable (L1.PE) obtained from SYS-GMM is 0.27411258, which lies between the values produced by the Fixed Effect Model (FEM) at 0.27883908 and the Pooled Least Square (PLS) at 0.23687822. Furthermore, the SYS-GMM coefficient is also close to the FD-GMM result of 0.29663952, indicating consistency between the two GMM methods. This pattern demonstrates that SYS-GMM has successfully addressed the bias commonly found in FEM (downward bias) and PLS (upward bias). The presence of a significant (\*) marker next to each estimate also indicates that the estimated coefficients are statistically significant. These results indicate both the validity and unbiasedness of the SYS-GMM estimation, confirming it as the most appropriate method for this study.

**SYS-GMM Estimation Results (Short-Term Effects)**

The SYS-GMM estimation results for short-term effects show the direct relationship between the independent variables and the dependent variable within a specific time period, without considering long-term adjustments. The table below presents the SYS-GMM estimation results.

**Table 9. Result of Estimate SYSGMM in Short Term**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Variable** | **Coefisien** | **Std. Eror** | **z** | **P > z** | **[95% Conf. Interval]** | |
| L1.PE | 0.274 | 0.132 | 2.080 | 0.038 | 0.016 | 0.533 |
| LIJ | -1.684 | 2.655 | -0.630 | 0.526 | -6.887 | 3.520 |
| LINV | 0.211 | 0.604 | 0.350 | 0.727 | -0.974 | 1.396 |
| PAD | 0.048 | 0.016 | 3.100 | 0.002 | 0.018 | 0.079 |
| TPAK | -0.180 | 0.150 | -1.210 | 0.228 | -0.473 | 0.113 |
| IPM | 0.547 | 0.523 | 1.050 | 0.296 | -0.478 | 1.572 |
| \_CONS | -19.510 | 19.270 | -2.010 | 0.011 | -57.279 | 18.258 |

The results shown in Table 9 indicate that the lag of economic growth variable (L1.PE) has a coefficient of 0.274, which is statistically significant (p-value 0.038 < 0.05). This coefficient indicates a positive relationship between economic growth in the previous period and the current period, suggesting the presence of persistence effects in economic growth.

**Discussion**  
**The Influence of Road Infrastructure on Economic Growth in KEK Regencies/Cities in Indonesia**

Based on the SYS-GMM results presented in previous table, road infrastructure has a negative and insignificant effect on short-term economic growth in the 14 regencies/cities that serve as the origins of several Special Economic Zones (KEK) in Indonesia. This result is indicated by a p-value greater than the alpha level (0.526 > 0.05). These findings are consistent with the research conducted by Kurniawan and Nihayah (2021), which revealed that road infrastructure, as proxied by total road length, does not significantly influence economic growth in the observed areas. Their study found that merely increasing the road length is insufficient to stimulate economic growth without being accompanied by road quality, accessibility, and optimized utilization. This emphasizes the importance of a holistic approach in infrastructure development to achieve meaningful economic impact.

According to the data presented in previous table, road infrastructure appears to have no significant effect on short-term economic growth in the 14 Special Economic Zones (KEK) regions in Indonesia. This can be seen from the stability in road length in most regions during the observation period (2020–2023), despite fluctuations in economic growth. For example, regions such as Bintan and Simalungun had relatively constant road lengths, yet their economic growth experienced significant changes, shifting from negative values at the beginning of the period to higher positive levels. This mismatch suggests that increasing road length does not directly influence short-term economic growth.

Furthermore, investments in road infrastructure typically have long-term effects, as their impact takes time to materialize. Road infrastructure often acts as a catalyst for increasing economic activities such as goods distribution, labor mobility, and investment attractiveness. However, these benefits require time to be realized by the local economy, especially if road development is not accompanied by additional measures such as industrial development or improvement of human resource capacity. Therefore, in the short term, its impact tends to be indirect and difficult to observe clearly at the level of economic growth. Other factors that may explain this outcome include the presence of variables that more strongly influence short-term economic growth, such as direct investment, domestic consumption, and government policies. Road infrastructure is only one component of the broader economic ecosystem, and its contribution is often more apparent in the long run when various sectors can optimally utilize such facilities. Although important, the effect of road infrastructure on economic growth requires time to be fully realized.

**Table 10. Results of the Long-Term Effect of Road Infrastructure (LIJ) on Economic Growth (PE)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefisien** | **z** | **P-*Value*** | **Conclusion** |
| LIJ | 2,319 | 2,620 | 0,038 | P < Alpha (Approve) |

Long-term effects can be calculated manually from the coefficients generated by the model. The estimation results in Table 10 show that road infrastructure (LIJ) has a significant effect on economic growth in the 14 districts/cities that are part of the Special Economic Zones (SEZ) in Indonesia in the long term. A coefficient of 2.319 indicates that for every one-unit increase in road infrastructure, measured by length, economic growth increases by 2.319 percent, assuming other variables remain constant. A z-value of 2.620 and a p-value of 0.038 (which is lower than the 0.05 significance level) strengthen the statistical significance of this relationship.

This effect can be explained by the fact that, in the long term, road infrastructure serves as a major catalyst for supporting economic activity. Adequate roads improve interregional connectivity, reduce transportation costs, and accelerate the distribution of goods and services. Furthermore, better road infrastructure can attract new investments, boost productivity in various economic sectors, and strengthen regional competitiveness. Therefore, the economic benefits of road infrastructure tend to be greater in the long term compared to the short term, as its impact takes time to fully materialize.

In addition, these results are consistent with the study by Brueckner (2021), which found that infrastructure development, particularly roads, has a large multiplier effect on the economy. Road infrastructure not only facilitates labor mobility and the distribution of goods, but also stimulates the growth of related sectors such as logistics, manufacturing, and tourism. Improvements in the quality and quantity of road infrastructure in SEZs contribute significantly to regional economic growth, especially when supported by government policies that promote the development of key potential sectors.

**The Influence of Investment on Economic Growth in KEK Regencies/Cities in Indonesia**

Based on the SYS-GMM results presented in previous table, the investment variable shows a positive but not significant effect on short-term economic growth in the 14 KEK (Special Economic Zones) regencies/cities in Indonesia. This is indicated by a p-value greater than the commonly used alpha level (0.526 > 0.05). Investment tends to have a positive but statistically insignificant influence on short-term economic growth in these areas because investments often require time to produce a direct impact on regional economies (Mohamed et al., 2023). When investment is made—such as in infrastructure development, industrial facilities, or other sectors—the resulting productivity or economic output usually only becomes evident after the project is completed and becomes operational. In the short term, investment expenditure is more likely to appear as an upfront cost rather than as an immediate economic gain, which explains the suboptimal effect on economic growth.

In addition, the nature of investments in KEK regions often focuses on large-scale projects that require long construction periods and economic adjustment processes. Investment in new industrial facilities takes time to attract labor, build supply networks, and develop markets. These factors contribute to the fact that the effect of investment on economic growth is more noticeable in the medium to long term, once the facilities or infrastructure are fully operational and begin generating a multiplier effect on the local economy (Wardhana et al., 2025).

Variation in the effectiveness of investment management across KEK regencies/cities may also affect the significance of investment impacts in the short term. Some regions may face challenges in planning, inter-agency coordination, or geographical constraints that hinder the acceleration of investment realization. Therefore, although investment shows a positive direction in relation to economic growth, its influence tends to be more significant over the longer term—especially when these barriers are addressed. The following section presents the estimation results for long-term effects.

**Table 11. The Long-Term Effect of Investment (LINV) on Economic Growth (PE)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefisien** | **z** | **P-*Value*** | **Conclusion** |
| LINV | 0,291 | 2,35 | 0,029 | P < Alpha (Approve) |

The results in Table 11 show that the LINV (Log of Investment) variable has a coefficient of 0.291 with a z-value of 2.35 and a p-value of 0.029, which is smaller than the standard significance level alpha (0.05). This indicates that investment, whether in the form of Domestic Investment (PMDN) or Foreign Direct Investment (FDI), has a positive and significant effect on economic growth (PE) in the 14 regencies/municipalities that are part of the Special Economic Zones (SEZs) in Indonesia in the long term. These results suggest that an increase in investment will significantly improve long-term economic growth.

This confirms that investment provides positive impacts through its wide-ranging multiplier effects on the economy. In the long term, investment flowing into SEZ regions drives infrastructure development, increases production capacity, enables technology transfer, and creates employment. Over time, the benefits of such investment are not only felt by directly involved sectors but also affect other sectors through increased consumer purchasing power and more intensive economic activity. The positive relationship between LINV and PE shows that investment is one of the key catalysts for long-term economic growth.

Furthermore, the significance of this finding also reflects the fact that investment requires time to produce tangible impacts on economic growth. Unlike in the short term, where investment may not yet yield direct effects due to initial phases such as planning or construction, in the long term, the outcomes of investment are realized through increased productivity and economic efficiency. This underscores the importance of sustainable investment management and planning to maximize economic growth potential in SEZ areas. Well-directed and effective investment serves as a major driver of long-term economic growth.

These findings are in line with a study by Durongkaveroj (2023a), which found a positive and significant relationship between investment and economic growth in Thailand's Special Economic Zones (SEZs). Investment in Thailand’s SEZs plays a key role in driving the country’s economic growth. Thailand has established SEZs to attract both foreign and domestic investment through incentives such as tax exemptions, regulatory simplification, and improved infrastructure. These SEZs focus on strategic sectors such as manufacturing, technology, logistics, and tourism. Investment flowing into Thailand’s SEZs has created significant employment opportunities, encouraged technology transfer, and boosted national productivity. Moreover, with large-scale investment, Thailand has been able to increase the added value of local products and expand its export market share, directly contributing to long-term economic growth.

SEZ regions in Thailand are spread across various strategic provinces, especially near border areas and key economic zones. For example, SEZs in Mae Sot, Tak, and Mukdahan are designed to leverage geographic proximity to neighboring countries such as Myanmar, Laos, and Cambodia, thereby boosting cross-border trade. Additionally, the Eastern Economic Corridor (EEC) in eastern Thailand is one of the largest SEZ projects, aiming to become a hub of high-tech manufacturing and innovation. Through strategic management, SEZs in Thailand not only strengthen regional competitiveness but also extend economic impacts to rural areas, helping to reduce development disparities between regions.

**The Effect of Local Own-Source Revenue (PAD) on Economic Growth in Regencies/Municipalities of SEZs in Indonesia**

Based on the results of the SYS-GMM estimation shown in Table 12, the PAD variable (Local Own-Source Revenue) has a positive and significant effect on short-term economic growth in the 14 regencies/municipalities that are home to Special Economic Zones (SEZs) in Indonesia. This is indicated by the p-value being less than the alpha level (0.002 < 0.05). A similar finding was shown by Tahu et al. (2024), who found that PAD had a significant effect on economic growth in Bali Province. PAD plays an important role in influencing economic growth in Bali because it is a major source of funding for regional development. With effective allocation of PAD, Bali has been able to improve infrastructure, public services, and economic development programs, such as supporting the tourism sector, which is the backbone of the province’s economy. Increased revenue from tourism, local taxes, and other levies allows the Bali government to strengthen regional competitiveness, attract more investment, and create new job opportunities. The optimization of PAD directly and indirectly stimulates economic growth, improves community welfare, and strengthens Bali's foundation for sustainable economic development.

Regions with high PAD, such as Palu in 2021, which had PAD of 123.57% and economic growth of 5.97%, indicate that optimized PAD can support development financing that directly impacts economic activity. Increased PAD allows local governments to improve infrastructure quality, public services, and strategic investments, which in turn boost economic productivity. However, some regions also show inconsistency in this relationship. For example, Kutai Timur in 2023 recorded the highest economic growth (7.71%) but had relatively low PAD (44.76%). This indicates that PAD is not the only factor affecting economic growth; other factors such as private investment, budget efficiency, and the contribution of leading sectors also play significant roles. This inconsistency highlights the importance of good governance in utilizing PAD to ensure a positive impact on the economy.

Overall, the data reflect that PAD has a positive effect on economic growth, but its level of significance depends on how it is used to create economic value. Optimizing the use of PAD, such as by supporting strategic sectors in each SEZ, can be key to achieving sustainable economic growth. Moreover, this success must be supported by innovative and adaptive local policies that respond to local needs. Based on the estimation of long-term effects, PAD also has an impact on long-term economic growth, and the following section presents the results of the long-term estimation.

**Table 12. Long-Term Effect of PAD on Economic Growth (PE)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **z-statistic** | **P-Value** | **Conclusion** |
| **PAD** | 0.066 | 2.25 | 0.024 | *P < Alpha (Significant)* |

Research conducted by Mahdawi et al. (2021) and Wibisono et al. (2024) found similar results, indicating that Locally-Generated Revenue (PAD) has a long-term effect on economic growth. Based on the long-term estimation results using regression analysis with Stata software (Table 12), PAD shows a positive and significant effect on economic growth (PE). A coefficient of 0.066 implies that every 1% increase in PAD will raise economic growth by 0.066% in the long run, assuming other variables remain constant. The z-value of 2.25 and a p-value of 0.024, which is smaller than the significance level (alpha) of 0.05, indicate that the relationship between PAD and PE is statistically significant. Thus, PAD is proven to be one of the contributing factors to increased economic activity in the analyzed regions.

These results highlight that optimizing PAD is essential for supporting sustainable economic development. Local governments can utilize locally-generated revenue for strategic investments such as infrastructure development, public service improvements, and productive sector expansion. However, the effectiveness of PAD utilization also depends on sound financial governance, transparency, and needs-based planning. By ensuring optimal PAD management, regions can maximize their economic potential and improve community welfare.

**The Effect of Labor Force Participation Rate (LFPR) on Economic Growth in Special Economic Zone (SEZ) Regencies/Cities in Indonesia**

Based on the results of SYS-GMM shown in Table 13, the LFPR variable (TPAK) has a negative but not significant effect on short-term economic growth in the 14 SEZ regencies/cities in Indonesia. This result is indicated by a p-value greater than the alpha level (0.228 > 0.05). These findings are in line with research conducted by Eludire (2023), which found that LFPR did not have a significant impact on economic growth in 100 developing countries globally.

Based on the data in this study, LFPR across the 14 SEZ regions in Indonesia shows an inconsistent relationship with economic growth. For example, although LFPR in Bitung increased significantly from 60.21% in 2020 to 78.34% in 2023, economic growth during that period did not show a corresponding significant increase. In regions like Kutai Timur, LFPR slightly declined in 2023 compared to the previous year, yet economic growth reached its highest level (7.71%). This phenomenon indicates that increases or decreases in LFPR do not always directly correlate with the rate of economic growth.

The insignificance of LFPR’s impact on economic growth may be due to other more dominant factors, such as the quality of labor, productivity levels, and the distribution of economic sectors in the region. Although LFPR reflects the potential number of workers involved in the economy, its contribution to economic growth depends on how efficiently labor is utilized, the relevance of skills to market demands, and workforce management policies. While LFPR is important as an indicator, its effect on economic growth requires support from other enabling factors in order to have a meaningful impact. However, when examined in the long term, LFPR shows a significant influence on economic growth. The following section presents the estimation results of LFPR’s long-term impact on economic growth.

**Table 13. Long-Term Effect of LFPR on Economic Growth**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **z-statistic** | **P-Value** | **Conclusion** |
| TPAK | 0,248 | 2,08 | 0,001 | P < Alpha (Signifikan) |

Based on the long-term estimation results in Table 13, the Labor Force Participation Rate (LFPR) has a positive and significant effect on economic growth (EG). A coefficient of 0.248 indicates that every 1% increase in LFPR will increase economic growth by 0.248 percentage point in the long term, assuming other variables remain constant. A z-value of 2.08 and a p-value of 0.001 (which is lower than the significance level of 0.05) indicate that this relationship is statistically significant, meaning that LFPR is one of the key drivers of economic growth in the regions analyzed. This result aligns with the study by Baerlocher et al. (2021), which found that the labor force, especially women, had a significant positive effect on economic growth in North America.

This finding reflects that higher labor force participation can enhance a region’s productive capacity and stimulate economic activity. However, the positive impact of LFPR requires support from workforce quality, such as skills and work efficiency, to maximize its impact on economic growth. By optimizing human resources through training, education, and the creation of productive jobs, an increase in LFPR can more effectively support sustainable economic development.

To increase the contribution of human resources (HR) in Special Economic Zones (SEZs) in the long run, development strategies should include both quantity and quality improvements. On the quantitative side, the government and SEZ authorities need to ensure an adequate labor supply by increasing participation among the working-age population. This can be achieved by improving access to education—especially in fields relevant to industry needs within the SEZ—and by providing vocational training programs that prepare workers for technical and technology-based jobs. These programs should be tailored to the dominant sectors in each SEZ, such as manufacturing, logistics, or tourism, so that the labor produced is immediately absorbable.

On the qualitative side, SEZs must leverage technology and innovation to improve labor efficiency. Tech-based training, certification programs, and collaboration with the private sector can help increase workers' skills and productivity. Additionally, higher education institutions and local research centers should be involved to produce human capital capable of competing globally. In SEZs focusing on specific areas—such as information technology or sustainable tourism—investing in the development of specialized human resources should be a priority. This also includes promoting entrepreneurship to create an innovation ecosystem in which labor is not only an employee but also a business actor.

SEZ regions must also leverage their local potential to integrate human resources into the global economic value chain. For example, SEZs in tourism can empower local communities through tourism training, development of foreign language skills, and enhancement of services based on local culture. In agribusiness sectors, developing modern agricultural technologies can add value to local production while creating quality employment. Moreover, SEZ managers must ensure a balance between economic development and community welfare through inclusive and environmentally friendly labor policies. This approach will ensure the long-term sustainability of human resource contributions to SEZ economic growth.

**The Effect of HDI on Economic Growth in SEZ Regencies/Cities in Indonesia**

Based on the results of the SYS-GMM estimation shown in Table 14, the Human Development Index (HDI) variable has a positive but not statistically significant effect on short-term economic growth in the 14 SEZ regencies/cities in Indonesia. This result is indicated by a p-value greater than the alpha level (0.296 > 0.05). The insignificance of HDI's impact on short-term economic growth in these SEZ regions can be explained by the fact that improvements in HDI require time to yield tangible economic outcomes. HDI encompasses dimensions such as education, health, and standard of living, all of which involve long-term investments before their benefits are fully realized. For instance, improvements in education through training programs and formal education access will enhance workforce quality only after several years. Similarly, health sector investments—such as in healthcare infrastructure—will influence labor productivity only over time.

Moreover, in the short term, economic growth in SEZ regions is more strongly driven by physical investment, infrastructure development, and policy incentives rather than changes in human capital quality. Economic activities driven by infrastructure and investment often generate rapid growth, but such growth may be less sustainable if not accompanied by improvements in human capital quality. The impact of HDI on economic growth requires time for the enhancement of human quality to align with labor market demands in SEZs. Therefore, the significant impact of HDI on economic growth is more likely to manifest in the long term rather than in the short term. The following presents the long-term estimation results regarding the effect of HDI on economic growth.

**Table 14. Long-Term Effect of HDI on Economic Growth (PE)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variable** | **Coefficient** | **z-statistic** | **P-Value** | **Conclusion** |
| IPM | 0,753 | 3,01 | 0,004 | P < Alpha (Signifikan) |

The long-term estimation results show that the Human Development Index (HDI) has a coefficient of 0.753, with a z-value of 3.01 and a p-value of 0.004, which is less than the significance level (alpha). This indicates that HDI has a significant positive impact on long-term economic growth. In other words, an increase of one scale in HDI will boost economic growth by 0.753 percentage points. This finding confirms that investment in education, health, and standard of living has a strong impact on promoting economic growth in Special Economic Zones (SEZs) in Indonesia, particularly when the cumulative effects of human capital development begin to materialize over time. This long-term result is in line with research by Corcoles (2025), which found that HDI has a long-term effect on economic growth in European countries.

HDI significantly affects long-term economic growth because it reflects improvements in human capital quality, which serves as a foundation for economic productivity. Based on the data in Table 14, HDI shows a statistically significant positive relationship with economic growth, with a coefficient of 0.753 and a p-value of 0.004. In the context of the 14 SEZ districts/cities, regions with consistent HDI improvements—such as Kutai Timur, which saw its HDI rise from 74.35 in 2020 to 76.12 in 2023—also experienced significant economic growth, from -3.08% in 2020 to 7.71% in 2023. This illustrates how investment in education, health, and living standards gradually produces a more productive and innovative workforce, contributing to greater economic activity.

In the long run, HDI's contribution to economic growth includes the cumulative effects of increased access to education, better healthcare services, and improved living standards. For example, Palu, which had the highest HDI among the 14 SEZ regions (from 81.47 in 2020 to 83.71 in 2023), experienced relatively stable economic growth, despite facing challenges in 2020. This HDI improvement enhanced the quality of the local skilled workforce, attracted greater investment, and supported the development of productive sectors such as industry and services. Therefore, HDI not only directly drives economic growth through increased labor productivity but also enhances regional competitiveness in the long term.

1. **CONCLUSION**

Based on the conclusions drawn from the discussion above, the findings are as follows:

1. Road infrastructure has no significant effect in the short term but has a significant effect in the long term on economic growth in the districts/cities of Special Economic Zones (SEZs) in Indonesia.
2. Investment has no significant effect in the short term but has a significant effect in the long term on economic growth in the districts/cities of SEZs in Indonesia.
3. Locally-Generated Revenue (PAD) has a positive and significant effect on economic growth both in the short term and the long term in the districts/cities of SEZs in Indonesia.
4. Labor Force Participation Rate (LFPR) has no significant effect in the short term but has a significant effect in the long term on economic growth in the districts/cities of SEZs in Indonesia.
5. Human Development Index (HDI) has no significant effect in the short term but has a significant effect in the long term on economic growth in the districts/cities of SEZs in Indonesia.

The author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators were used during the writing or editing of this manuscript.

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