Journal of Asset Management and Public Economy (JAMPE)
Vol. 4, No. 1, pp. 1-16
DOI : https://doi.org/10.12928/jampe.v3i2.11599

The Impact of MSMEs, Population, Road Infrastructure, and Human Development Index on GRDP in Central Java

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Abstract
National economic development is an effort to improve people's welfare in order to fulfil their basic needs. This study analyses the effect of the number of Micro, Small, and Medium Enterprises (MSMEs), population, road infrastructure, and the Human Development Index (HDI) on Gross Regional Domestic Product (GRDP) in Central Java in 2018-2022 with the aim of knowing whether umkm, population, road infrastructure, and human development index affect GRDP. By using a descriptive quantitative approach using secondary data obtained from the Central Bureau of Statistics (BPS), this study uses statistical analysis to test the relationship. The results showed that although MSMEs and population did not have a significant effect on GRDP. This study makes a significant contribution to the Human Development Index (HDI) in Central Java so as to successfully build a human development index that is in line with the growth of GRDP, we can see from the results of the study which show that HDI has a positive effect on GRDP when HDI increases by 1 per cent, the value of GRDP will increase by Rp 2,185,483. Road infrastructure shows a significant positive effect. This finding suggests that investment in infrastructure and human development is an important driver of economic growth in the region.

Article history
Received 2024-09-20
Revised 2024-10-28
Accepted 2024-11-22

Keywords
GRDP
HDI
Infrastructure
MSMEs
Population

JEL Classification*:
O12, Q12, R21

Introduction

Economy is one of the most influential factors as a benchmark for a country's progress. National economic development is an effort to improve people's welfare, allowing people to meet their basic needs. Economic development is a multidimensional concept, and a one-dimensional study cannot

 ISSN 2827-9816

understand the long-term impacts of economic development (Wang et al., 2024). In building a country's economy, it cannot be separated from road infrastructure, employment and population. Central Java Province is the research destination because the infrastructure in the region is relatively good compared to other provinces, which is an important factor in supporting economic activity and distribution of goods. According to (Audina et al., 2023) a country is considered successful when many jobs are created and its economy grows. So that national policies can be analyzed according to existing conditions. Economy is one of the variables that factor into the growth of Gross Regional Domestic Product (GRDP) (Haksanggulawan et al., 2023).

Gross Regional Domestic Product (GRDP) can be one of the measures to assess the economic condition of a region. GRDP is obtained through the calculation of the total value of goods and services produced by economic actors within a specific region. The macroeconomic indicator used to measure a country's economic growth is the Gross Domestic Product (GDP). At the provincial and district/city level, it is referred to as the Gross Regional Domestic Product (GRDP), according to (Panjaitan et al., 2019).

According to (Leonita & Sari, 2019), GRDP is divided into two types: based on current prices, which is calculated using the prices of the current year, and based on constant prices, which is calculated using the prices of a specific base year. GRDP at current prices serves as a basis for measuring the economic capacity of a region, while GRDP at constant prices is used as a basis for evaluating annual economic growth without being affected by price factors. According to (Winowoda et al., 2023), Gross Regional Domestic Product is one of the indicators of economic growth of a country/region/area. This growth can be influenced by several factors, including economic infrastructure.

Infrastructure generally includes public facilities provided by central or regional governments as public services (because market mechanisms do not function) to support and promote economic and social activities. The infrastructure provided must also be adapted to the specific needs of each region to improve welfare. The infrastructure needed by developed countries differs from that required by developing or even less developed countries.

According to (Ramadhian, 2018), infrastructure can be divided into three types based on its nature, the first is Hard Physical Infrastructure which includes facilities such as roads, railways, airports, seaports, dams, and irrigation channels. According to (Chan et al., 2022) Hard Infrastructure is important in a country's competitiveness because when competitiveness drops it will reduce a country's income. Non-Hard Physical Infrastructure involves aspects such as clean water supply, electricity,

telecommunications, and energy (Artati & Musyafa, 2015). And the third is Soft infrastructure which includes norms and laws that regulate and support the implementation of physical and non-physical infrastructure.

Road infrastructure, as a key component of transportation infrastructure, plays a role in driving economic growth because the availability of roads minimizes complementary capital, making production and distribution processes more efficient. Poor and damaged road infrastructure will hinder resource allocation, industrial development, and the distribution of production factors, goods, and services, thus affecting income. Infrastructure undergoes many changes to adapt to mobility, technology, and the evolving environment (Ninan et al., 2024). In agricultural development and rural economies in general, roads are crucial for the smooth flow of production factors and product marketing. According to (NSS et al., 2015), infrastructure generally includes public facilities provided by central or regional governments as public services (due to market mechanisms not working) to support and promote economic and social activities within a community. The infrastructure provided should also be tailored to the needs of each region to enhance its welfare.

Economic growth and development play a crucial role in increasing regional economic income, including enhancing community welfare. Micro, Small, and Medium Enterprises (MSMEs), which encompass micro, small, and medium-sized businesses, have been an essential part of Indonesia's economic landscape for many years. MSMEs play a significant role in the economy and have been present in Indonesia for a long time. Compared to high-income countries, MSMEs contribute more to the economic development of Indonesia and other LMICs, contributing to a larger share of enterprises than high-income countries (Widita et al., 2024). The number of MSMEs is directly proportional to the income of individuals or capital owners, who will use their income to establish businesses or MSMEs. This, in turn, helps reduce poverty through high employment absorption or Human Resources (HR). The MSME sector is considered a strategic sector with great potential in Indonesia, aligned with government planning for its growth and development.

According to (Adif et al., 2021), the existence of MSMEs is an alternative effort to tackle poverty, as MSMEs have shown relatively strong resilience in facing economic crises experienced by Indonesia. The role of Micro, Small, and Medium Enterprises (MSMEs) is significant for a region, especially as a primary driver of regional economic growth. MSMEs play an important role in national development, including in employment absorption, income distribution, rural economic development, increasing non-oil and gas exports, and enhancing Gross Domestic Product (GDP).

 ISSN 2827-9816

Micro, Small, and Medium Enterprises (MSMEs) are an economic sector consisting of micro, small, and medium-sized businesses. Theories related to MSMEs cover various aspects, including characteristics, roles, and challenges faced by this sector. MSMEs can be the backbone of regional economies because, with MSMEs, communities can drive economic growth in a region. (Fidela et al., 2020) highlight other issues, such as limited working capital, very low human resource capacity, and minimal knowledge and technology expertise, which generally affect the unclear prospects of businesses. One issue in MSME development is the limited capital available and the difficulty in accessing funding sources.

Population is considered an economic potential for a country because population growth can increase the level of consumption in that country. However, this must be balanced with the availability of adequate job opportunities. One of the main components of a society's economic growth is population and labour growth because both are positively related to stimulate economic growth. Because an increase in the number of workers will increase the number of productive forces (Syahza et al., 2021). There are two sides that must be considered, namely total output (GNP) and population, because economic growth is related to the increase in output per capita in the long term (Audina et al., 2023). From a sociological perspective, population refers to a group of individuals inhabiting a specific geographical area. An important aspect of population involves the number of people as an indicator of social, economic, political, cultural, and religious conditions in a region or country.

According to (Yuniana, 2018), the population density in Central Java Province is quite high. With the large number of residents, human development is highly considered. Human development is a form of development that can drive economic growth. Factors influencing economic growth include population growth, availability of capital, land area, natural resources, and the level of technological advancement. However, the focus is on increasing population that can affect economic growth. Developing high-quality human resources can mitigate population growth as an important step in accelerating economic growth.

The population used as a numerator can include the total population in the area or specific segments such as rural populations or those working in the agricultural sector. The denominator could be the total area, agricultural land area, or rural area. Population growth is also a focus, with urbanization as a migration activity that can present various challenges in economic and demographic sectors. Residents' rights and obligations, including protection of local culture, justice, and welfare, are also important aspects in a sociological context. Low education levels have been identified as a determining factor for an individual's decision to become a migrant worker. This

provides an opportunity to earn higher wages, save, and invest in businesses and homes in Indonesia. High population growth threatens economic functioning.

This condition indicates that relatively high population density in a wide area provides opportunities for positive population development and utilization to enhance economic potential. Population density is one of the important factors in creating a compact city (Chauhan & Tailor, 2024). The Head of the Child, Youth, and Community Empowerment Division at the Santai Foundation mentions two contributing factors: lack of parental supervision because both parents work as migrant workers, and economic problems faced by children, leading them to hope that marriage could change their fate. However, becoming a migrant worker does not necessarily reduce poverty. Although income may increase, poverty levels remain high due to expenditures on housing and vehicles rather than investing in businesses for future development, as cited by (Haer & Yuniarti, 2023).

According to (Setiawan & Hakim, 2013), the most important aspects of life are seen in long life and good health, adequate education levels, and a decent standard of living. The United Nations Development Programme (UNDP) defines human development as "the process of expanding people's choices," which means broadening the range of choices available to people. These essential choices include living a long and healthy life, acquiring knowledge, and having access to resources needed to achieve a decent standard of living (Lian et al., 2023). According to (Akay & Van, 2017), the goal of the Human Development Index (HDI) is to create a single statistic that serves as a reference for social and economic development.

The Human Development Index (HDI) is a comparative measure of life expectancy, educational attainment (years of schooling), and standard of living across countries. HDI is used to classify countries into categories such as developed, developing, or underdeveloped, and to assess the impact of economic policies on quality of life. Theories such as the Basic Needs Approach, the Capability Approach, and the Human Development Index are helpful to understand the socioeconomic conditions among countries and regions (Dey et al., 2024). The Central Statistics Agency (BPS) explains that HDI is determined through three basic dimensions: longevity and health, knowledge, and a decent standard of living.

The Human Development Index (HDI) is a single composite indicator that, while not measuring all dimensions of human development, assesses three fundamental dimensions considered to reflect the basic capabilities of the population. The three basic capabilities are Longevity and good health, measured by life expectancy at birth. Knowledge and skills, measured by

 ISSN 2827-9816

average years of schooling and expected years of schooling. Access to resources needed to achieve a decent standard of living, measured by Gross National Income (GNI) per capita.

HDI is often used as an indicator of human resource development in a region. According to the Central Statistics Agency, regions with high HDI values indicate that they provide a good quality of life for their citizens. Good human resources are believed to improve per capita income, which directly impacts higher economic mobility. In the context of economic development, a strong human resource base can enhance economic growth, which ultimately affects the quality of the surrounding environment. Key indicators that can guide improvements in human quality include life expectancy (health sector), average years of schooling (education sector), and per capita expenditure (economic sector). The level of Gross Regional Domestic Product (GRDP) per capita is also suspected to influence the Human Development Index (HDI). Increased spending by the population drives better fulfillment of basic needs. This increase promotes higher consumption for education and health, thereby affecting the Human Development Index in a region.

Literature Review

Rasid (2012) Gross Regional Domestic Product (GRDP) is an important factor in reflecting the economic level in a region, covering goods and services produced by households, the private sector, and the government in a certain period. All production results of goods and services are recorded in GRDP which makes it a tool for assessing economic growth in a certain region. According to (Case and Fair, 2017) GRDP can also be interpreted as the total amount of market output in a regional area. This includes the market value of all final goods and services produced by production factors in the location of the region during a certain period.

According to Warkum Sumitro, micro, small and medium enterprises are businesses carried out by a company with a workforce of no more than 50 people.1 Micro-scale businesses are the majority of micro and small businesses, for example street vendors, handicrafts, souvenir businesses, and the like.Meanwhile, according to Law Number 20 of 2008 concerning MSMEs, micro business units are productive businesses owned by individuals and individual business entities that meet the criteria for micro businesses as regulated in the law.

Micro, Small, and Medium Enterprises (MSMEs) are an economic sector consisting of micro, small, and medium businesses. Theories related to MSMEs cover various aspects, including the characteristics, roles, and challenges faced by this sector. Rahman (2016) MSMEs use technology that is more suitable according to the proportion of production factors and local conditions. MSMEs have a very important role in the regional economy. For example, the contribution of MSMEs to the

manufacturing sector in Central Java is around 35 per cent of GRDP, indicating that the more MSMEs there are, the greater their contribution to regional economic growth (UMKM & Koperasi, 2014).

Population is considered as an economic potential for a country, because population growth can increase the level of consumption in the country. However, this needs to be balanced with the availability of balanced employment opportunities. From a sociological perspective, population is a collection of individuals who inhabit a certain geographical area and space. An important aspect of population involves the number of residents as an indicator of the social, economic, political, cultural, and religious conditions of a region or country. With an increase in population, there is a possibility to increase productivity and economic output, which in turn can drive GRDP growth (Juliansyah & Sulkadria, 2018). Population growth is also a focus, with urbanization as an activity of moving residence that can create various challenges in the economic and population sectors. The rights and obligations of residents, including protection of local culture, justice, and welfare, are also important aspects in the context of sociology.

Infrastructure can be defined as public infrastructure, including public facilities such as roads, electricity, water, sanitation, and various other facilities according to the 2008 Big Indonesian Dictionary (KBBI). Adequate infrastructure will help increase GRDP, as more goods and services can be produced and distributed efficiently (Aldona et al., 2021). The World Bank Report divides infrastructure into three main categories, namely (1) Economic Infrastructure: These are physical assets that provide services and are used in final production and consumption. These include public utilities, public works, and transportation; (2) Social Infrastructure: Assets that support the health and skills of the community, including education, health, and recreation; and (3) Administrative/Institutional Infrastructure: Involves law enforcement, administrative control, coordination, and cultural elements.

The Human Development Index is often used as an indicator of the progress of Human Resources (HR) in a region. According to the Central Statistics Agency, regions with a high HDI value indicate that the region provides a good quality of life for its people. Good quality HR is believed to be able to increase per capita income, which directly impacts higher economic mobility. From a development economic perspective, the existence of good HR can increase economic growth, which in turn affects the quality of the surrounding environment.

Method

This research uses a quantitative descriptive method to describe, explain, or summarize conditions, situations, phenomena, or research variables based on observed events. The quantitative

descriptive approach is used to provide an objective description and draw conclusions from observed phenomena using numerical data to determine the effect of the relationship between variables. The data has been processed using machine learning software, specifically the STATA application. In the current study, the research method uses secondary data obtained from the Central Statistics Agency (BPS). The presentation of descriptive data aims to facilitate researchers and readers in understanding the quantitative characteristics of the variables studied. The data used is data for the period 2018 - 2022 using cross-section data for the Central Java region. The dependent variable used is Gross Regional Domestic Product (GRDP), while the independent variables are Population, Number of MSMEs, Road Infrastructure, and Human Development Index. The structural equation model for panel data regression analysis is formulated as follows:

$$Y_{it} = \beta_0 + \beta_1 X1_{it} + \beta_2 X2_{it} + \beta_3 X3_{it} + \beta_4 X4_{it} + \varepsilon_{it} \quad (1)$$

Where *Y* is Gross Regional Domestic Product (GRDP), *X1* is Number of MSMEs, *X2* is Total Population, *X3* is Road Infrastructure and *X4* is Human Development Index (HDI).

Result and Discussion

Table 1 is a summary of panel data with time-series 2018-2022 with cross sectional consisting of 35 districts / cities throughout Central Java province. The dataset comprises 175 observations for each variable, focusing on Micro, Small, and Medium Enterprises (MSMEs), population, infrastructure, and the Human Development Index (HDI).

Table 1. Descriptif Statistic

Var	Num. Sam	Mean	Stand.Dev	Min	Max
GRDP	175	2.82	2.57	6138623	1.53
MSMEs	175	25641.65	16920.04	1829	85966
POP	175	1025714	442301.3	121526	2016017
INS	175	757.782	305.916	118.92	1508
HDI	175	7.260.971	4.421.859	65.67	84.35.00

Table 1 shows that the mean GRDP across the districts is 2.82, with a standard deviation of 2.57, indicating variability. MSMEs have a mean value of 25641.65, suggesting a robust small business sector. The population mean stands at 1025714, highlighting the demographic scale, while infrastructure and HDI values suggest varying levels of development and public services quality

 ISSN 2827-9816

across the region. The range in minimum and maximum values for each variable reflects the economic and social diversity within Central Java.

The regression method used is panel data regression. There are three estimation models in panel data regression, namely Common Effect Model, Fixed Effect Model, and Random Effect Model. To select the best model, we need to estimate the Chow Test and Hausman Test.

Table 2. Chow Test

	Probability
Prob	0.000

Following the Chow Test (see Table 2), which supported the use of the Fixed Effect Model with a probability value of 0.000, indicating significant differences across entities, the next step involves conducting the Hausman Test. This test will help determine whether the Fixed Effect Model or the Random Effect Model is more appropriate for our analysis by examining the consistency of the estimators. A significant result (p-value < 0.05) from the Hausman Test would affirm the suitability of the Fixed Effect Model, reinforcing the initial findings from the Chow Test.

Table 3. Hausman Test

	Probability
Chi 2 (3)	14.98
Prob Chi>2	0.0018

Table 3 presents the results of the Hausman Test, which is employed to decide between the Fixed Effect Model and the Random Effect Model in panel data regression. The test results show a Chi-square value of 14.98 with three degrees of freedom and a probability of 0.0018. Since this probability is less than 0.05, it indicates a significant difference between the estimators for the two models, suggesting that the Fixed Effect Model is more appropriate for this data. This conclusion supports the findings from the Chow Test which recommended the use of the Fixed Effect Model.

Next, Table 4 presents the results of the multicollinearity test using the Variance Inflation Factor (VIF) for each variable within the regression model. The VIF values are as follows: Infrastructure (INS) at 2.17, population (POP) at 1.88, Micro, Small, and Medium Enterprises (MSMEs) at 1.58, and HDI at 1.49, with a mean VIF across all variables of 1.78. These values indicate that there is no significant multicollinearity affecting the estimations since all VIFs are well below the common threshold of 10.

Table 3. Multicollinearity Test

Variabel	VIF	1/VIF
INS	2.17	0.460882
POP	1.88	0.533200
MSMEs	01.58	0.634791
HDI	01.49	0.672942
Mean VIF	1.78	

Following the multicollinearity assessment, Table 5 details the heteroscedasticity test using Cameron & Trivedi's methodology. The test yields a Chi-square value of 107.76 with a probability of 0.0768. Since the probability value exceeds the 0.05 threshold, it suggests that heteroscedasticity is not a concern in the model, affirming the consistency of variance across the data.

Table 4. Heteroscedasticity Test

Cameron & Trivedi's	Total
Chi2	107.76
Probability	0.0768

Table 6 following as a determination test, provides crucial insights into the explanatory power of the regression model utilized in the study. The table indicates that the model includes 175 observations with an F-statistic of 32.29 and a highly significant probability (Prob>F) of 0.0000, suggesting that the model's independent variables collectively provide a statistically significant fit to the data. Furthermore, the R-squared value reported is 0.46, meaning that the model explains 46% of the variance in the Gross Regional Domestic Product (GRDP) in Central Java. This level of explanation is substantial, considering that the remaining 54% of the variance is attributed to factors outside the model's independent variables, such as MSMEs, population numbers, road infrastructure, and the Human Development Index (HDI). The ability to account for nearly half of the variability in GRDP emphasizes the relevance and utility of the model in understanding economic dynamics in the region.

Table 5. Determination Test

Obs	F(4.136)	Prob>F	R-Squared
175	32.29	0.0000	0.46

Next, Table 7 as a simultaneous test, provides results from a simultaneous equation test analyzing the impact of independent variables on the Gross Regional Domestic Product (GRDP) in

Central Java during the period from 2018 to 2022. The F-count, or the computed F-value, is 29.11, which is considerably higher than the critical value from the F-Table, which is 2.69. This comparison indicates a strong statistical significance as the Prob>F value is reported as 0.0000, clearly below the alpha level of 0.05. The table essentially confirms that the independent variables, which include the total number of Micro, Small, and Medium Enterprises (MSMEs), population, road infrastructure, and the Human Development Index (HDI), significantly affect the GRDP in Central Java. This result underscores the robustness of the model and the importance of these variables in influencing regional economic performance.

Table 7. Simultaneous Test

F-count	F-Table	Prob>F	Alpha	Description
29.11	2.69	0.0000	0.05	Significant

Table 8, details the outcomes of the Fixed Effects Model (FEM) assessing the impact of various variables on the Gross Regional Domestic Product (GRDP) in Central Java. The results show that Micro, Small, and Medium Enterprises (UMKM) and the total population (JP) are not statistically significant, with t-counts of -0.74 and -4.60 respectively, and probabilities above the critical threshold, indicating no substantial effect on GRDP. Conversely, road infrastructure (JI) and the Human Development Index (IPM) demonstrate significant positive impacts on GRDP, with t-counts well above the critical value (3.47 and 9.94 respectively) and negligible probabilities, underscoring the importance of infrastructure and human development in enhancing economic output in the region.

Tabel 8. Partial Test

Variable	T-Count	T-Table	Prob > |t|	α	Description
MSMEs	-0.74	1.697	0.462	0.05	Not Significant
POP	-4.60	1.697	0.000	0.05	Not Significant
INS	3.47	1.697	0.000	0.05	Significant
HDI	9.94	1.697	0.000	0.05	Significant

Micro, Small, and Medium Enterprises (MSMEs) appear to have an insignificant effect on GRDP, as evidenced by a t-statistic of -0.74 and a probability value of 0.462, both indicating non-significance. This finding contradicts the expectation that MSMEs, often regarded as engines of economic growth due to their role in job creation and innovation, would have a substantial impact on regional economic performance. The results suggest that while MSMEs are crucial, their economic

output might be too dispersed or insufficiently integrated into the broader economic activities to significantly sway regional GDP, as also noted in the study by Alima Shofia et al. (2023).

Population dynamics also do not significantly effect GRDP, despite a statistically significant t-count of -4.60 and a corresponding probability of 0.000. This indicates a negative relationship contrary to typical economic theories that posit population growth as a fundamental driver of economic expansion through increased labor force and market demand. The findings imply that mere population increases in Central Java do not necessarily translate into economic growth, possibly due to a mismatch between population skills and job market needs or insufficient economic opportunities to leverage the growing population.

Infrastructure, specifically road infrastructure, has a statistically significant and positive effect on GRDP with a t-statistic of 3.47 and a probability value below 0.05. This underscores the critical role of infrastructure in economic development, facilitating efficient transport, reducing operational costs for businesses, and enhancing accessibility to markets. Improved infrastructure supports economic activities by improving logistics and connectivity, thereby directly boosting economic output and efficiency.

Road infrastructure directly influences economic activity by reducing travel times and transportation costs, which in turn facilitates better access to markets for goods and services. Efficient roads enable faster movement of raw materials to production sites and finished products to markets, thus minimizing the logistical costs and enabling businesses to operate more competitively both locally and in broader markets. Improved road conditions also attract investments by increasing the accessibility for potential investors who seek reliable transportation networks for their supply chains and operations. Moreover, robust infrastructure supports the tourism sector by improving accessibility to tourist destinations, which can significantly contribute to local economies. It also plays a crucial role in the agricultural sector by enabling farmers to get their produce to market while fresh, reducing waste and increasing profitability.

In essence, road infrastructure acts as a catalyst that propels economic growth not just by supporting existing economic activities but also by unlocking new opportunities. As roads improve, they lay the foundation for sustainable economic development by integrating remote areas with mainstream economic centers, thereby promoting equitable economic growth across the region. This dynamic is evident in Central Java, where enhanced road infrastructure has been a key driver in boosting the GRDP, as demonstrated by the findings of this study.

The Human Development Index (HDI) measures the overall human resource quality in a region and shows a strong positive correlation with GRDP. A t-statistic of 9.94 significantly above the critical value indicates that improvements in education, health, and living standards, which HDI measures, contribute directly to economic productivity and growth. The analysis shows that a 1% increase in HDI correlates with a significant increase in GRDP by IDR 2,185,483, emphasizing that investments in human capital not only enhance the well-being of the population but also promote substantial economic growth. This relationship highlights the dual benefits of human development initiatives, as supported by research from Sukma Wardani & Huda (2023).

Conclusion

Based on data analysis from 2018 to 2022, it can be concluded that while the number of MSMEs and population size do not significantly influence the Gross Regional Domestic Product (GRDP) in Central Java, both road infrastructure and the Human Development Index (HDI) play significant roles in driving economic growth. Simultaneous testing indicates a positive and significant impact of these variables on GRDP, suggesting that targeted investments in infrastructure and human resource development are crucial. Given these findings, it is recommended that the Central Java Provincial Government enhance policies related to population growth to maintain purchasing power and continue to optimize infrastructure programs for more efficient goods and services distribution. Furthermore, improvements in the Human Development Index through better healthcare and educational services, and efforts to increase real community income, are essential for sustainable economic development.

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