THE INFLUENCE OF ROAD INFRASTRUCTURE ON THE HUMAN DEVELOPMENT INDEX IN SPECIAL REGION OF YOGYAKARTA

A THESIS

Presented as Partial Fulfillment of the Requirements

to obtain the Bachelor Degree in Economic Development Program

By

AZMAL AZHAYAT

Student Number: 20313117

INTERNATIONAL UNDERGRADUATE PROGRAM IN ECONOMIC DEVELOPMENT

FACULTY OF BUSINESS AND ECONOMICS

UNIVERSITAS ISLAM INDONESIA

2024

DECLARATION OF AUTHENTICITY

Herein I declare the originality of the thesis; I have not presented anyone else's work to obtain my university degree, nor have I presented anyone else's words, ideas or expression without acknowledgment. All quotations are cited and listed in the bibliography of the thesis.

If in the future this statement is proven to be false, I am willing to accept any sanction complying with the determined regulation or its consequence.

Yogyakarta, 13 February 2024

Azmal Azhayat

THE INFLUENCE OF ROAD INFRASTRUCTURE ON THE HUMAN DEVELOPMENT INDEX IN SPECIAL REGION OF YOGYAKARTA

Written By:

AZMAL AZHAYAT

Student Number: 20313117

Approved by

Content Advisor,

Abdul Hakim, S.E., M.Ec., Ph.D. January 5, 2024

Language Advisor,

Alfi Zakiya., S.Kom., S.Pd. February 13, 2024

THE INFLUENCE OF ROAD INFRASTRUCTURE ON THE HUMAN DEVELOPMENT INDEX IN SPECIAL REGION OF YOGYAKARTA

A BACHELOR DEGREE THESIS

By:

AZMAL AZHAYAT

Student Number: 20313117

Defended before the Board of Examiners

On March 13, 2024 and Declared Acceptable.

Board of Examiners

Examiner I

Dr. Rokhedi Priyo Santoso S.E., MIDEc. March 13, 2024

Examiner II

Abdul Hakim, S.E., M.Ec., Ph.D. March 13, 2024

Yogyakarta, March 13, 2024

International Program

Faculty of Business and Economics

Universitas Islam Indonesia

(Johan Arifin, S.E., M.Si., Ph.D.)

MOTTO

"If you cannot bear the fatigue of learning, you must be able to bear the pain of ignorance"

(Imam Syafi'i)

"The impossibility is not a fact, but an opinion"

(Muhammad Ali)

"The winners don't take all, They take most"

(Jordan Peterson)

DEDICATION

The author dedicated this thesis to:

1. The author's parents, ABD. Azis and Nurhayati have given me the motivation to always fight without complaining.
2. Family and relatives who always support.
3. To someone who always gives me a color in my life named Auti Amalia
4. To all my respected lecturers who have given me miraculous insights
5. Faculty of Business and Economics, Indonesian Islamic University.
6. My friends who always help me complete this final assignment.

ACKNOWLEDGEMENT

بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

Assalamu'alaikumWarahmatullahWabarakatuh

Praise be to God, the author would like to say to Allah SWT who has bestowed all His blessings and guidance. I don't forget to send prayers and greetings to the great Prophet Muhammad SAW, his family, friends, and followers as well as his help in the final yaumil. The writing of this thesis was completed to complete the final assignment of the Undergraduate Program in the Department of International Development Economics, Faculty of Business and Economics, Islamic University of Indonesia. The title of this thesis is **"The Influence of Road Infrastructure on The Human Development Index in Special Region of Yogyakarta"**. The author realizes that this thesis is far from perfection and there are still many errors, shortcomings, and oversights so The author expects corrective corrections, constructive criticism, and good suggestions for the perfection of this thesis.

This time the author would like to express his thanks profusely to:

1. Mr Abdul Hakim, S.E., M.Ec., Ph.D. as supervisory lecturer with his patience he has directed and provided a lot of input and advice so that the writer can complete this thesis.
2. Ms. Alfi Zakiya., S.Kom., S.Pd as a language advisor who has provided direction and guidance to the author while working on this thesis.
3. Mr. Abdul Hakim, S.E., M.Ec., Ph.D. as Head of the Development Economics Study Program, Undergraduate Program at the Islamic University of Indonesia
4. My parents, my brother, and loved ones whom the author really loves, love and respect that is ABD. Azis and Nurhayati, Muh. Asmil Azhayat, Auti Amalia who always provides prayers, support, and love dear, which gives the writer strength to finish this thesis

5. Mr. Johan Arifin, S.E., M.Si., Ph.D. as Dean of the University's Faculty of Economics Indonesian Islamic University of Economics
6. Mr/Mrs. Lecturers at the Department of Development Economics who had provided and taught his knowledge while the author was studying at this alma mater. Lecturers, Administrative Staff, and Academic Staff in the Faculty Environment Indonesian Islamic University of Economics
7. Friends who are in the IP class cannot be mentioned one by one. Thank you always pray, comfort, help, giving a piece of useful and encouragement. May Allah always protect you all, Aamiin.

The author hopes that this thesis will be useful for all parties, especially for the alma mater of the Indonesian Islamic University Yogyakarta, Aamiin.

Wassalamu'alaikum Warahmatullahi Wabarakatuh

Yogyakarta, February 2024

Author

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Raising the Human Development Index (HDI), one of the metrics used to gauge the degree of human well-being in one of these regions, The Yogyakarta Special Region, has proven to be difficult for the local administrations there. actions taken by governments to raise the standard of living for people and society. The availability of auxiliary resources like infrastructure development is one of them. The purpose of this study is to ascertain how the Special Region of Yogyakarta's road infrastructure development will affect the index of human development between 2015 and 2022. The human development index is the dependent variable, and the road infrastructure, growth rate of regional gross domestic product (GRDP), Gini index, and minimum wage level are the independent variables. Both the Ministry of Works and Housing and the Central Bureau of Statistics (BPS) provide data. The method used in this study is panel regression analysis. The data is then processed using Eviews-10. The results of this study show that the value of the human development index in the Yogyakarta Special Region is significantly influenced by road infrastructure (local, provincial, district, urban), growth rate of regional gross domestic product (GRDP), and minimum wage level. It shows that. On the other hand, the human development index value of the Special Region of Yogyakarta is negatively affected by the Gini ratio/Gini index.

Keywords: Infrastructure, Human Development Index, Special Region of Yogyakarta

ABSTRACT

Meningkatkan Indeks Pembangunan Manusia (IPM), salah satu ukuran yang digunakan untuk mengukur tingkat kesejahteraan manusia di salah satu daerah, Daerah Istimewa Yogyakarta, terbukti sulit bagi pemerintah daerah di sana. Ketersediaan sumber daya pendukung seperti pembangunan infrastruktur adalah salah satunya. Tujuan dari penelitian ini adalah untuk mengetahui bagaimana pembangunan infrastruktur jalan di Daerah Istimewa Yogyakarta akan mempengaruhi indeks pembangunan manusia antara tahun 2015 dan 2022. Indeks pembangunan manusia merupakan variabel dependen, sedangkan infrastruktur jalan, tingkat pertumbuhan dari produk domestik regional bruto (PDRB), indeks gini, dan tingkat upah minimum merupakan variabel independen. Kementerian Pekerjaan Umum dan Perumahan Rakyat (PUPR) dan Badan Pusat Statistik (BPS) menyediakan data. Metode yang digunakan dalam penelitian ini adalah analisis regresi panel. Data tersebut kemudian diolah dengan menggunakan Eviews-10. Hasil dari penelitian ini menunjukkan bahwa nilai indeks pembangunan manusia di Daerah Istimewa Yogyakarta dipengaruhi secara signifikan oleh infrastruktur jalan (lokal, provinsi, kabupaten, kota), tingkat pertumbuhan dari produk domestik regional bruto (PDRB), dan tingkat upah minimum. Hal ini menunjukkan bahwa. Di sisi lain, nilai indeks pembangunan manusia di Daerah Istimewa Yogyakarta dipengaruhi secara negatif oleh rasio gini/indeks gini.

Kata kunci: Infrastruktur, Indeks Pembangunan Manusia, Daerah Istimewa Yogyakarta

CHAPTER 1

INTRODUCTION

1.1. Background

The undeveloped nations generally have big populations, but the quality of their human resources tends to be low (UNDP, 2015). As one of the developing countries, Indonesia needs high-quality human resources to improve development, productivity, and contribution to technological advancement for the welfare of society (Tyas & Ikhsani, 2015). One of the important components in assessing people's living standards is the Human Development Index (HDI). In addition to physical measures, a country's development must be assessed from the point of view of its human capital management. One of the crucial functions of the United Nations Development Program (UNDP) is to provide technical and development assistance worldwide. The organization publishes the Human Development Index (HDI) as a key indicator for assessing the success of a nation's development and well-being, so an increase in the HDI reflects how effectively human development and well-being are functioning. This will serve as an important benchmark for evaluating how well you are doing to assess the level of the nation. UNDP publishes the Human Development Index (HDI) measure of success and well-being.

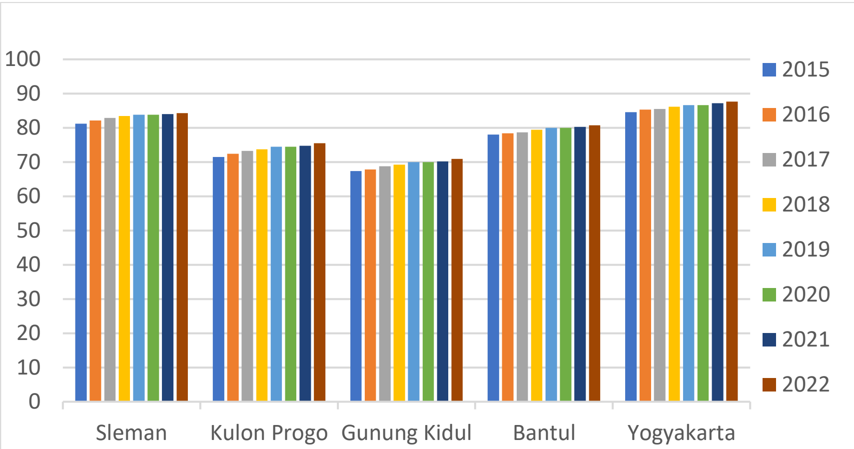
The HDI rate in Indonesia is currently still at an average of 70%, which in 2020 amounted to 71.94%, then there was a slight increase in 2021, which amounted to 72.29%, and then another increase in 2022, which amounted to 72.91%, in this case of course there is only a slight increase in each year (Central Bureau of Statistics, 2023). To enable increased human development, the development of social infrastructure and physical infrastructure must be balanced. Human development is very important and much needed in a developing country like Indonesia. This is because people are the main and most fundamental component of economic growth. In other word, when the population achieves a high level of quality of life, a country's economic performance and growth can also be anticipated to be much better according to Brata (2002).

A country consists of several provinces or cities. To increase growth evenly and thoroughly, Governments should be concerned about the growth of the human population, or human quality in each region for national progress. One of the regions where the Human Development Index rate is increasing year by year is the Special Region of Yogyakarta (DIY). The human development index rate in this region is stable every year, neither too high nor too low. But in this case, in the Yogyakarta area, especially in the five regencies/cities in the province of Yogyakarta, there is still a lot of infrastructure development that can be said to be uneven, in this case of course greatly affecting the flow of the economy and the figure of the Human Development Index itself. DIY or Yogyakarta Special Region is located in the southern part of Java Island, with the capital city of Yogyakarta. Yogyakarta consists of five districts/cities including Sleman, Kulon Progo, Gunung Kidul, Bantul, and Yogyakarta, and the total population is around 4,073,907 people. The economic growth rate in the province is 5.16 percent (Yogyakarta Central Bureau of Statistics, 2023).

Table 1. 1 Average HDI In Special Region of Yogyakarta from 2015-2022

Year	HDI
2015	69.55
2016	70.18
2017	70.81
2018	71.39
2019	71.92
2020	71.94
2021	72,29
2022	72,91

Source: Badan Pusat Statistik Yogyakarta, 2023



Source: Badan Pusat Statistik Yogyakarta, 2023

Figure 1.2 Graph of HDI Values in Five Regencies/Cities in the Special Region of Yogyakarta from 2015-2022

In the province of Yogyakarta, one of the duties of the local government is to determine the Human Development Index (HDI) score, the rationale behind this figure's application as a proxy for human welfare in that specific situation. According to data released by the Central Bureau of Statistics, Yogyakarta's average Human Development Index (HDI) continues to increase every year (see Table 1.1). However, information on the human index values of each district and city within the Special Region of Yogyakarta is needed to assess the welfare level of the local populace. This will display the districts with the highest and lowest levels of welfare.

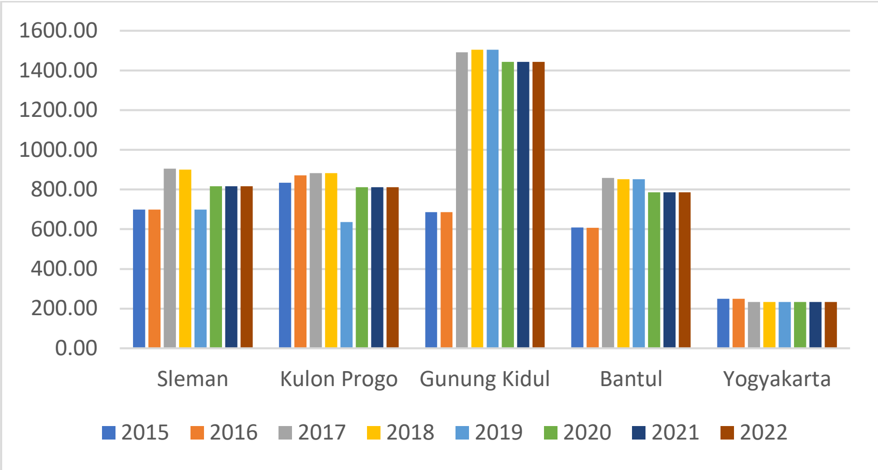
Economic development, urban development, and economic growth are all topics where the term infrastructure is often used. The public infrastructure and facilities that are critical to driving a country's economy are called infrastructure. An area's economy is greatly impacted by its infrastructure, and well-maintained infrastructure can raise local standards of living. Additionally, infrastructure promotes the smooth operation of people's economic activity and the distribution of goods. Adequate infrastructure ensures an economical, efficient, safe, smooth, and seamless transportation system. One of the most frequently used forms of infrastructure is the road network. According to Law No. 38/2004 on roads, roads have a key role as vital transportation infrastructure for politics, economy, culture, environment, defense, and security. Roads are also used to improve people's welfare, as a means of distributing goods, and as an integral component in the system of roads that links and integrates various regions in the Republic of Indonesia.

To improve people's welfare, the government conducts elaboration that focuses on the availability of infrastructure. According to Haris (2009), The presence of infrastructure in a nation is necessary for both national and regional development. Furthermore, infrastructure contributes to increasing the value of consumption, and labor productivity, including labor markets, expanding employment, quality of life, community welfare, and achieving the goal of sustainable economic growth. The infrastructure required in a region is determined by its natural characteristics and the distribution patterns of its inhabitants. To boost competitiveness through more trade, investment, and production and to expedite equitable economic development, infrastructure is crucial. Infrastructure, such as roads, clean water, irrigation, health, electricity, sanitation, and others, which are available to everyone and are known as social capital, correlate better with economic growth and community welfare compared to regions with limited infrastructure. Therefore, one of the components that support national progress is the provision of infrastructure. Road infrastructure can improve community welfare because it can facilitate all access and activities (Sukirno, 2012).

Table 1. 2 Average Road Length (Km) by Good Road Condition in the Special Region of Yogyakarta from 2015-2022

Year	Road Length
2015	220.72
2016	219.92
2017	240.11
2018	191.09
2019	357.370
2020	366.520
2021	341.840
2022	301.205

Source: PUPR Yogyakarta, 2023



Source: Badan Pusat Statistik Yogyakarta, 2023

Figure 1.2 Graph of Road Length (Km) in Five Regencies/Cities In The Special Region of Yogyakarta from 2015-2022

One of the infrastructures provided by the government is roads, which in this case is to facilitate people to carry out their activities. The Central Bureau of Statistics has released data on the length and state of roads in the Special Region of Yogyakarta, as well as the overall length and state of roads in all districts and cities. This data is displayed in Figure 1.2.

The growth rate of Gross Regional Domestic Product (GRDP), Gini Ratio, and Minimum Wage Level are supporting factors in achieving a good Human Development Index figure. Table 1.3 explains the annual changes in the growth rate of Gross Regional Domestic Product (GRDP), Gini Ratio, and Minimum Wage Level that take place in the five districts/cities that make up the Special Region of Yogyakarta.

Table 1. 3 Growth rate of GRDP, Gini Ratio, and Minimum Wage Level in Five Districts/Cities in The Special Region of Yogyakarta in 2022

Regency	Growth Rate Of GRDP (Percent)	Gini Ratio (Percent)	Minimum Wage Level
Yogyakarta	5.26	0.519	2,153,970
Sleman	5.15	0.418	2,001,000
Kulon Progo	6.57	0.38	1,904,275
Bantul	5.2	0.41	1,916,848
Gunung Kidul	5.37	0.323	1,900,000

Sources: Badan Pusat Statistik Yogyakarta, 2023

The achievement of a good Human Development Index figure is of course inseparable from the growth rate of GRDP, the decline in poverty, and the minimum wage level in each district/city of Yogyakarta. It is explained in Table 1.3 that the growth rate of GRDP in 2022 in each district/city is around five to six percent on average, which in each district/city, Kulong Progo currently has a GRDP rate of around 6.57% of the others. On the other hand, the level of inequality in every city or district within Yogyakarta's Special Region is in the range of 0.38-0.519%, in this case, the level of the Gini index is still quite large. Furthermore, the minimum wage level of each district/city is also in the range of 1,900,000-2,153,970, in which case the community income in every city or district within Yogyakarta's Special Region is still quite small. With the stability between the growth rate of GRDP, Gini Ratio, and Minimum wage level, the income per capita will rise, resulting in an automatic rise in community prosperity (BPS Yogyakarta, 2023).

This research's goal is to ascertain how the improvement of road infrastructure, increase in the growth rate of GRDP, increase or decrease in Gini ratio, and minimum wage level change impact the human development index in five districts/cities within the Special Region of Yogyakarta. For this reason, the study's title:

The Influence of Road Infrastructure on the Human Development Index in the Special Region of Yogyakarta from 2015-2022 (Case study: Five districts/cities in the Special Region of Yogyakarta).

1.2. Research Problem

Based on what has been described in the previous background, The research problems are as follows:

1. What effect does road infrastructure have on the Human Development Index in each of the Special Region of Yogyakarta's five regencies and cities from 2015 to 2022?
2. How does the rise in the Human Development Index in each of the five districts/cities that make up the Special Region of Yogyakarta from 2015 to 2022 relate to the development of road infrastructure?

1.3. Research Objectives

Regarding the problem formulation above, the research objectives are as follow:

1. To examine how road infrastructure affects five regencies/cities in the Yogyakarta Special Region from 2015 to 2022 in terms of the Human Development Index.
2. To evaluate the relationship between the development of road infrastructure and the increase in the five cities and regencies that make up the Special Region of Yogyakarta's Human Development Index from 2015 to 2022.

1.4. Research Benefits

This research will result in many advantages and information for various parties as follows:

1. For Educational Institutions
   Expected as a source of information for readers and as a reference for parties in need and subsequent researchers who will conduct research in the same field.
2. For Community Organizations and Other Organizations
   Many interested parties are anticipated to use the findings of a study conducted from 2015 to 2022 in five regencies/cities of the Special Region of Yogyakarta on the impact of road infrastructure on the Human Development Index.

CHAPTER 2

LITERATURE REVIEW

2.1. Theoretical Review of Infrastructure

At the moment, there is no consensus on what constitutes infrastructure. On the other hand, public facilities and infrastructure are included in the definition of infrastructure in the large Indonesian dictionary. Facilities include things like telephones, roads, bridges, hospitals, and sanitary facilities. Infrastructure is a type of public capital, or capital resulting from government investment, in the economics sense as well.

Roads, bridges, and sewer systems are all considered infrastructure in this research (Mankiw, 2003: 38). According to Familoni (2004: 16), infrastructure is a key essential service in the development process. Infrastructure can also be defined as physical capital facilities as well as the organizational, knowledge, and technological frameworks necessary for the organization of society and economic development. The infrastructure consists of the legal system, public education and health systems, water distribution and treatment systems, garbage and waste collection, treatment and disposal, and public safety systems such as security and firefighting, as well as communication, transportation, and public utility systems (Tatom, 1993: 124).

Infrastructure can also be divided into two categories based on its function and designation. According to Familoni (2004: 20), infrastructure is divided into economic and social infrastructure. Economic infrastructure is critical to boost the country's economic growth rate. Public utilities like gas, electricity, clean water, sewage, and telecommunications are all part of the economic infrastructure. Public works like roads, canals, dams, irrigation systems, and drainage systems are also included. Moreover, this category includes transportation projects like airports, waterways, trains, and urban transportation. Social infrastructure, on the other hand, can be categorized into infrastructure that focuses on education and health.

In addition, the investment made towards infrastructure often determines the development of infrastructure. Two types of investments are disaggregated. First, extensive communication and transportation networks (railways, roads, ports, and telecommunication systems). Second, infrastructure that includes local and regional assets, such as municipal transportation systems, power distribution, and clean water systems. This distinction is related to the different levels of intervention at each level of government. This categorical distinction depends on the characteristics of each region.

According to Stiglitz (2000: 104), infrastructure such as toll roads includes public goods when talking about infrastructure provided by the government, although this infrastructure is not a pure public good (impure public good). Regarding how public goods are used, public goods have two main characteristics: non-excludable and non-rivalrous. When it comes to consuming and using goods, there is the nature of rivalry or competition. That is, if a good is used by someone, it cannot be used by someone else. If a person consumes or uses good, there is no competition in consuming it. In other words, if the opposite condition occurs, i.e. when a person cannot restrain others from consuming the good together, the good can be considered a public good.

Since infrastructure is considered a public good, according to his theory, it has externalities because it is provided by the government and for the public. Infrastructure is not paid for directly by any party that uses it. In the private sector, infrastructure externalities refer to unpaid inputs.

The condition in which one party's actions affect the value of other non-actors, without a price, is called an externality. There are two types of externalities in theory: positive externalities and negative externalities. Positive externalities tend to cause supply shortages, while negative externalities cause overproduction (Stiglitz, 2000: 78). Without taking into account the good's social value, the demand curve represents a shortage in the supply of an item. The social value curve is above the demand curve because the good has a higher social value than a private one. When the social value curve crosses the supply curve, it indicates that the socially ideal amount is more than the amount that is ideal based on its private value. This is the optimal quantity to be provided. Overproduction, on the other hand, is the opposite condition, which is when social costs are not taken into account when producing something, resulting in lower private costs of production. In other words, more goods are produced, where the amount of goods produced should be less because social costs must be included (Mankiw, 2003: 21).

Roads, schools, healthcare, and other forms of infrastructure are examples of externalities according to Canning and Pedroni (2004: 11) ensuring that the facilities provided by various infrastructures are external features that can increase the productivity of all components in the production process. The beneficial externality of infrastructure is the spillover effect, which increases business and agricultural production without the need to raise the amount of labor and capital inputs or the degree of technology. Productivity levels in both the business and agricultural sectors will increase as a result of infrastructure development, for instance, road development.

2.2. Theoretical Foundation

2.2.1. The Definition of Infrastructure

The physical infrastructure that provides buildings, transportation, and other public facilities for meeting basic human social and economic needs is known as infrastructure (Grigg, 1988). Infrastructure systems are crucial to the daily operations of society because they enable the social and economic systems to function. The fundamental buildings, machinery, and gadgets required for the functioning of social and socioeconomic systems are referred to as the infrastructure system (Grigg in Kodoatie, 2003). According to The World Bank, infrastructure types were split into three categories in 1994:

1. The physical infrastructure needed to support economic activity is known as economic infrastructure, and it is made up of public utilities (such as gas, water, sanitation, power, and telecommunications), public works projects (like highways, dams, waterways, water supply, and drainage), and the transport industry (like railroads, roads, ports, and airports).
2. Social support includes things like dwellings, recreation, health care, and educational opportunities.
3. Infrastructure of policies that includes management, justice, and integration.

The Commission for the Acceleration of Infrastructure Delivery was established by Presidential Regulation No. 42/2005, which outlined the various categories of infrastructure that the government regulates. These categories comprise the following: telematics infrastructure, electricity infrastructure, road infrastructure, water supply infrastructure, drinking water and sanitation infrastructure, and infrastructure for the transportation of oil and gas. Infrastructure can be categorized as such because it necessitates government regulation and is required by the larger community.

2.2.2. Function and Classification of Road Infrastructure

Road Law Number 38 of 2004 states that, aside from railroads, truck routes, and cable roads, all portions of the road, including structures and auxiliary traffic equipment, on and above land and/or water, are considered to be land transportation infrastructure.

Road classification or road hierarchy is a grouping of roads. Road grade determination is related to road traffic volume, road capacity size, road economic efficiency, road financing status, road construction and maintenance. The following are the categories:

2.2.2.1. Based on Road Function

According to RI Law No. 38 of 2004 concerning roads and Law No. 22 of 2009, there are four primary categories into which roads in Indonesia are classified according to their functions. These categories include the following:

a. Arterial Road: This kind of road is essential for tying together big areas, economic centers, and important cities.
b. Collector Road: serves as a link between arterial roads and local roads. It collects and distributes traffic to and from arterial roads.
c. Local Roads: Local roads are a type of road that focuses on serving traffic within a specific residential area or neighborhood.
d. Neighborhood Road: Neighborhood roads are located within a settlement or neighborhood and serve as access to homes and limited facilities within the neighborhood.

This classification assists governments and relevant stakeholders in effective road infrastructure planning, ensuring that each type of road can be developed and managed according to its purpose and role in the wider transportation system.

2.2.2.2. Classification by Government Administration

Road classification is an effort to make road administration clearer legally between the central and local governments. National, provincial, district, city, and village roads are categorized as public roads based on their status.

a. Roadway National

   In addition to national strategic routes or toll roads, this type of road system typically links provincial capitals through arterial and collector roads.

b. Roadway Provincial

   The major road network system has branch roads connecting provincial capitals and district (city) capitals, as well as district (city) capitals and provincial important highways.

c. Roadway City

   The public route links the settlement areas within the city, parcels and service centers, and parcels and service centers. It is part of the secondary road network system.

d. Roadway Village

   It is a public road linking different areas and/or communities inside the village, in addition to neighborhood roads.

2.2.2.3 Classification based on axis load weight

For use and compliance with regulated traffic requirements, roads are divided into categories according to transportation needs. Taking into account the superior characteristics of each model, the development of motor vehicle technology, the axle load of motor vehicles, and the heaviest road construction. Road groups related to road traffic and transportation (Law No. 14 of 1992) based on axle loading (also called road rating) are as follow:

a. Class I road

   Main roads open to motor vehicles, including vehicles with a carrying capacity not exceeding 2,500 mm, a length not exceeding 18,000 mm, and a vehicle carrying capacity not exceeding 10 tons.

b. Class II road

   It is a main road that can be used by motorized vehicles, including cargo, with a width of 2,500 mm or less, a length of 18,000 mm or less, and a maximum allowable axle load of 10 tons. This class of roads is suitable for container transport.

c. Class III A road

   A main road or collector road that can be used by motorized vehicles with a maximum width of 2,500 mm, a maximum length of 18,000 mm, and a cargo capacity of 8 tons.

d. Class III B road

   A main road or collector road that can be used by motorized vehicles with a maximum width of 2,500 mm, a maximum length of 18,000 mm, and a cargo capacity of 8 tons.

e. Class III C road

   These are local and neighborhood roads open to vehicles containing cargo with a maximum width of 2,100 millimeters, a maximum length of 9,000 millimeters, and a permissible axle load of 8 tons.

2.2.3. Human Development Index

According to Azhari (2000), an indicator of human progress can be the development that involves humans as the main actors and places humans as the ultimate goal. The Indonesian government shows human development as a process from the people, to the people, and for the people, which means that humans are the oppressed order during the development process. The human development process focuses on several elements, such as health, education, morale, purchasing power, and faith.

Overall, the World Bank has placed people's well-being as the main goal of development; development should achieve people's well-being through improving health, nutrition, and education systems to the best standards and quality. In the development process, the World Bank has set three targets for countries to achieve: economic improvement, social development, and environmental improvement. These three targets have strategies that are very closely related to human development, such as reducing infant mortality, implementing compulsory basic education, health, and improving the quality of nutrition, and not forgetting the importance of sustainable development. Achieving inclusive growth across Indonesia, especially in lagging regions, requires improved services at the local level and increased equity (World Bank, 2017).

Human development requires strong human resources and infrastructure and human resource development must be aligned. If infrastructure development is not followed by human resource development, the competitiveness of Indonesia's human resources will decline. In this case, human resources must continue to improve their basic needs and capabilities to contribute the national development.

2.2.3.1 Concept of Human Development Index

Indicator of human progress was proposed in 1990 by the World Development Program (UNDP). With four main components empowerment, equity, sustainability, and productivity. The Index of Human Development measures average accomplishments of Growth in humanity dimensions, including health, knowledge, longevity, and a reasonable standard of living. This idea has also been applied by the Indonesian government named HDI.

According to Baeti (2013), utilizing the Human Development Index, one can gauge how much impact efforts to improve basic human capital capabilities can have. Population empowerment which is more prominent in basic human improvement is part of development. Measurements of health, education, and purchasing power are used to calculate this development. The amount of development achieved is proportional to the amount gained.

The foundation of the HDI concept is the understanding of the significance of people-centered development. The primary objective of development is to enhance human well-being and income, but it also aims to improve human life quality in every area. According to Jim Young Kim, president of the World Bank, HDI is now a crucial element of sustainable economic growth. Nonetheless, the World Bank (2018) asserted that insufficient spending on healthcare and education can impede economic expansion. Humans are the process's ultimate objective; they are not merely instruments in it.

2.2.3.2 Calculation of Human Development Index Value

A technique to gauge both a population's physical and non-physical characteristics is the human development index (HDI). Non-physical qualities consist of life expectancy and literacy rates based on the economic capabilities of the people. The main indicators of the human development index are health, education level, and economy.

It makes use of three fundamental criteria: age, education, and a respectable quality of life. Instead of operating separately from one another, the three parts work together. Other variables that may have an impact include the availability of jobs, which is influenced by several variables, particularly those about infrastructure, economic growth, and government policies (Kurniasari, 2013).

The human growth index value is calculated using the following components (BPS Yogyakarta, 2021):

a. Life Expectancy
   An index that describes the approximate average lifespan lived by each person while living in an area. As a result of UNDP standards, minimum and maximum values of life expectancy per capita are calculated. The minimum value is 20 years and the upper limit is 85 years.
b. Literacy Rate
   The literacy rate consists of individuals aged fifteen years and above who can write and read Latin and other alphabets.
c. Average Number of Years in Education
   The number of years that people over the age of fifteen spend in formal education is known as their average number of years in school.
d. Adjusted Real Expenditure per Capita
   While BPS calculates a decent standard of living using the average value of adjusted real per capita expenditure using the Atkinson formula, UNDP uses adjusted real gross domestic product (GRDP).

UNDP (2015) stated that since Indonesia has embraced the concept of human development that includes equity, productivity, empowerment, and sustainability, the focal point of Indonesia's national development is to raise the population's level of mental, physical, and spiritual well-being. The following formula is used to calculate HDI:

$$\text{HDI} = (\text{Indeks } X_1 + \text{Indeks } X_2 + \text{Indeks } X_3)/3$$

Description:

X_1 = Life Duration

X_2 = Level of Education

X_3 = Adequate Living Standard

2.2.4. Relationship between Road Infrastructure Development and Human Development Index

The government seeks to implement development initiatives to raise community well-being, one of which is infrastructure accessibility. Infrastructure accessibility in this nation is crucial. According to Haris (2009), the availability of infrastructure is one of the sources of development taking place throughout the country; region. More broadly, infrastructure plays a role in improving the value of consumption, labor productivity (including the labor market) jobs, improving quality of life and social welfare, and expanding employment opportunities with the ultimate goal of achieving sustainable economic growth. Road infrastructure is one of the very important infrastructures the community needs because it makes things easier for visits and events carried out by the community. Thus, road infrastructure helps improve people's welfare.

Research conducted by Safitri (2016) concluded that human development depends on the availability of purchased infrastructure that is also available to enhance the growth of human resources quality. Infrastructure availability is the main engine of economic development with full benefits of integration, plus an increase in trade and investment activities, as shown by the study's findings, which indicate a positive influence on the development of road infrastructure with a coefficient value of 0.14. It is determined that there is a positive correlation between the two effects of road infrastructure development on indicators of human progress. This is in line with the research conducted by Annafi (2020).

Road infrastructure has a strategic role in a country's development where road infrastructure is very important in building an efficient land transportation network and supporting logistics distribution in the area/region:

1. Backbone of Land

   Transportation Road infrastructure acts as the backbone of the land transportation system. With proper construction and maintenance, the road network can easily connect various cities and regions throughout Indonesia. This provides better access for people to travel, optimizes the mobility of goods and people, and improves connectivity between regions.
2. Economic Impact

   Road infrastructure has a significant economic impact. With a good land transportation network, trade becomes smoother and shipping costs can be minimized. This helps improve business efficiency and economic competitiveness of a country.
3. Sustainable Development

   Road infrastructure must be built with a sustainable approach. The use of green technology and environmentally friendly materials, such as asphalt from recycled materials, helps reduce environmental impacts. Road construction that pays attention to water flow and rainwater absorption also helps reduce the risk of flooding and protects groundwater resources.

4. Support for Logistics Distribution

   A good road network makes it easier to move goods from producers to consumers with shorter travel times and lower transportation costs. The overall efficiency of the logistics supply chain has also increased. Products can reach the market on time, avoiding losses due to storage or damage to goods during the shipping process.

With a strong road infrastructure, a region can accelerate development and improve people's quality of life (UNDP, 2015).

2.3. Previous Research

This research used several related research sources that aim at references that are being carried out, including:

1. The research conducted by Sapkota (2014) entitled "Access to Infrastructure and Human Development: Cross-Country Evidence". This research aims to ascertain the impact of infrastructure on the index of human development, which continues to be restricted. Furthermore, the Millennium Development Goals (MDGs) do not include essential infrastructure services like energy, transportation, or roads, despite the widespread agreement that having a strong infrastructure is essential to achievie the MDGs. Panel data covering 91 developing countries from 1995 to 2010 and General Methods of Moments dynamic panel estimation, one of the most popular forms of semiparametric estimation applied to data lacking distributional information were the data and methods employed in the analysis. Therefore, the moment equation was used by the researcher instead of the probability density function to estimate the parameters. Infrastructure, such as having access to clean drinking water

sources, electricity, and a sufficient number of roads, was found to have a significant positive impact.

2. The study carried out by Liu et al. (2023) entitled "Infrastructure development, human development index, and CO2 emissions in China: A quantile regression approach". The purpose of this study is to identify the relationship among infrastructure development, the Human Development Index, and 〖CO〗_2 Emissions in China. The data and methods used are Time Series data from 1990 - 2021 and Quantile Regressions, which found the results that the availability of good infrastructure can have a positive and significant impact on the Human Development Index.
3. The study carried out by Weya et al. (2023) entitled "Analysis of the Effect of HDI and Road Length Infrastructure Development on Improving Economic Inequality in Eight Districts of the Region La Pago Tradition". This research aimed to determine the effect between two existing variables, namely the Human Development Index and Road Length Infrastructure, where the availability of adequate infrastructure can have an influence on various sectors, one of which is the Human Development Index. The model used in this research used panel data with a linear regression approach (OLS). The results found that Road Length Infrastructure has a positive and significant influence on the Human Development index.
4. The research carried out by Sinaga (2020) was entitled "Influencce of Infrastructure on the index of human development in the province results of expansion in Indonesia period 2015 - 2019". This research aimed to identify effective and optimal utilization related to existing infrastructure and attention to its quality and the effects that arise from the availability of qualified infrastructure. The method used in

this research is using Panel Data which combines cross-section and Time series which has the advantage of producing a greater Degree of Freedom and has fewer problems than cross-section and time series. The results of this research indicate that education, health, and road infrastructure did not affect the Human Development Index.

5. The research carried out by Brata (2016) entitled "The Influence of Infrastructure on Human Development in the Provinces of Eastern Indonesia 2006-2013 Period". The purpose of this research is to ascertain how human development was impacted by infrastructure in the eastern Indonesian provinces between 2006 and 2013. The Indonesia Database for Policy and Economic Research (INDODAPOER) and the Central Bureau of Statistics (BPS) provided the secondary data and models used in this research to determine the relationship between the variables that are currently in place. Panel data regression with a fixed effect model was the analytical tool employed. According to the study's estimation results, the coefficient of the percentage of households with access to electricity is 0.086174. This indicates that 1% increase in the proportion of households with electricity access that will positively affect the human development index, causing it to rise by 0.086 points. The coefficient value for the percentage of households with access to clean water is 0.120012, indicating a 0.086-point increase in the proportion of households with clean water. The highway length to provincial area ratio's coefficient value of 1.722844 indicates that an increase of 1 km in highway length to the provincial area will positively impact the human development index (HDI), adding 1.722 points to the index. Overall, the results of this research indicated that

infrastructure had a positive influence on the human development index (HDI).

2.4. Framework

To make this research easier to understand and carry out, a framework is needed to explain how this research will be carried out. The framework is as follows:

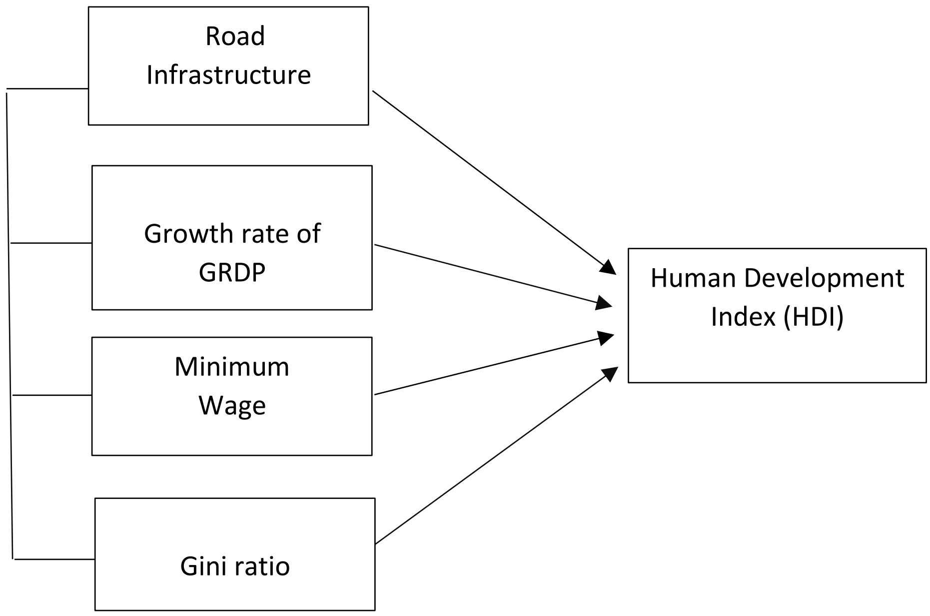


Figure 2.1 Framework

This research used a research framework to explain the Independent variable (Road Infrastructure, the growth rate of GRDP, Minimum Wage Level, and Gini Ratio) and the Dependent variable (Human Development Index). From Figure 2.1, the goal of this research is to ascertain how the Human Development Index is affected in five regencies/cities that are part of the Special Region of Yogyakarta by road infrastructure, the growth rate of GRDP, minimum wage, and Gini Ratio. Empirical research findings will supplement the theoretical interpretations.

2.5. Hypothesis

Based on the previous problems, theories, and frameworks discussed, the hypothesis arises that in each of the five districts/cities that comprise the Special Region of Yogyakarta, there is a positive association between the Road Infrastructure variable (X) and the Human Development Index variable (Y). Besides, the better and more developed the road infrastructure in an area, the more likely its Human Development Index will also increase. In addition, it is expected that the variables of the growth rate of GRDP, Minimum Wage Level, and Gini Ratio influence the Human Development Index; however, to find out how these variables relate to road infrastructure, it is necessary to identify their relationship.

CHAPTER 3

RESEARCH METHODS

3.1. Data and Data Sources

The Central Statistics Agency (BPS) in the Yogyakarta Special Region provided the secondary data for this investigation. This study's time series spans seven years, from 2015 to 2022, and it gathers data from a cross-section of five districts/cities in the Special Region of Yogyakarta. Approximately, forty observations are obtained during this period. Four independent and one dependent variable are used in this research: the length of road infrastructure (national, provincial, district, or city), the percentage-based Gini ratio, the minimum wage in each district and city within the Special Region of Yogyakarta, both the number of human development indexes in percent scale across five districts/cities in the Special Region of Yogyakarta and the growth rate of Gross Regional Domestic Product (GRDP) per capita in each district or city.

3.2. Data Collection Method

Data collection methods are essential to ensure the scientific validity of the research and the production of results that support its objectives. This research data came from secondary sources or information that had already been analyzed by someone else and is usually available in published form. Panel data, which is a cross-sectional and time series combination, spans the Special Region of Yogyakarta's five districts and cities between 2015 and 2022. Data sources acquired from the Central Statistics Agency (BPS) include the Human Development Index (HDI) in percentage form, road infrastructure data in kilometers/km, Growth rate of GRDP data in percentage form, Gini ratio data in percentage form, and minimum wage level data in millions.

3.2.1. Definition and Operation of Variables

The variable in this research is the Human Development Index (Y) as the dependent variable. While, Road Infrastructure (X1), Growth rate of GRDP (X2), Gini Ratio (X3), and Minimum Wage Level (X4) as independent variables. The definition of variables in this research is as follows following:

1. Human Development Index (Y)
   Human development index (HDI) in this research using data with a ratio measurement scale (%) in the year 2015-2022 per Regency/City in the Special Region of Yogyakarta obtained from the Central Statistics Agency (BPS).
2. Road infrastructure (X1)
   Road infrastructure in this research uses data total length of good roads (km) in 2015-2022 with a nominal measurement scale per Regency/City in the Special Region of Yogyakarta obtained from the Public Works and Public Housing Department (PUPR) and the Central Statistics Agency (BPS).
3. Growth rate of GRDP (X2)
   The growth rate of GRDP in this research using data with a ratio measurement scale (%) in the year 2015-2022 per Regency/City in the Special Region of Yogyakarta obtained from the Central Statistics Agency (BPS).
4. Gini Ratio (X3)
   The Gini ratio in this research using data with a ratio measurement scale (%) in the year 2015-2022 per Regency/City in the Special Region of Yogyakarta obtained from the Central Statistics Agency (BPS).
5. Minimum Wage Level (X4)
   The Minimum Wage Level in this research using data with a ratio measurement scale (%) in the year 2015-2022 per Regency/City in the Special Region of Yogyakarta obtained from the Central Statistics Agency (BPS).

3.3. Tool of Analysis

This method used panel regression as an analytical tool. This analysis's goal is to ascertain the degree to which road infrastructure affects each of the five districts and cities within Yogyakarta's Special Region's human development index. There are two advantages of using panel data, namely:

1. Generates a higher degree of freedom, this research combines cross-sectional and time series data to collect more information.
2. Integrates data information and can solve the issue of committed/omitted variables.

Three models were used for estimation in the panel data regression method: the Common Effect Model, the Fixed Effect Model, and the Random Effects Model (Widarjono, 2013: 353-359).

3.3.1. Common Effect Model Test

The simplest model combination involves the use of time series and cross-section data; this data combination can show the actual conditions. If all objects exist at all times and data are combined with the OLS method to estimate the model, the regression analysis results are considered valid (Winarno, 2009: 9.11).

3.3.2. Fixed Effect Model Test (Chow Test)

In this test, the most appropriate regression result is used contrasting the Fixed Effect Model with the Common Effect Model, known as the Chow Test. The Chow Test hypothesis decision is as follows:

H_0 = Common Effect Model
H_a = Fixed Effect Model

The F-statistical test is used to determine against H_0:

$$F_{hitung} = \frac{\frac{(RSS_1 - RSS_2)}{n-1}}{\frac{RSS_2}{nt-n-k}}$$

Where:

RSS_1 = Residual sum of squares CEM technique.

RSS_2 = Residual sum of square FEM technique.

n = Amount of Cross-sections unit.

t = Amount of Cross-sections unit.

k = Amount of independent variable.

The following are the choices made to not be rejected or rejected:

1. If the Chi-square probability value> alpha, H_0 is accepted and the model that should be used is the Common Effect Model.
2. If the Chi-square probability value < alpha, H_0 is rejected and the model that must be used is the Fixed Effect Model.

3.3.3. Random Effect Model Test (Hausman Test)

The Random Effect Model is the basis for choosing the best model between the Random Effect Model and the Fixed Effect Model. The steps are as follows:

1. Regress each model from the Fixed Effect Model and Random Effect Model.
2. Formulate H_0 null hypothesis and H_a alternative hypothesis, as follows:

   H_0 : Random Effect Model

   H_a : Fixed Effect Model
3. Determine the critical limit at which a hypothesis should be rejected or not.
4. The decision to reject or accept H_0 is as follows:
   a. If the Cross Section Random probability value < alpha, H_0 is rejected and the model used is a fixed effect.

b. If the Cross Section Random probability value > alpha, H_0 is accepted, and the model used is a random effect.

3.4. Statistical Test

Statistical tests are employed to examine the outcomes of an appropriate panel model. Finding the independent regression coefficients' significance level on the dependent is the first step. This examination consists of:

3.4.1. t-Test

To find out the influence of the independent variables that have a variable in influencing the non-independent variable, at a certain level of significance, the t-test is used. The following is the decision-making process:

1. Create a hypothesis using a one-sided test:
   - $H_0 : \beta_1 \geq 0$.
   - $H_a : \beta_1 > 0$.
2. The decision to reject or not a null hypothesis H_0 is as follows:
   - If $t_{count} < -t_{table}$: H_0 Rejected. Which means that the independent variable individually influences the dependent variable.
   - If $t_{count} > -t_{table}$: H_0 Not Rejected. That is, individual independent variables did not affect the dependent variable.

3.4.2. F-Test

The F-test is used to ascertain whether the independent variable significantly affects the dependent variable. Explanation of the F-test used analysis of variance = ANOVA. To ascertain whether the regression coefficient β_1, β_2, β_3 and β_4 simultaneously has an impact on the dependent variable. The F test method and 5% alpha decision-making criteria are explained as follows (Widarjono, 2013: 65):

1. Create the null hypothesis H_0 and alternative hypothesis
   - $H_0 : \beta_1 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0.$
   - $H_a : \beta_1 \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0.$
2. Determine the important limits that influence the decision to accept or reject a hypothesis H_0, where the F-table value = $F_{a;df1;df2}$. The critical value is determined by the alpha level of 5%, df1 is determined by the numerator (k-1) df2 is the denominator (n-k), and the k value, which is the dependent variable, is the number of model parameters determined.

3.5. Analysis of Determination Coefficient (R^2)

The following formula can be used to get the coefficient of determination: It illustrates the extent to which the independent variable can account for the variation in the dependent variable.

$$R^2 = \frac{ESS}{TSS} = \frac{TSS-SSR}{TSS} = 1 - \frac{SSR}{TSS}$$

$$R^2 = 1 - \frac{e_{i^2}}{y_{i^2}} = 1 - \frac{e_{i^2}}{(y_i - y)^2}$$

Where:

R^2 = Determination Coefficient.

ESS = Explained Sum of Square

TSS = Amount of Sum of Square

RSS = Residual Sum of Square

e_{i^2} = Estimated value of the residual

Based on the value of the adjusted R-square. The value of R^2 lies between zero and one (0 <R^2< 1). The greater the associated variable that can be explained by the other independent variable the greater the variable when R^2 is closer to the value of one.

3.6. Heteroscedasticity Test

The condition where random variables have different variances is known as heteroscedasticity. In OLS, heteroscedasticity causes the coefficients to no longer have the minimum and best variance although they remain linear and unbiased. The results of heteroscedasticity for OLS are as follows (Nachrowi and Usman, 2002:33):

1. Due to the inconsistency of variance, one of the impacts is the greater variance of the estimates.
2. Since the hypothesis tests (t and F tests) use the magnitude of the estimated variance, the larger variance of the estimates will have an impact on the results.

As a result, both tests are inaccurate. To identify the heteroscedasticity test as it progresses, where Ho is heteroscedasticity, and Ho is rejected, indicating that there is a heteroscedasticity problem if the R-squared statistic's probability is less than alpha ($\alpha = 0.05$). Modifying the model with a weighted estimation method is a way to overcome this problem. We can reduce the symptoms of heteroscedasticity by using the cross-section weights criterion during the panel data processing.

3.7. Multicollinearity Test

When independent variables are highly dependent on each other, multicollinearity occurs. This can lead to unstable numerical coefficient estimates. There are two situations in which this test is performed. First, if the f-statistic has a high level of significance but the t-statistic is not significant; second, if the R^2 is comparatively high but the t-statistic is not significant. A quick way to determine whether multicollinearity exists is to examine the independent variables' correlation matrix. If an independent variable's correlation coefficient is greater than 0.8 or 0.9, multicollinearity is a significant problem.

CHAPTER 4
RESULT AND DISCUSSION

This chapter discusses the results of research and discussion of Road infrastructure's impact on the Human Development Index in five districts/cities within the Yogyakarta Special Region, 2015–2022. To obtain the regression used in this research, panel data was combined with time series and cross-section data. The data set utilized spans seven years, sequentially from 2015 to 2022, and encompassed five districts/cities within the Special Region of Yogyakarta. This research used Eviews 10 software. This research used five variables: the Human Development Index is the dependent variable, and the other four are independent variables: road infrastructure, the growth rate of GRDP, Gini Ratio, and the minimum wage level.

4.1. Result

4.1.1. Regression Estimation Results

4.1.1.1. Common Effect Model (CEM) Estimation

According to Table 4.1 regarding panel data regression processing results, the coefficient of determination (R-squared) from the estimation results was 0.826079. It means that 82% of the dependent variable can be explained by each of the listed independent variables while the remaining 12% was explained by factors outside the model.

Table 4.1 Estimated Results from Common Effect Model (CEM) Regression

Variable	Coefficient	t-Statistic	Prob.
C	45.05880	7.205256	0.0000
GR	77.52435	5.566345	0.0000
MW	4.69E-06	2.722690	0.0100
GRDP	-0.019175	-0.135719	0.8928
RI	-0.006198	-3.916957	0.0004
R-squared	0.826079		
Adjusted R-squared	0.806202		
F-statistic	41.56022		
Prob(F-statistic)	0.000000		

Source: Secondary data processed, 2023

4.1.1.2. Fixed Effect Model (FEM) Estimation

The coefficient of determination (R-squared) value from the estimation results was 0.998696, which indicated that all of the listed independent variables can explain 99% of the dependent variable, according to the panel data regression processing results in Table 4.2.

Table 4.2 Estimated Results from Fixed Effect Model (FEM) Regression

Variable	Coefficient	t-Statistic	Prob.
C	72.20169	97.41992	0.0000
GR	-1.596997	-0.843201	0.4056
MW	3.85E-06	22.78486	0.0000
GRDP	0.038913	2.955281	0.0059
RI	0.000572	2.182477	0.0368
Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.998696		
Adjusted R-squared	0.998360		
F-statistic	2968.282		
Prob(F-statistic)	0.000000		

Source: Secondary data processed, 2023

4.1.1.3. Random Effect Model (REM) Estimation

Based on the panel data regression processing results presented in Table 4.3, it is possible to determine that the estimation results' coefficient of determination (R-squared) was 0.826079. This indicated that all of the listed independent variables can account for 82% of the dependent variable.

Table 4.3 Estimated Results from Random Effect Model (REM) Regression

Variable	Coefficient	t-Statistic	Prob.	
C	45.05880	78.31991	0.0000	
GR	77.52435	60.50523	0.0000	
MW	4.69E-06	29.59518	0.0000	
GRDP	-0.019175	-1.475247	0.1491	
RI	-0.006198	-42.57665	0.0000	
	Effects Specification			
			S.D.	Rho
Cross-section random			2.59E-06	0.0000
Idiosyncratic random			0.256387	1.0000
	Weighted Statistics			
R-squared	0.826079			
Adjusted R-squared	0.806202			
S.E. of regression	2.786885			
F-statistic	41.56022			
Prob(F-statistic)	0.000000			

Source: Secondary data processed, 2023

4.1.2. Model Significance Test

Three models are used in this research: the random effect model, the fixed effect model, and the common effect model. To prevent bias during testing, the model selected for this research needed to be appropriate. The Chow Test is the first step in selecting between the Common Effect Model and the Fixed Effect Model. The Hausman

Test is the second step in selecting between the Fixed Effect Model and the Random Effect Model.

4.1.3. Significance Test of Fixed Effect Model

This is a test used to select the appropriate regression results from the Common Effect Model and Fixed Effect Model, also known as the Chow Test. The Chow Test decision is as follows:

H_0 : The Common Effect Model
H_a : The Fixed Effect Model

The decision to reject or not reject the null hypothesis H_0, with an alpha significance level of 0.05 (α = 5%) is as follows:

a. If the Chi-square probability value > alpha, H_0 is not rejected and the model used is the Common Model Effect.
b. If the Chi-square probability value < alpha, H_0 is rejected and the model used is the Fixed Effect Model.

- Following are the Chow Test estimation results

Table 4.4 Chow Test Estimation Results

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1026.090599	(4,31)	0.0000
Cross-section Chi-square	195.733722	4	0.0000

Source: Secondary data processed, 2023

The Chi-square Cross-Section probability results were 0.0000 based on the Chow Test results and the alpha significance level was set at 5%. It can be deduced that the probability of 0.0000 for the Chi-square Cross-Section is less than the alpha significance level which is 0.05 (α = 5%). Therefore, the best model to use is the Fixed Effect Model.

4.1.4. Random Effect Model Significance Test

- The following are the estimated results of the Hausman Test using EViews:

Table 4.5 Hausman Test Estimation Results

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	4104.362396	4	0.0000

Source: Secondary data processed, 2023

Based on the results of the estimation carried out using the Hausman Test, the random cross-section probability value of the test results showed 0.0000 and this research used a significance level of 5% (α = 0.05). Therefore, it can be concluded that the random cross-section probability value above is smaller than alpha 0.05 (α = 5%). Based on this, the best model to use is the Fixed Effect Model.

As previously explained, this test was done to select a model between the Fixed Effect model and the Common Effect model; thus, the hypothesis is as follows:

H_0 : The Common Effect Model

H_a : The Fixed Effect Model

The decision to reject or not a hypothesis is as follows:

a. If the Chi-square probability value > alpha, H_0 is not rejected and the model used is a common effect.
b. If the Chi-square probability value < alpha, H_0 is rejected and the model used is fixed effect.

4.1.5. Multicollinearity Test

A test carried out using the multicollinearity test can be explained as follows:

Table 4.6 Estimated Results of The Multicollinearity Test

	GR	**MW**	**GRDP**	**RI**
GR	1.000000	0.329994	-0.072684	-0.643264
MW	0.329994	1.000000	-0.203857	-0.104000
GRDP	-0.072684	-0.203857	1.000000	-0.203857
RI	-0.643264	-0.104000	-0.203857	1.000000

Source: Secondary data processed, 2023.

The conclusion was that there was no multicollinearity or passes the multicollinearity test in this research because each variable correlation showed that the regression result value was <0.85.

4.1.6. Hypothesis Test Results

4.1.6.1. T-Test

Table 4.7 T-test Result

variable	Coefficient	T-Statistic	Probability
C	72.20169	97.41992	0.0000
GR	-1.596997	-0.843201	0.4056
MW	3.85E-06	22.78486	0.0000
GRDP	0.038913	2.955281	0.0059
RI	0.000572	2.182477	0.0368

Source: Secondary data processed, 2023

The following represents the partial impact of independent variable on the dependent variable:

1. Gini Ratio

   The t-statistic value of -0.843201 was less than the t-table value of 2.024394, and the probability value of this variable was 0.4056 > α = 5% (0.05), which indicated that it was not noteworthy and has no bearing on the human development index score in any of the Special Region of Yogyakarta's districts or cities.
2. Minimum Wage Level

   The t-statistic value of 22.78486 was greater than the t-table value of 2.024394, and the probability value of this variable was 0.0000 < α = 5% (0.05), which indicated that it matters and influences each district's or city's human development index number within the Special Region of Yogyakarta.
3. GRDP

   The t-statistic value of 2.955281 was greater than the t-table value of 2.024394, and the probability value of this variable was 0.0059 < α = 5% (0.05), which indicated that it matters and influences each district's or city's human development index number within the Special Region of Yogyakarta.
4. Road Infrastructure

   According to the significance test results, this variable had a probability value of 0.0368 < α = 5% (0.05) and, a t-statistic value of 2.182477, which was greater than the t-table value of 2.024394. It indicated that it matters and influences each district's or city's human development index score within the Special Region of Yogyakarta.

4.1.6.2. F Test

Table 4.8 F test and Coefficient of Determination (R^2)

R-squared	0.998696
Adjusted R-squared	0.998360
F-statistic	2968.282
Prob(F-statistic)	0.000000

Source: Secondary data processed, 2023

The calculated F value of 2968.282 was greater than the F table value, namely 2.641465, and the Probability value sig. namely, 0.000000, which was a value smaller than alpha 0.05 (α = 5%). Therefore, H_0 was rejected and H_a was not rejected, which means that the variables of GDRP, MW, GR, and RI influenced the HDI of the five regencies/cities in Yogyakarta.

4.1.7. Analysis of the Determination Coefficient (R^2)

At 0.998360 or 99%, the adjusted R-squared value was found. This figure indicated that the dependent variable or HDI variable from five districts/cities in Yogyakarta, can be explained by the independent variables of GDRP, MW, GR, and RI by 99%. The remaining 1% (100 – -adjusted R-squared value) was explained by other variables that are not part of this research model.

4.2. Discussion

Regarding the panel calculation results with forty observations, the Fixed Effect Model is a good fit for this research. Additionally, the following regression equation was employed in this research:

Table 4.9 Summary of Fixed Effect Model Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	72.20169	0.741139	97.41992	0.0000
GR	-1.596997	1.893970	-0.843201	0.4056
MW	3.85E-06	1.69E-07	22.78486	0.0000
GRDP	0.038913	0.013167	2.955281	0.0059
RI	0.000572	0.000262	2.182477	0.0268
R-squared	0.998696			
Sum Squared	2.037766			
F-Statistic	2968.282			
Prob(F-statistic)	0.000000			

Source: Secondary data processed, 2023

$$G_{it} = \beta_0 + \beta_1 GR_{it} + \beta_2 MW_{it} + \beta_3 PDRB_{it} + \beta_4 RI_{it} + \varepsilon_{it}$$

- The results of the regression equation from the Fixed Effect Model are as follows

G_{it} = 72.20169 β_0 + -1.596997 GR_{it} + 3.85E-06 MW_{it} + 0.0389913 $PDRB_{it}$ + 0.000572 RI_{it} + ε_{it}

Where:

HDI = Human Development Index per district/city in the Special Region of Yogyakarta (percent)

GR = Gini index (Gini Ratio) per district/city in the Special Region of Yogyakarta (Percent)

MW = Minimum Wage Level per district/city in the Special Region of Yogyakarta (Percent)

GRDP = Gross Regional Domestic Product (GRDP) per capita growth rate (%) in districts and cities within the Special Region of Yogyakarta

RI = Road length (national, provincial, district, or city) per district/city in the Special Region of Yogyakarta (km)

$\beta_1;\ \beta_2;\ \beta_3;\ \beta_4$ = Regression coefficient

ε_{it} = Error term

i = District/City

t = Year

After testing and obtaining the results of the equation, it can be interpreted that Table 4.9 explained the results of the coefficient value of Road Infrastructure (National, Provincial, district, or city) of 0.000572, which showed that the significance level of alpha was 5% (0.05) and the probability value of the road infrastructure was 0.0268 or it can be said that the value was smaller than alpha. Therefore, H_0 is rejected. This means that the independent variable length of road infrastructure (national, provincial, district, or city) had a positive significant effect on the Human Development Index. Collectively, the five districts/cities in the Yogyakarta Special Region significantly improve the human development index between the regions. An increase of one kilometer in road infrastructure can have an impact of 0.000572 points on the Human Development Index. Because of this, this research differs from Tampubolon's research (2013).

The coefficient value of the Gini Ratio (Five districts/cities in the Special Region of Yogyakarta) was -1.596997. This identifies that the alpha significance level was 5% (0.05) and the probability value of the variable was 0.4056; therefore, H_0 was not rejected. This indicated that in five districts/cities within the Special Region of Yogyakarta, the Gini

Ratio variable has no discernible impact on the Human Development Index. Ceteris paribus, there was no discernible impact of a rise or fall in the Gini Ratio on the -1.59% value of the Human Development Index. The findings were consistent with Tampubolon's (2013) research.

The Minimum Wage Level variable's coefficient value for the Special Region of Yogyakarta's five districts and cities was 3.85E-06, where this indicated an alpha level of 5% (0.05) and the probability significance value of the variable was 0.0000. This identifies that the probability value is smaller than the alpha of 5% (α = 0.05). Thus, it can be concluded that H_0 was rejected. In this case, The Human Development Index is significantly impacted by the Minimum Wage Level Variable. The Human Development Index will rise by 0.00000385 if the Minimum Wage Level increases by 1%.

The coefficient value of the GRDP per capita variable was 0.038913. This value indicated that the value of the significance probability of this variable was 0.0059, which was smaller than the predetermined alpha of 5% (α = 0.05). Thus, it can be explained that H_0 was rejected. This means that the variable of GRDP per capita from (Five regencies/cities in the Special Region of Yogyakarta) had a positive significant effect on the Human Development Index. This can be seen if there is a 1% increase in GRDP per capita, the Human Development Index was 0.038913.

CHAPTER 5

CONCLUSION AND SUGGESTION

5.1. Conclusion

Based on the findings of the research, analysis, and discussion conducted to identify The Influence of Road Infrastructure On the Human Development Index in Five Districts/Cities in the Special Region of Yogyakarta 2014-2022, it can be concluded as follows:

1. Road infrastructure (national, provincial, district, or city) had a significant positive influence on the human development index (HDI) in five of the Special Region of Yogyakarta's districts and cities from 2015 - 2022. A one-kilometer increase in road infrastructure can have an impact of 0.000572 points on the Human Development Index.
2. The Human Development Index in the five districts/cities of the Special Region of Yogyakarta from 2015–2022 was significantly positively impacted by the growth rate of GRDP per capita in those districts/cities. This is demonstrated by the fact that the Human Development Index is 0.038913 for every 1% increase in GRDP per capita.
3. There was a notable inverse relationship between the Human Development Index and the Gini Ratio in the five districts/cities of the Special Region of Yogyakarta from 2015 to 2022.
4. From 2015 - 2022, the minimum wage level in five districts and cities within the Special Region of Yogyakarta significantly improved the Human Development Index in those same districts and cities. The Human Development Index will rise by 0.00000385 if the Minimum Wage Level increases by 1%.
5. The road infrastructure, GRDP, Gini Ratio, and Minimum Wage Level were examples of independent variables that had a significant relationship with the dependent variable, the human development index concurrently, according to the results of the simultaneous

significance test (F test). The adjusted R-squared value of the road infrastructure, GRDP, Gini Ratio, and Minimum Wage Level variables was 0.998360, or 99% of the variation in the human development index, the dependent variable. While other factors not covered in this research accounted for the remaining 1%.

5.2. Suggestions

Based on the results and findings of the research, Road infrastructure plays a crucial role in the Human Development Index (HDI) of a region or country. the suggestions are as follows:

1. Access to Basic Services: Improved road infrastructure enhances accessibility to essential services such as healthcare, education, and markets. Better access means people can reach hospitals, schools, and markets more easily, thereby improving their quality of life and contributing to higher HDI scores.
2. Employment Opportunities: Good road networks facilitate the transportation of goods and people, leading to economic development and job creation. This, in turn, improves income levels and reduces unemployment, both of which are factors considered in HDI calculations.
3. Social Inclusion: Well-connected roads reduce social exclusion by enabling marginalized communities, such as those in remote areas or with limited mobility, to access services and opportunities. This fosters a more inclusive society, which is a key component of HDI.
4. Infrastructure Development: Road infrastructure projects often accompany other infrastructural developments such as water supply, electricity, and telecommunications. This comprehensive development improves overall living standards and contributes to a higher HDI.

REFERENCES

Azahari, A. (2000). Pembangunan sumberdaya manusia dan indeks pembangunan manusia sektor pertanian. *Journal of Indonesian Economy and Business (JIEB)*, *15*(1), 56-69.

Arsyad, L. (2010). *Ekonomi Pembangunan Edisi Ke-5.* Yogyakarta: Upp Stim Ykpn.

Annafi, S. N. (2020). *Analisis pengaruh pembangunan infrastruktur sosial dan ekonomi terhadap indeks pembangunan manusia kabupaten/kota di provinsi Jawa tengah tahun 2014-2018* (Doctoral dissertation, Universitas Islam Negeri Sunan Kalijaga).

Badan Pusat Statistik DIY, various publications on the Indonesian Socio-Economic Balance System. accessed from https://yogyakarta.bps.go.id, accessed on 2 November 2023

Badan Pusat Statistik City of Jogja, various publications on the Indonesian Socio-Economic Balance System. accessed from, accessed on 2 November 2023

Badan Pusat Statistik Sleman, various publications on the Indonesian Socio-Economic Balance System. accessed from, accessed on 2 November 2023

Badan Pusat Statistik Kulon Progo, various publications on the Indonesian Socio-Economic Balance System. accessed from, accessed on 2 November 2023

Badan Pusat Statistik Gunung Kidul, various publications on the Indonesian Socio-Economic Balance System. accessed from, accessed on 2 November 2023

Badan Pusat Statistik Bantul, various publications on the Indonesian Socio-Economic Balance System. accessed from, accessed on 2 November 2023

Canning, D., & Pedroni, P. (2004). The effect of infrastructure on long-run economic growth. *Harvard University*, *99*(9), 1-30.

Familoni, K.A. (2004). The Role of Economic and Social Infrastructure in Economic Development: A Global View. v

Grigg, Kodoatie. 2003. *Pengantar Manajemen Infrastruktur*. Book · ind · Yogyakarta : Pustaka Pelajar

Harris, A. (2009). Pengaruh Penatagunaan Tanah Terhadap Keberhasilan Pembangunan Infrastruktur dan Ekonomi. Jakarta : Direktorat Tata Ruang dan Pertahanan, BAPPENAS

Liu, Y., Poulová, P., Pražák, P., Ullah, F., & Nathaniel, S. P. (2023). Infrastructure development, human development index, and CO2 emissions in China: A quantile regression approach. *Frontiers in Environmental Science*, *11*, 1114977.

Mankiw, G.N. (2003). *Teori Makro Ekonomi*. Terj. Imam Nurmawan, SE. Jakarta: Erlangga.

Mankiw, G.N., Quah, E., & Wilson, P. (2012). *Pengantar Ekonomi Makro*, Terj. Fitria Liza, Imam Nurmawan, Jakarta : Erlangga

Maryozi, Z., Isyandi, B., & Aulia, A. F. (2022). Pengaruh Pengeluaran Bidang Pendidikan, Kesehatan Dan Infrastruktur Jalan Terhadap Indeks Pembangunan Manusia (IPM) Di Provinsi Riau. *Jurnal Niara*, *15*(1), 1-11.

Nachrowi, Nachrowi dan Usman, Hardius (2002), Penggunaan teknik ekonometri. Jakarta: Lembaga penerbit Fakultas Ekonomi Universitas Indonesia.

PUPR DIY, Road Infrastructure data. Accessed from https://pu.jogjakota.go.id, Accessed on 3 November 2023

Safitri, I. (2016). Pengaruh Pengeluaran Pemerintah Sektor Kesehatan, Pendidikan dan Infrastruktur terhadap Indeks Pembangunan Manusia di Provinsi Aceh. Jurnal Ekonomi Pembangunan. 1(1), 66-76

Saputra, R. E., Handra, H., & Primayesa, E. (2021). Analisis Pengaruh Infrastruktur Jalandan Teknologi Informasi Dan Komunikasi (Tik) Terhadap Pembangunan Manusia Di Wilayah Timur Indonesia. *Jurnal Menara Ekonomi: Penelitian dan Kajian Ilmiah Bidang Ekonomi*, *7*(1).

Sapkota, J. (2015). *Access to infrastructure and human development: Cross-country evidence*. SSRN.

Setiawan, M.B., & Hakim, A. (2011). Indeks Pembangunan Manusia Indonesia. Jurnal Pembangunan. 9(1).

Sinaga, G. P. (2020). Pengaruh Infrastruktur terhadap Indeks Pembangunan Manusia Pada Provinsi Hasil Pemekaran di Indonesia Periode Tahun 2015–2019.

Siregar, D. R., & Tanjung, A. A. (2020). Pengaruh Infrastruktur Dan Indeks Pembangunan Manusia Terhadap Pertumbuhan Ekonomi Kabupaten Langkat 2010-2019. *E-Jurnal Matematika*.rosy

Schmitt, B.H. (1999). Experiential Marketing: How to Get Customer to Sence, Feel, Think, Act, and Relate to Your Company and Brands. New York: Free Press.T

Stigliz, J.E. (2000). Economic of the Public Sector. London: W. W. Norton and Company Ltd.

Tatom, J.A. (1993). Paved with Good Intentions: the Mythical National Infrastructure Crisis Policy Analysis. Cato Institute.

Thazafi, M. R. (2022). Pengaruh Pembangunan Infrasturktur Terhadap Indeks Pembangunan Manusia (IPM) Di Provinsi Aceh 2016-2020.

Tampubolon, N.H., (2013), "Pengaruh Ketersediaan Infrastruktur Terhadap Ketimpangan Pendapatan per kapita: Analisis Provinsi di Indonesia 2007-

2011", Journal of Economics & development studies, Faculty of Economics and Management, Bogor Agricultural Institute, Bogor.

Tyas, P.W.A.A & Ikhsani, W.T.K (2015). Sumber Daya Alam & Sumber Daya Manusia untuk Pembangunan Ekonomi Indonesia. Jurnal Ekonomi. 12(1).

Law of the Republic of Indonesia Number 38 of 2004 concerning Roads. Taken on 22 Agustus 2021, from https://luk.staff.ugm.ac.id/atur/kontruksi/UU38-2004Jalan.pdf

UNDP. (2015). Human Development Report 2015: Work From Human Development. New York. Taken on 2 April 2021, from http://report2015.archive.s3-website-useast1.amazonaws.com

Weya, I., Sirojuzilam, S., Syafi'i, M., & Ruslan, D. (2023, December). Analysis of the Effect of HDI and Road Length Infrastructure Development on Improving Economic Inequality in Eight Districts of the Region La Pago Tradition. In *Journal of International Conference Proceedings* (Vol. 6, No. 5, pp. 137-150).

World Bank. (2018). About the Human Capital Project. Taken on August 23, 2023, on https://www.worldbank.og/in/publication/human-capital/brief/about-h

The World Bank. (2017). New Funding to Develop Infrastructure in Indonesia. Taken on August 23, 2021, on https://www.worldbank.org/in/news/press-release/2017/03/13/world-bank-approves-new-financing-to-support-infrastructure-development-across-indonesia

Widarjono, A., (2013), *Ekonometrika: Teori dan Aplikasinya, Edisi Keempat*, Yogyakarta: UPP STIM YKPN.

Winarno, W.W., (2009), *Analisis Ekonometrika dan Statistika, edisi kedua*, Yogyakarta : UPP STIM YKPN.

APPENDICES

Appendix 1 The data from five regencies/cities of the Special Region of Yogyakarta (Ginii Ratio, HDI, Minimum Wage Level, GRDP, Road Infrastructure)

Regency	Year	GR	HDI	MW	Growth rate of GRDP	RI
Yogyakarta	2015	0.446	84.56	1.302.500	5.04	249.09
Yogyakarta	2016	0.429	85.32	1.452.400	5.03	249.09
Yogyakarta	2017	0.446	85.49	1.572.200	5.3	233.21
Yogyakarta	2018	0.42	86.11	1.709.150	5.63	233.21
Yogyakarta	2019	0.371	86.65	1.848.400	5.25	233.33
Yogyakarta	2020	0.421	86.61	2.004.000	-2.42	233.33
Yogyakarta	2021	0.464	87.18	2.069.530	5.52	233.33
Yogyakarta	2022	0.519	87.69	2.153.970	5.26	233.33
Kulon Progo	2015	0.37	71.52	1.138.000	4.62	834.87
Kulon Progo	2016	0.37	72.38	1.268.870	4.76	871.21
Kulon Progo	2017	0.39	73.23	1.373.600	5.97	882.42
Kulon Progo	2018	0.37	73.76	1.493.250	10.83	882.42
Kulon Progo	2019	0.36	74.44	1.613.200	13.49	636.03
Kulon Progo	2020	0.379	74.46	1.750.500	-4.06	811.17
Kulon Progo	2021	0.367	74.71	1.770.000	4.33	811.17
Kulon Progo	2022	0.38	75.46	1.904.275	6.57	811.17
Bantul	2015	0.3761	77.99	1.163.800	4.97	609.44
Bantul	2016	0.3967	78.42	1.297.700	5.05	607.7
Bantul	2017	0.4126	78.67	1.373.600	5.1	859
Bantul	2018	0.448	79.45	1.572.150	5.47	851.87
Bantul	2019	0.422	80.01	1.649.800	5.53	851.87
Bantul	2020	0.418	80.01	1.750.500	-1.65	786.62

Bantul	2021	0.44	80.28	1.805.000	4.99	786.62
Bantul	2022	0.41	80.69	1.916.848	5.2	786.62
Gunung Kidul	2015	0.32	67.41	1.108.249	4.82	686
Gunung Kidul	2016	0.334	67.82	1.235.700	4.88	686
Gunung Kidul	2017	0.34	68.73	1.337.650	5.01	1490.86
Gunung Kidul	2018	0.337	69.24	1.454.200	5.16	1504.58
Gunung Kidul	2019	0.337	69.96	1.571.000	5.34	1504.58
Gunung Kidul	2020	0.352	69.98	1.705.000	-0.68	1443.5
Gunung Kidul	2021	0.323	70.16	1.842.460	5.29	1443.5
Gunung Kidul	2022	0.323	70.96	1.900.000	5.37	1443.5
Sleman	2015	0.45	81.2	1.200.000	5.18	699.50
Sleman	2016	0.39	82.15	1.338.000	5.22	699.50
Sleman	2017	0.41	82.85	1.448.385	5.34	904.46
Sleman	2018	0.425	83.42	1.574.550	6.42	899.59
Sleman	2019	0.417	83.85	1.701.000	6.48	699.50
Sleman	2020	0.42	83.84	1.846.000	-4.05	815.82
Sleman	2021	0.425	84	1.903.500	5.61	815.82
Sleman	2022	0.418	84.31	2.001.000	5.15	815.82

Unit Description:

Gini Ratio (GR) = Percent

Human Development Index (HDI) = Percent

Minimum Wage Level (MW) = Million

Growth rate of Gross Regional Domestic Product (GRDP) = Percent

Road Infrastructure (RI) = Kilometers

Appendix 2 Estimated Results from Common Effect Model (CEM) Regression

Dependent Variable: HDI
Method: Panel Least Squares
Date: 12/26/23 Time: 03:02
Sample: 2015 2022
Periods included: 8
Cross-sections included: 5
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	45.05880	6.253602	7.205256	0.0000
GR	77.52435	13.92733	5.566345	0.0000
MW	4.69E-06	1.72E-06	2.722690	0.0100
GRDP	-0.019175	0.141281	-0.135719	0.8928
RI	-0.006198	0.001582	-3.916957	0.0004

R-squared	0.826079	Mean dependent var	78.37425
Adjusted R-squared	0.806202	S.D. dependent var	6.330600
S.E. of regression	2.786885	Akaike info criterion	5.004195
Sum squared resid	271.8355	Schwarz criterion	5.215305
Log likelihood	-95.08389	Hannan-Quinn criter.	5.080525
F-statistic	41.56022	Durbin-Watson stat	0.682081
Prob(F-statistic)	0.000000		

Appendix 3 Estimated Results from Fixed Effect Model (FEM) Regression

Dependent Variable: HDI
Method: Panel Least Squares
Date: 12/26/23 Time: 03:04
Sample: 2015 2022
Periods included: 8
Cross-sections included: 5
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	72.20169	0.741139	97.41992	0.0000
GR	-1.596997	1.893970	-0.843201	0.4056
MW	3.85E-06	1.69E-07	22.78486	0.0000
GRDP	0.038913	0.013167	2.955281	0.0059
RI	0.000572	0.000262	2.182477	0.0368

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.998696	Mean dependent var	78.37425
Adjusted R-squared	0.998360	S.D. dependent var	6.330600
S.E. of regression	0.256387	Akaike info criterion	0.310852
Sum squared resid	2.037766	Schwarz criterion	0.690850
Log likelihood	2.782966	Hannan-Quinn criter.	0.448247
F-statistic	2968.282	Durbin-Watson stat	1.109834
Prob(F-statistic)	0.000000		

Appendix 4 Estimated Results from Random Effect Model (REM) Regression

Dependent Variable: HDI
Method: Panel EGLS (Cross-section random effects)
Date: 12/26/23 Time: 03:05
Sample: 2015 2022
Periods included: 8
Cross-sections included: 5
Total panel (balanced) observations: 40
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	45.05880	0.575317	78.31991	0.0000
GR	77.52435	1.281284	60.50523	0.0000
MW	4.69E-06	1.58E-07	29.59518	0.0000
GRDP	-0.019175	0.012998	-1.475247	0.1491
RI	-0.006198	0.000146	-42.57665	0.0000

Effects Specification

	S.D.	Rho
Cross-section random	2.59E-06	0.0000
Idiosyncratic random	0.256387	1.0000

Weighted Statistics

R-squared	0.826079	Mean dependent var	78.37425
Adjusted R-squared	0.806202	S.D. dependent var	6.330600
S.E. of regression	2.786885	Sum squared resid	271.8355
F-statistic	41.56022	Durbin-Watson stat	0.682081
Prob(F-statistic)	0.000000		

Unweighted Statistics

R-squared	0.826079	Mean dependent var	78.37425
Sum squared resid	271.8355	Durbin-Watson stat	0.682081

Appendix 5 Chow Test Estimation Results

Redundant Fixed Effects Tests
Equation: FEM
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	1026.090599	(4,31)	0.0000
Cross-section Chi-square	195.733722	4	0.0000

Cross-section fixed effects test equation:
Dependent Variable: HDI
Method: Panel Least Squares
Date: 12/26/23 Time: 03:09
Sample: 2015 2022
Periods included: 8
Cross-sections included: 5
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	45.05880	6.253602	7.205256	0.0000
GR	77.52435	13.92733	5.566345	0.0000
MW	4.69E-06	1.72E-06	2.722690	0.0100
GRDP	-0.019175	0.141281	-0.135719	0.8928
RI	-0.006198	0.001582	-3.916957	0.0004

R-squared	0.826079	Mean dependent var	78.37425
Adjusted R-squared	0.806202	S.D. dependent var	6.330600
S.E. of regression	2.786885	Akaike info criterion	5.004195
Sum squared resid	271.8355	Schwarz criterion	5.215305
Log likelihood	-95.08389	Hannan-Quinn criter.	5.080525
F-statistic	41.56022	Durbin-Watson stat	0.682081
Prob(F-statistic)	0.000000		

Appendix 6 Hausman Test Estimation Results

Correlated Random Effects - Hausman Test
Equation: FEM
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	4104.362396	4	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
GR	-1.596997	77.524351	1.945436	0.0000
MW	0.000004	0.000005	0.000000	0.0000
GRDP	0.038913	-0.019175	0.000004	0.0000
RI	0.000572	-0.006198	0.000000	0.0000

Cross-section random effects test equation:
Dependent Variable: HDI
Method: Panel Least Squares
Date: 12/26/23 Time: 03:11
Sample: 2015 2022
Periods included: 8
Cross-sections included: 5
Total panel (balanced) observations: 40

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	72.20169	0.741139	97.41992	0.0000
GR	-1.596997	1.893970	-0.843201	0.4056
MW	3.85E-06	1.69E-07	22.78486	0.0000
GRDP	0.038913	0.013167	2.955281	0.0059
RI	0.000572	0.000262	2.182477	0.0368

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.998696	Mean dependent var	78.37425
Adjusted R-squared	0.998360	S.D. dependent var	6.330600
S.E. of regression	0.256387	Akaike info criterion	0.310852
Sum squared resid	2.037766	Schwarz criterion	0.690850
Log likelihood	2.782966	Hannan-Quinn criter.	0.448247
F-statistic	2968.282	Durbin-Watson stat	1.109834
Prob(F-statistic)	0.000000		