

Investment Spillover Impact of The Jakarta Mass Rapid Transit Project: An Inter-Regional Input Output Analysis

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Abstract

Purpose: This study analyzes the economic spillover effects of investment in the Jakarta Mass Rapid Transit (MRT) project using an Inter-Regional Input Output (IRIO) approach. The analysis integrates realized investment from Phase I and projected investment from Phase II to capture both ex-post and ex-ante economic impacts across sectors and regions.

Research Methodology: Using Indonesia's IRIO table with 34 provinces and 17 sectors, this study estimates the multiplier effects on output, value added, and employment, while explicitly accounting for interregional leakages and production linkages.

Results: The results indicate that MRT investment generates substantial economic impacts that are highly concentrated in DKI Jakarta. Interregional spillover effects to other provinces are present but relatively limited, reflecting Jakarta's dominant intra-regional supply chains and strong agglomeration economies. The employment impact analysis shows that MRT investment creates jobs with the largest employment gains occurring in business services, construction, and wholesale-retail trade sectors.

Conclusions: These findings confirm that urban rail infrastructure functions as a highly localized growth catalyst, strengthening metropolitan economic structures rather than evenly distributing benefits across regions.

Limitations: The investment data used in this study only comes from grant and loan data from the Japan International Cooperation Agency (JICA) managed by Investment Treasury Office.

Contributions: The study contributes to the literature by applying an IRIO framework to a large-scale urban transport project in Indonesia, providing empirical evidence on the magnitude and spatial distribution of infrastructure spillovers.

Keywords: *Infrastructure Investment, Inter Regional Input Output, MRT, Spillover Effect, Urban Economy*

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1. Introduction

Infrastructure development is a key driver of economic growth and competitiveness, as it enhances productivity, reduces costs, and improves connectivity across regions (Foster, Butterfield, & Chen, 2023). Well-planned infrastructure investment has also been shown to reduce economic disparities by

improving access to services in underserved regions and attracting foreign investment to support sustainable growth ([Khoirunurrofik & Anas, 2023](#)). Within this broad spectrum, transportation infrastructure plays a particularly crucial role because it functions as the lifeblood of the economy, connecting production centers with markets, facilitating the movement of goods, services, and people, and promoting regional economic integration. Without efficient connectivity, logistics costs rise, labor mobility is constrained, and the economic potential of a region cannot be optimally realized. Therefore, strategic investment in transportation infrastructure is not merely an option, but an urgency to maintain development momentum and economic equity.

Investment in large-scale transportation infrastructure projects does not only generate direct impacts such as job creation during the construction phase. The development of transportation networks, for example, directly reduces the cost and time required to move goods and labor, while improvements in supporting energy and telecommunications systems ensure that other sectors can enhance their productivity ([Kim, Lee, Albis, & Ang III, 2020](#)). Spillover effects materialize through several mechanisms. First, improved regional connectivity links areas that were previously isolated with economic centers, thereby attracting investment and stimulating new economic activities ([Hutahayan, Mollet, & Urip, 2025](#); [Masua & Mollet, 2025](#); [Mujtaba & Shahzad, 2021](#); [Ramadhani, Rinaldi, & Fitria, 2025](#); [Wahyudi & Zapita, 2022](#); [Yang et al., 2025](#)). Second, enhanced accessibility triggers economic agglomeration, where firms and workers concentrate in locations served by new infrastructure, fostering innovation and efficiency ([Fujita & Thisse, 2013](#)). Third, land and property values increase along transportation corridors. Fourth, multiplier effects emerge in related economic sectors, where increased demand in the construction sector stimulates output in industries such as steel, cement, and financial services. This chain of positive impacts ultimately creates a growth reaction encompassing job creation, income growth, and overall improvements in living standards across sectors and regions ([Hardana, Nasution, Damisa, Lestari, & Zein, 2023](#); [Ramadhani et al., 2025](#); [Wahyudi & Zapita, 2022](#); [Yin, Qian, Zeng, & Wei, 2024](#)).

The development of the Mass Rapid Transit (MRT) system in DKI Jakarta represents a strategic response to severe congestion, high economic losses, and environmental challenges. While the MRT has demonstrated strong operational performance and increasing ridership, existing studies have largely focused on feasibility, congestion reduction, and land value impacts. However, these studies remain partial and do not capture how MRT investment propagates through intersectoral and interregional economic structures. Moreover, most analyses are limited to Phase I, without integrating the ongoing Phase II investment, resulting in an incomplete understanding of the overall economic impact.

The application of the Input-Output (I-O) model to analyze the economic impact of transportation infrastructure development, particularly metro or MRT systems, has become common practice in international literature. In their research using the I-O model, [Xu and Zhang \(2016\)](#) noted that the construction of Beijing Subway Line 4 in China resulted in an output multiplier effect of 2.17. This means that every 1 yuan invested in construction generated a total economic output of 2.17 yuan across all related sectors. The study also identified that the manufacturing, business services, and wholesale/retail trade sectors were the largest beneficiaries from backward linkages. Similarly, an analysis of the Delhi Metro construction in India shows a significant impact not only on output, but also on job creation and an increase in aggregate household income ([Begam et al., 2024](#)). Other studies in various countries consistently show that the indirect effects and induced effects of massive infrastructure investments such as the MRT often exceed the direct effects, emphasizing the importance of using I-O analysis to capture the full spectrum of economic benefits. These international precedents provide strong methodological justification for applying the IRIO framework to the Jakarta MRT case in order to comprehensively quantify its spillover effects.

Various studies on the Jakarta MRT have been conducted and have made important contributions from various perspectives. Early studies focused more on feasibility analysis, measuring the willingness to pay of potential passengers, and conducting cost-benefit analyses to justify the initial investment. As the MRT began operating, research shifted toward evaluating its operational impact. For example, [Hanafie, Suprpto, and Nugraha \(2024\)](#) examined the effectiveness of the MRT in reducing traffic

congestion, while other studies analyzed the impact of MRT stations on changes in land and property values in the surrounding area, known as the land value capture phenomenon. This study addresses these gaps by applying an Inter-Regional Input-Output (IRIO) framework to simultaneously analyse ex-post impacts from Phase I and ex-ante impacts from Phase II. Furthermore, the study captures not only direct effects but also indirect and induced effects across sectors and regions. Specifically, it aims to quantify the magnitude and spatial distribution of spillover effects on output, value added, and employment within DKI Jakarta, the surrounding Bodetabek area, and other provinces.

The main contribution of this study lies in providing a comprehensive and integrated assessment of MRT investment spillovers using an IRIO approach in the Indonesian context. Unlike previous studies, this research explicitly incorporates interregional linkages and sectoral multipliers, offering new empirical evidence on how urban transport infrastructure affects economic structure and regional distribution of benefits. The findings are expected to support more effective infrastructure planning, interregional coordination, and policy design to enhance the broader economic impact of large-scale transport investments.

2. Literature Review

2.1 *Economic Growth and Investment*

Economic growth is commonly used as an indicator to assess the level of economic development. One of the most influential theories of economic growth is the neoclassical growth model developed by Solow, commonly referred to as the Solow Growth Model. According to Solow, there are three key components that influence economic growth. The first component is capital accumulation, which includes various forms of investment such as investment in land, physical equipment, and human capital development. The second component is population growth, which leads to an increase in the labor force as the population expands. The third component is technological progress. In this model, capital and labor are considered the primary inputs for producing output, while technology plays a role in improving the efficiency of these two inputs. Solow argued that in the long run, economic growth cannot be sustained solely through increases in capital and labor due to the presence of diminishing returns, whereby each additional unit of input produces a smaller increment of output. As a result, technological progress becomes the key driver of sustainable long-term economic growth. The Solow growth model can be expressed mathematically as follows:

$$Y = F(K, AL) \tag{1}$$

Where:

- Y = output Gross Domestic Product (GDP)
- K = capital
- A = technology
- L = labor

Within the Solow framework, investment is one of the main factors influencing capital accumulation and, ultimately, economic growth. Investment increases the capital stock, which is then utilized in the production process to raise output. The investment function in the Solow model is expressed as:

$$I = sY \tag{2}$$

Where:

- I = investment
- s = savings rate
- Y = output

Another prominent theory of economic growth is the Harrod–Domar model, which emphasizes the role of investment as the primary driver of economic growth. Harrod and Domar argued that investment plays a crucial role in economic development because it serves as the main source of new capital formation, which is used to expand productive capacity and increase national output. This theory assumes a linear relationship between investment and output growth, where each additional unit of investment leads to a proportional increase in output. This relationship is captured by the concept of the

Incremental Capital–Output Ratio (ICOR). A lower ICOR indicates more efficient use of capital in generating output (Masloman, 2020). Mathematically, the Harrod–Domar model is formulated as:

$$G = s / k \quad (3)$$

Where:

G = growth rate of total output

s = savings ratio

k = capital–output ratio

Both, the Solow and Harrod–Domar theories argue that investment influences aggregate demand. Through the multiplier process, changes in aggregate demand subsequently affect aggregate supply, including productive capacity. When a country aims to achieve steady-state economic growth, maximum production capacity must be matched by increases in aggregate supply (Berg, 2016). Investment is undertaken by capital owners with the expectation of future profits. However, profits tend to decline as economic development progresses because increased capital accumulation intensifies competition among capital owners, thereby reducing profit margins (Iudwig, Dewi, & Nurmala, 2025). Jogiyanto (2010) defines investment as the postponement of current consumption to be used as a productive resource in the future, with the expectation of receiving returns.

Sukirno (2016) further argues that investment stimulates economic growth, increases employment opportunities, raises national income, and improves societal welfare. These outcomes arise from three main functions of investment, such as investment is a component of aggregate expenditure, so increases in investment raise aggregate demand, national income, and employment, investment promotes technological advancement, and investment increases capital accumulation, thereby expanding productive capacity.

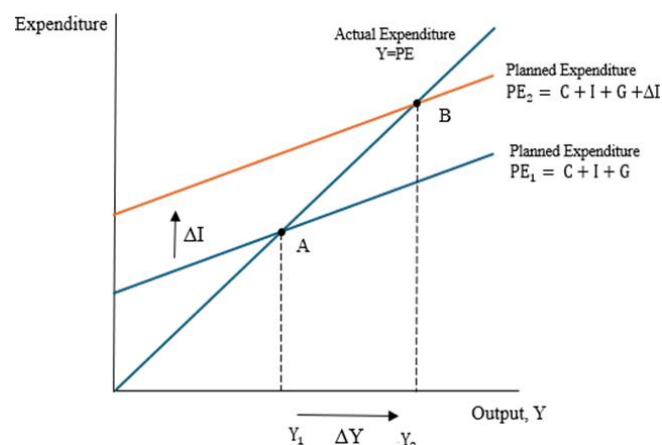


Figure 1. The impact of increased investment on economic growth

Figure 1 shows the impact of investment on economic growth which can also be explained using the Keynesian Cross framework. In this model, the initial equilibrium of the economy is at point A, where total national output is Y_1 . When investment increases, Planned Expenditure (PE) rises and shifts the PE curve upward by ΔI . This results in a new equilibrium at point B, where total national output increases to Y_2 . The increase in the national total output (ΔY) in this Keynesian Cross model represents economic growth as shown in Figure 1. Keynes's theory of the Marginal Efficiency of Capital (MEC) further explains that investment decisions depend on whether the expected rate of return (MEC) exceeds the prevailing interest rate. If MEC is greater than the interest rate, investment will be undertaken; if it is lower, investment will not occur, as firms seek to maximise profits.

2.2 General Equilibrium

Input–Output tables represent an analytical method used to systematically measure the interrelationships between economic sectors. This method was first introduced by Wassily Leontief to map the impacts of changes in one sector on output, income, and employment across the economy. The Input–Output analysis uses an Input–Output table (I–O Table), which is a matrix containing information

on transactions of goods and services and the relationships among economic sectors within a given region and time period.

At the national level, Statistics Indonesia is the institution responsible for compiling and producing Input–Output tables. In this study, the Input–Output table adopts a 17-sector classification in accordance with the Indonesian Standard Industrial Classification 2020. Rows in the Input–Output table represent the distribution of a sector’s output, which is used either as intermediate input by other sectors or directly consumed as final demand. Columns represent the input structure of each sector, including intermediate inputs and primary inputs required for production. The I-O Table framework is as shown in Table 1.

Table 1. The I-O Table framework

From	To	Industry				Final demand categories (F)				Total (X)
		1	2	3	4	Households	Government	Investments	Export	
Industry	1	z_{11}	z_{12}	z_{13}	z_{14}	c_1	g_1	i_1	e_1	X_1
	2	z_{21}	z_{22}	z_{23}	z_{24}	c_2	g_2	i_2	e_2	X_2
	3	z_{31}	z_{32}	z_{33}	z_{34}	c_3	g_3	i_3	e_3	X_3
	4	z_{41}	z_{42}	z_{43}	z_{44}	c_4	g_4	i_4	e_4	X_4
Primary input factors	Labor	l_1	l_2	l_3	l_4	-	-	-	-	L
	Capital	k_1	k_2	k_3	k_4	-	-	-	-	K
	Government	o_1	o_2	o_3	o_4	-	-	-	-	O
	Import	m_1	m_2	m_3	m_4	-	-	-	-	M
Total (Z)		Z_1	Z_2	Z_3	Z_4	C	G	I	E	

Quadrant I represents intermediate transactions, illustrating the flow of goods and services produced and used by sectors as intermediate inputs. Quadrant II represents final demand, including household consumption, government consumption, gross fixed capital formation, changes in inventories, and exports. Quadrant III represents primary inputs, reflecting compensation of employees, operating surplus, and net taxes.

The benefits of Input-Output tables are that they can describe the structure of a country's or region's economy, including the output and value added Gross Domestic Product (GDP) of each sector; break down the components of value added in each economic sector; analyze the use of various materials and services in a production process; analyze the supply of goods and services, both domestically produced and imported; demonstrate how goods and services are used, both by the production sector and for final consumption, investment, and exports; estimate how final demand affects various economic aspects such as output, added value, imports, taxes, and employment; project macroeconomic variables in the future; analyze the impact of price changes by looking at the relationship between changes in input and output prices; and identify leading sectors for economic growth and which sectors are sensitive to economic growth (Cahyono & Sumargo, 2005). The Input–Output Table has limitations. It does not allow for substitution among inputs or changes in the production process. As a result, proportional increases in inputs are assumed to lead to proportional increases in output, which may not reflect real-world conditions where technological change and productivity improvements may occur and affect the output value.

3. Methodology

This study employs a quantitative research approach using Input–Output (IO) and Inter-Regional Input–Output (IRIO) analytical tools. The data utilized in this study consist of secondary data sources, including:

1. The DKI Jakarta IO Table of domestic transactions at producer prices for 17 economic sectors for the year 2016, published in 2021 using the RAS approach and the Indonesian Inter-Regional Input–Output (IRIO) Table compiled by Statistics Indonesia;
2. Realised investment data for Phase I and Phase II of the MRT project financed through grants and loans from the Japan International Cooperation Agency (JICA), obtained from the Investment Treasury Office (*KPPN Investasi*);

- The MRT investment data consist of realized expenditures for Phase I and projected cumulative expenditures for Phase II. Phase I was implemented over the period 2013–2019, while Phase II investment covers the period 2020–2023. For the analysis of Phase I, the accumulated investment was introduced into the 2016 IRIO table, which was updated to reflect the GDP level of 2019. Similarly, for Phase II, the cumulative investment was injected into the same 2016 IRIO table, adjusted to the GDP level of 2023. The updating procedure was limited to scaling aggregate GDP, without modifying the underlying intersectoral and interregional technical coefficients. Therefore, the production structure of the economy is assumed to remain constant over time;
- For the estimation of employment impacts, the cumulative Phase II investment is introduced as a final demand shock into the 2016 DKI Jakarta Input–Output table, which has been updated to the 2023 economic structure using the RAS adjustment method.

3.1 IO Table and IRIO Table Analysis

The Input–Output model is fundamentally based on the concept of interlinkages between input utilization structures and output distribution. Accordingly, the Input–Output model provides information on transactions of goods and services among interrelated sectors within an economy during a specific period. An Input–Output table that describes transactions of goods and services within a single region can be extended into an Inter-Regional Input–Output (IRIO) table, which simultaneously presents transaction relationships among multiple regions. Through the IRIO table, analysis is not only focused on economic linkages within a single region but also on economic interconnections across regions. The 2016 IRIO table published by Statistics Indonesia is structured across several dimensions, including six island groups with 17 industrial sectors, 34 provinces with 17 sectors, and 34 provinces with 52 sectors.

This study applies IRIO analysis using the Indonesian IRIO Table of domestic transactions at producer prices for 34 provinces and 17 industrial sectors. The use of a 17-sector classification is intended to focus the analysis on key sectors that play a significant role in the economy. The IRIO model also enables the calculation of economic impacts arising from changes in final demand due to specific shocks. Data processing for the IRIO analysis in this study was conducted using Microsoft Excel software. Conceptually, the IRIO model is the mathematical representation of an economic structure. The basic framework of the IRIO table can be explained through its vertical and horizontal structures, assuming that the economy is divided into 17 main sectors. The Basic Framework of IRIO is as shown in Table 2.

Table 2. Basic Framework of IRIO

Alokasi Output Susunan Input				Permintaan Antara						Permintaan Akhir						Ekspor	Jumlah Output		
				Provinsi R			...	Provinsi S			Provinsi R			...	Provinsi S				
				Industri 1				Industri 2			Industri 1				Industri 2				
1	...	17	...	1	...	17	1	...	17	...	1	...	17						
I n p u t	Provinsi R	I n d u s t r i	1	X_{ii}^{RR}	...	X_{ij}^{RS}	F_{ii}^{RR}	...	F_{ij}^{RS}	E_i^R	X_j^R	2							
			.																
			.																
			.																
			17																
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
A n t a r a	Provinsi S	I n d u s t r i	1	X_{ij}^{SR}	...	X_{jj}^{SS}	F_{ij}^{SR}	...	F_{jj}^{SS}	E_i^S	X_j^S	2							
			.																
			.																
			.																
			17																
Impor				X_i^{MR}		X_j^{MS}		F_i^{MR}		F_j^{MS}									
Jumlah Input Primer				V_i^R		V_j^S													
Jumlah Input				X_i^R		X_j^S													

In the horizontal (row) dimension, industries act as producers that generate output. In the vertical (column) dimension, industries act as consumers that use output as input in the production process. The input coefficient matrix for each province in the IRIO table can be expressed mathematically as follows:

$$a_{ij}^{RR} = \frac{z_{ij}^{RR}}{x_j^R} \quad \text{and} \quad a_{ij}^{SS} = \frac{z_{ij}^{SS}}{x_j^S} \quad (4)$$

Interregional transactions within the economy can be described by the following equation:

$$a_{ij}^{RS} = \frac{z_{ij}^{RS}}{x_j^S} \quad \text{and} \quad a_{ij}^{SR} = \frac{z_{ij}^{SR}}{x_j^R} \quad (5)$$

When these formulas are expressed in matrix form, they yield the matrix of primary input or technology coefficients.

3.2 Shock Construction

The MRT investment is introduced into the model as a final demand shock vector (ΔY). The investment data consist of realized expenditure for Phase I and projected expenditure for Phase II obtained from JICA financing records. In constructing the shock, the primary allocation of investment is assigned to the construction sector, reflecting the capital-intensive nature of MRT development. To capture realistic intersectoral demand, part of the investment is distributed across related sectors, including manufacturing (steel and cement), business services (engineering and consultancy), and transportation and logistics services. This allocation follows the input structure of the IO table, ensuring consistency with the existing production technology. Formally, the investment shock is represented as:

$$\Delta Y = (\Delta Y_1, \Delta Y_2, \dots, \Delta Y_n) \quad (6)$$

Where each element represents additional final demand in sector i . This approach allows the model to simulate how MRT investment propagates through the economy via production linkages.

3.3 Leontief Inverse Formulation (IRIO Model)

The IRIO model extends the standard Input-Output framework by incorporating interregional transactions across 34 provinces. The basic IO identity is:

$$X = AX + Y \quad (7)$$

Which can be rearranged as:

$$X = (I - A)^{-1} Y \quad (8)$$

Where:

- X = total output vector
- A = technical coefficient matrix
- Y = final demand vector
- $(I-A)^{-1}$ = Leontief inverse matrix

To estimate the impact of MRT investment, the model computes:

$$\Delta X = (I - A)^{-1} (-1) \Delta Y \quad (9)$$

In the IRIO framework, matrix A includes interregional input coefficients, capturing flows between provinces and the Leontief inverse reflects both intra-regional and interregional multiplier effects.

3.4 Linkage Analysis

Linkage analysis measures intersectoral relationships within the economy and is conducted through backward linkage and forward linkage analysis. Backward linkage is used to determine the extent to which a sector is connected to its upstream input sectors. The backward linkage index is formulated as follows:

$$BL_j = \sum_{i=1}^n l_{ij} \quad (10)$$

Where:

BL_j = total backward linkage

l_{ij} = elements of the total requirements matrix (L matrix) by column

$$FL_j = \sum_{i=1}^n g_{ij} \quad (11)$$

Where:

FL_j = total forward linkage

g_{ij} = elements of the total requirements matrix (L matrix) by row

Backward and forward linkage analyses are further reinforced through the analysis of the power of dispersion and sensitivity of dispersion. The power of dispersion measures a sector's ability to stimulate output growth in upstream sectors that supply inputs to that sector. Sensitivity of dispersion reflects a sector's ability to stimulate output growth in downstream sectors that use the sector's output as production input. Both indices are derived by normalizing total backward linkage values for the dispersion index and total forward linkage values for the sensitivity index, which are then compared to the average value of the total requirements matrix ([Miller & Blair, 2012](#)). The power of dispersion index is formulated as follows:

$$\overline{BL_j} = \frac{BL_j}{(1/n) \sum_{j=1}^n BL_j} \quad (12)$$

Where:

BL_j = power of dispersion index

BL_j = backward linkage value

The sensitivity of dispersion index is formulated as follows:

$$\overline{FL_j} = \frac{FL_j}{(1/n) \sum_{j=1}^n FL_j} \quad (13)$$

Where:

FL_j = sensitivity of dispersion index

FL_j = forward linkage value

Power of dispersion index and sensitivity of dispersion index can be used to identify an area's economic priority sector. A sector is categorized as a priority sector if it exhibits both a high power of dispersion index and a high sensitivity of dispersion index ([Rafiqah, Darson, & Sutrisno, 2018](#)).

3.5 Economic Impact Analysis

The economic impact analysis in this study aims to measure the total impact of shocks resulting from investments originating from JICA grants and loans for the Mass Rapid Transit (MRT) project. The economic impacts to be studied include an analysis of the multiplier effects on output, value added, and employment using IO and IRIO tables ([Marpaung, Wunas, Jinca, & Siahaan, 2025](#); [Miller & Blair, 2012](#)). The shock data used is the realized investment in the MRT Phase I and II projects.

3.6 Analytical Framework

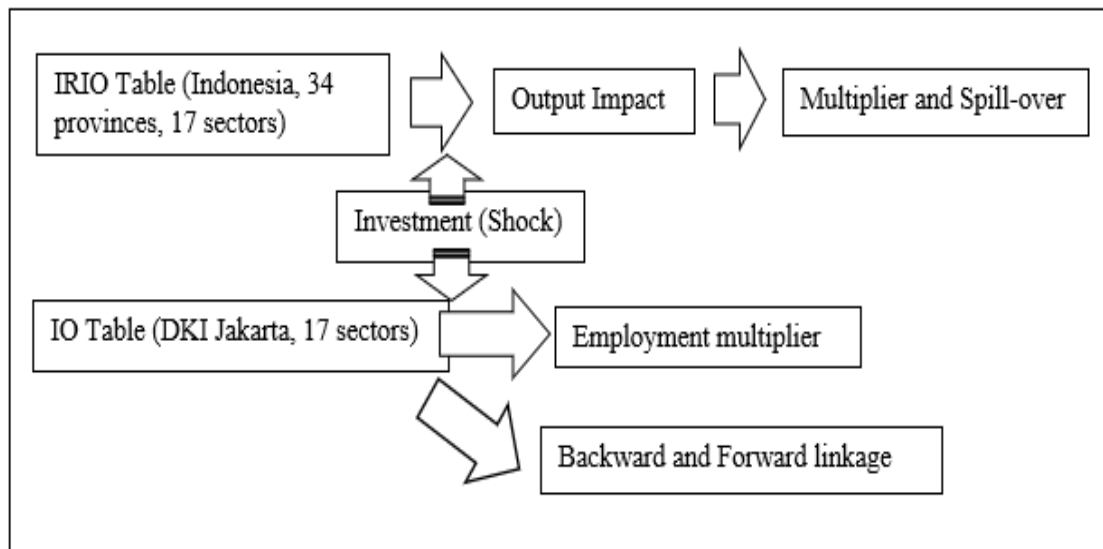


Figure 2. Analytical framework

Figure 2 shows the reliability of the results; several robustness considerations are applied. First, the distribution of the MRT investment shock across sectors is based on the proportional input structure of the IO table, and alternative allocations such as concentrating the shock entirely in the construction sector were tested to confirm that the overall pattern of results remains consistent. Second, the magnitude and direction of the estimated multipliers are compared with findings from previous Input–Output studies on transportation infrastructure, which similarly report strong localized impacts and relatively limited interregional spillovers. Third, sensitivity to the use of the 2016 IRIO table is addressed by updating the model using different GDP reference years (2019 and 2023), allowing the analysis to reflect recent economic conditions while maintaining a consistent production structure.

4. Results and Discussions

4.1 Input–Output Analysis and Output Impact

The initial analysis uses the Input–Output Table to analyze linkage relationships, namely backward linkage and forward linkage. Backward linkage and forward linkage analyses are used to determine the extent to which a sector influences its upstream sectors and its downstream sectors. Based on the analysis of backward linkage and forward linkage, leading sectors can then be identified through the calculation of the Power of Dispersion Index and the Sensitivity of Dispersion Index. The calculation results show that Sector D (Electricity and Gas Supply) has the highest backward linkage value (2.3158). This indicates that the sector is highly dependent on inputs from other sectors, such that an increase in its production activity will create large derived demand for upstream sectors. According to [Miller and Blair \(2012\)](#), sectors with high backward linkage play a role as driver sectors because they stimulate growth in supplying sectors.

Table 3. Table of backward linkages, forward linkages, dispersion power, and sensitivity degree of the input–output structure of DKI Jakarta

Sector Code	Backward Linkage	Forward Linkage	Spread	Sensitivity
A	1.1305	1.0065	0.7954	0.7081
B	1.1893	1.2250	0.8367	0.8619
C	1.3934	1.5127	0.9804	1.0643
D	2.3158*	2.2817*	1.6293*	1.6053*
E	1.3616	1.0321	0.9580	0.7261
F	1.4484	1.3343	1.0191	0.9388
G	1.2852	1.7981	0.9042	1.2651
H	1.4716	1.3595	1.0354	0.9565

I	1.2849	1.1806	0.9040	0.8306
J	1.3568	1.5895	0.9546	1.1183
K	1.3518	1.9700	0.9511	1.3860
L	1.3410	1.4033	0.9435	0.9873
MN	1.4185	2.1187	0.9980	1.4906
O	1.4840	1.1204	1.0441	0.7883
P	1.4551	1.0449	1.0238	0.7352
Q	1.5214	1.0342	1.0704	0.7276
RSTU	1.3531	1.1512	0.9520	0.8100
Average	1.4213	1.4213	1.0000	1.0000

Table 3 show in addition to Sector D, Sector Q (1.5214), Sector O (1.4840), Sector H (1.4716), Sector P (1.4551), and Sector F (1.4484) also have backward linkage values above the economic average (1.4213). These sectors are therefore categorized as sectors capable of generating significant demand effects on other sectors. This condition is consistent with the characteristics of an urban economy such as DKI Jakarta, where the electricity and gas supply sector (D) and several other sectors exhibit strong linkages within the supply chains. The forward linkage indicator reflects the role of a sector as a supplier of inputs to other sectors. Sector MN (2.1187), Sector D (2.2817), and Sector K (1.9700) record the highest forward linkage values and exceed the economic average (1.4213). This finding confirms that these sectors are not only dependent on upstream inputs but also function as important suppliers in the production processes of other sectors.

Theory of Input–Output, sectors with high forward linkage values are categorized as base sectors or key supplying sectors, because their existence determines the smooth functioning of production processes throughout the economy. Literature such as [Dietzenbacher \(1997\)](#) explains that high forward linkage values reflect the central position of a sector within the production network. In the context of DKI Jakarta, this is relevant because the construction sector (D) and related service sectors (K and MN) play an important role in supporting urban economic growth. The highest spread value is recorded by Sector D (1.6293), indicating that an increase of one unit in final demand in this sector generates the largest dispersion impact across all sectors. A high dispersion effect demonstrates a sector’s ability to drive broad-based economic growth, as explained in [\(Hirschman, 1958\)](#) development theory, which states that sectors with large spread effects can become priority targets in industrialization policy.

Other sectors that show relatively high dispersion values include Sector G (1.7981), Sector H (1.0354), and Sector O (1.0441). These findings indicate that the vitality of certain service sectors in DKI Jakarta also exerts follow-on effects on the stability and growth of various other economic sectors. Sensitivity measures the magnitude of changes in sectoral output in response to changes in final demand in other sectors. Sector D (1.6053), Sector K (1.3860), and Sector G (1.2651) show the highest sensitivity values. This means that these sectors are highly responsive to overall economic dynamics.

Input–Output literature states that sectors with high sensitivity values have the potential to act as supporting sectors, because small changes in demand structure can generate large changes in output. This is important for policymakers to monitor, as such sectors may be vulnerable to economic shocks. Based on a simultaneous approach combining backward linkage and forward linkage, a sector is categorized as a key sector if both linkage values exceed the economic average. This approach is consistent with the classical criteria introduced by [\(Chenery & Watanabe, 1958\)](#) and further developed by [\(Rasmussen, 1956\)](#), which state that key sectors are those capable of driving upstream growth (power of dispersion) while simultaneously acting as important suppliers for downstream sectors (sensitivity of dispersion).

Table 4. Output impact spillovers

No	Phase I Impact		Phase II Impact	
	Province	Impact	Province	Impact
1	DKI Jakarta	9718.608	DKI Jakarta	7304.258
2	Jawa Timur	117.918	Jawa Timur	111.1986
3	Banten	93.54887	Jawa Barat	96.0303
4	Jawa Barat	92.97791	Sumatera Selatan	95.17253
5	Sumatera Utara	89.54678	Banten	94.58457
6	Jawa Tengah	83.75695	Sumatera Utara	93.39913
7	Sumatera Selatan	83.13965	Jawa Tengah	90.40012
8	Riau	81.69385	Riau	79.35639
9	Sumatera Barat	40.89188	Sumatera Barat	50.33692
10	Kep. Bangka Belitung	36.76696	Kep. Bangka Belitung	45.16107
11	Sulawesi Selatan	35.1451	Sulawesi Selatan	41.37371
12	Kalimantan Timur	24.34972	Lampung	23.26788
13	Lampung	23.77016	Kalimantan Timur	22.29783
14	Kalimantan Barat	17.23611	Kalimantan Barat	15.52649
15	Kep. Riau	12.06758	Bengkulu	12.42836
16	DI Yogyakarta	11.30161	Kep. Riau	10.79665
17	Kalimantan Tengah	11.24055	DI Yogyakarta	10.19015
18	Papua	10.62541	Aceh	9.802214
19	Bengkulu	10.34688	Kalimantan Tengah	8.618087
20	Aceh	9.607973	Jambi	7.40175
21	Sulawesi Utara	9.120728	Sulawesi Utara	6.894766
22	Bali	8.791072	Bali	6.54602
23	Jambi	7.754534	Kalimantan Utara	6.008151
24	Kalimantan Utara	6.84136	Kalimantan Selatan	5.784809
25	Kalimantan Selatan	6.076978	Papua	4.498037
26	Maluku Utara	5.623296	Papua Barat	4.412995
27	Papua Barat	5.272931	Sulawesi Tengah	4.049337
28	Sulawesi Tenggara	4.928121	Sulawesi Tenggara	3.89268
29	Sulawesi Tengah	4.82677	Nusa Tenggara Barat	2.956441
30	Nusa Tenggara Barat	3.572122	Nusa Tenggara Timur	2.756639
31	Nusa Tenggara Timur	3.269582	Maluku Utara	1.792376
32	Maluku	2.120453	Maluku	1.709528
33	Gorontalo	1.122203	Gorontalo	0.765905
34	Sulawesi Barat	0.288251	Sulawesi Barat	0.291238

Table 4 show referring to the results of the Input–Output linkage analysis for DKI Jakarta, the leading sectors in DKI Jakarta are sector D – Electricity and Gas Supply, Sector MN – Business Services, and Sector K – Financial Services. Sector D – Electricity and Gas Supply have the highest values for backward linkage, forward linkage, power of dispersion, and sensitivity compared to other sectors. The strategic position of the energy sector within the economic structure indicates that increases in output in this sector will generate large multiplier effects on both the input and output sides. This is consistent with the findings of [Miller and Blair \(2012\)](#) that the energy sector is almost always the mainstay of production activity in metropolitan areas. As a high value-added service sector, business services play an important role as suppliers of professional services such as consultancy, engineering, technical design, research, management, and other corporate services.

The high forward linkage and dispersion values of Sector MN indicate that business services are widely used by various other sectors, both manufacturing and services. This is in line with the literature stating that the professional services sector is an enabling sector in a knowledge-based economy, especially in big cities such as Jakarta ([Fujita & Thisse, 2013](#)). With a high forward linkage value, the financial

services sector is one of the most important non-physical input suppliers for other sectors. The output of the financial sector financing, credit, insurance, and banking services is used as supporting input in production processes across almost all sectors. This places it as a sector with a systemic role in the economy. Theoretically, the financial sector has strong downstream links, because it provides financing services to various sectors, which acts as an indirect multiplier through its intermediary function, and has the characteristics of a backbone sector in urban economies ([Levine, 2005](#); [Sarangi & Pradhan, 2020](#)), and empirical findings on sectoral linkages in Indonesia ([Nazara, 2005](#)). The position of the financial sector as a key sector reflects its role in promoting stability and accelerating economic activity through the provision of necessary financial services throughout the production chain.

MRT investment generates the largest economic impact in DKI Jakarta itself. Total output impact reaches IDR 9,718 billion in Phase I and declines to IDR 7,304 billion in Phase II. This indicates that MRT infrastructure investment is highly dominant in influencing the local economy as the primary location of construction activities and MRT operations. Economic impacts spreading to other provinces are also observed, although on a much smaller scale. Provinces such as East Java, Banten, West Java, North Sumatra, and Central Java record output contributions ranging from approximately IDR 80 billion to IDR 118 billion in Phase I and Phase II. This phenomenon can be explained by infrastructure spillover theory, which states that large investments in a particular region generate leverage effects for connected regions through supply chains and interregional mobility of production factors ([Aschauer, 1989](#); [Bom & Ligthart, 2014](#); [Chakamera & Alagidede, 2018](#); [Khan, Khan, Jiang, & Khan, 2020](#); [Thacker et al., 2019](#)).

Differences in total output impacts between Phase I and Phase II also reflect the dynamics of the investment cycle and infrastructure project implementation. The decline in output impact in DKI Jakarta from Phase I to Phase II may be attributed to the fact that most large-scale investments were realized in Phase I, while Phase II focuses more on continuation and technical completion activities that generate smaller economy-wide impacts. However, output impacts in other provinces particularly West Java, South Sumatra, and Banten slightly increase in Phase II. This indicates that the project increasingly stimulates economic activity beyond DKI Jakarta.

The spillover impact of MRT investment in DKI Jakarta on other regions remains relatively small due to several factors. First, MRT infrastructure investment generally has high intensity and economic concentration in the local area, in this case DKI Jakarta. As a result, the main leverage effects such as job creation, raw material demand, and supporting business activities remain primarily concentrated in Jakarta. Other regions only experience a smaller impact due to limited economic ties and geographical distance, which affect the mobility of production factors and the distribution of output.

Second, the economic structures of other regions differ from that of DKI Jakarta and do not always possess sectors that are directly integrated with the MRT project. Consequently, their capacity to capture multiplier effects from this investment is lower. For example, suboptimal interregional connectivity and differences in the level of industrial sector development can reduce the magnitude of spillover effects. One of the main references supporting this argument is a study by LPEM FEB UI in 2021 in their Policy Brief on the impact of DKI Jakarta MRT development, which emphasizes that the greatest economic activity and value added occurs in the direct MRT development area, namely DKI Jakarta, while other regions receive a much smaller impact due to limited economic integration and mobility of production factors between regions. Furthermore, these findings are also in line with the results of an interregional input-output study at the University of Indonesia that analyzed Bundaran HI-Lebak Bulus MRT route, which showed that economic linkages and the multiplier effect of this investment were strongest in the DKI Jakarta area and decreased significantly with increasing distance and differences in the economic structure of other regions.

Third, as commonly observed in urban infrastructure studies, the long-term economic effects of projects such as MRT are more strongly felt in directly affected areas that serve as centers of transportation and business activities, compared to peripheral regions. This is in line with various studies showing that spillover effects often vary and depend on institutional factors, market integration, and economic

distribution channels at the regional level ([Lin, Yu, & Shen, 2025](#); [Marzolla, Campanelli, Melo, Bruno, & Loreto, 2025](#); [Shabani & Safaie, 2018](#); [Yin et al., 2024](#)). Therefore, large infrastructure investments concentrated in the core urban area naturally generate the greatest impacts locally, while spillover effects to other provinces remain limited.

4.2 Gross Value Added Impact Analysis

The estimation results of the impact of MRT investment on Gross Value Added (GVA) indicate that the majority of economic benefits are accumulated in sectors located in DKI Jakarta, particularly construction, business services, wholesale and retail trade, transportation and warehousing, information and communication, and financial services. This concentration of impacts is consistent with urban economics theory, which emphasizes intra-city connectivity as a key determinant of short-term productivity gains. Mass transportation such as the MRT primarily affects the local labor market, daily household consumption, and business interactions that depend on spatial proximity, so that its direct effects tend to be highly localized ([Banister & Berechman, 2001](#); [Cervero & Landis, 1993](#); [Ford, Barr, Dawson, & James, 2015](#); [Varghese & Pradhan, 2025](#); [Wekesa, Wawire, & Kosimbei, 2016](#)).

From a regional input–output perspective, the concentration of impacts in Jakarta also reflects a supply chain structure dominated by intra-regional linkages. Input–output multipliers are generated through backward and forward linkages, and interregional multipliers only emerge when sectors in one region have high dependence on inputs from other regions ([Miller & Blair, 2012](#)). In the case of MRT investment, sectors that experience positive impacts such as construction, financial services, professional services, retail trade, and information and communication technology tend to source the majority of their inputs from suppliers located within the Jakarta metropolitan area. Because the proportion of interregional input for these sectors is relatively low, the multiplier effect moving out of Jakarta is limited, so spillover to other provinces is naturally small.

Agglomeration economics theory provides a theoretical explanation for why MRT benefits reinforce the economic core rather than being evenly distributed across regions. Transportation infrastructure that improves internal accessibility within a city strengthens interactions between firms and workers in areas with already dense economic activity. This enhances productivity through knowledge spillovers, labor pooling, and input sharing ([Duranton & Puga, 2004](#); [Guo, Hu, Zhao, & Li, 2023](#); [Krugman, 1991](#)). When MRT reduces commuting costs and expands the effective labor market within the city, it increases the efficiency of existing agglomeration economies. However, it does not necessarily create incentives for firms to relocate activities to other regions or significantly increase demand for inputs from outside Jakarta. Agglomeration strengthens the locality of impact and reduces the intensity of inter-provincial spillover.

Research on the economic impacts of urban rail systems consistently finds that the largest benefits take the form of local productivity gains, increases in property values, growth in retail activity, and intensification of professional services, while interregional impacts tend to be small unless the project is part of a broader interregional logistics or transport integration reform ([Rosenthal & Strange, 2004](#)). This is in line with findings that the MRT plays a greater role as a commuter mobility enhancer than as a catalyst for interprovincial economic integration. Sectors outside Jakarta that appear on the GVA impact list are generally extractive sectors or certain processing industries that only receive secondary demand, and their value is much smaller than that of urban service sectors.

Therefore, the dominance of Gross Value-Added impacts in Jakarta is fully consistent with both theoretical mechanisms and empirical evidence from global studies. This implies that urban transit systems primarily function as enhancers of local economic performance. Spill-over to other regions requires additional channels such as, interregional supply chain integration ([Hirschman, 1958](#); [Miller & Blair, 2012](#)), a connected national logistics system ([Hirschman, 1958](#); [Miller & Blair, 2012](#)), procurement policies that involve suppliers outside the city center ([Flyvbjerg, 2009](#); [Rivadeneira, Dekyi, & Cruz, 2023](#)), or continued investment to connect the MRT with regional transportation networks ([Biehl, 1991](#)). Without these complementary policies, it is reasonable to expect that the economic impact will remain localized to high value-added sectors in Jakarta.

Table 5. Impact on gross value added

No	Impact on Gross Value Added (Phase I)			Impact on Gross Value Added (Phase II)		
	Province	Sector	GVA Impact	Province	Sector	GVA Impact
1	DKI Jakarta	Business Services	1591.0180	DKI Jakarta	Construction	4997.9862
2	DKI Jakarta	Construction	1296.9384	DKI Jakarta	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	482.5458
3	DKI Jakarta	Manufacturing	571.3206	DKI Jakarta	Financial service and Insurance	436.6823
4	DKI Jakarta	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	364.4719	DKI Jakarta	Business Services	402.1432
5	DKI Jakarta	Financial service and Insurance	333.3596	DKI Jakarta	Manufacturing	344.5499
6	DKI Jakarta	Information and Communication	168.2272	DKI Jakarta	Transportation and warehousing	177.3269
7	DKI Jakarta	Real Estate	123.6389	DKI Jakarta	Information and Communication	162.0747
8	DKI Jakarta	Transportation and warehousing	94.5658	DKI Jakarta	Real Estate	129.9718
9	DKI Jakarta	Other Services	34.7586	South Sumatra	Mining and Quarrying	66.1920
10	South Sumatra	Mining and Quarrying	34.3490	DKI Jakarta	Electricity and Gas Supply	61.9556
11	DKI Jakarta	Public Administration, Defence, and Compulsory Social Security	32.7505	Banten	Manufacturing	59.1396
12	DKI Jakarta	Accommodation and Food Service Activities	23.8967	West Java	Manufacturing	49.6830
13	Banten	Manufacturing	22.7524	Riau	Manufacturing	36.4862
14	West Java	Manufacturing	20.2556	DKI Jakarta	Accommodation and Food Service Activities	36.0771
15	East Java	Mining and Quarrying	19.0519	Central Java	Manufacturing	35.4860
16	Riau	Manufacturing	16.2805	East Java	Manufacturing	32.8079
17	East Java	Manufacturing	15.0780	DKI Jakarta	Other Services	32.4424
18	Sumatera Utara	Mining and Quarrying	15.0175	North Sumatra	Mining and Quarrying	31.8375

19	Riau	Mining and Quarrying	14.5536	East Java	Mining and Quarrying	29.1943
20	Central Java	Manufacturing	13.5820	North Sumatra	Manufacturing	27.9652
21	East Java	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	12.3232	Central Java	Mining and Quarrying	21.9936
22	Central Java	Mining and Quarrying	11.2277	DKI Jakarta	Public Administration, Defence, and Compulsory Social Security	20.9511
23	Bangka Belitung	Mining and Quarrying	10.9475	Riau	Mining and Quarrying	20.3625
24	DKI Jakarta	Electricity and Gas Supply	10.3204	Bangka Belitung	Manufacturing	18.6141
25	South Sulawesi	Mining and Quarrying	9.2224	Kep. Bangka Belitung	Mining and Quarrying	17.9957

The Table 5 presents the estimated impacts on Gross Value Added (GVA) across various provinces and economic sectors during two phases of the analysis. Phase I highlights the initial effects of sectoral activities on provincial GVA, while Phase II reflects subsequent shifts in economic contributions. The data reveal that DKI Jakarta consistently exhibits the highest GVA impacts across multiple sectors, including Business Services, Construction, and Manufacturing. Other provinces, such as Sumatera Selatan, Banten, and Jawa Timur, also show notable contributions, particularly in Mining, Manufacturing, and Trade sectors. This comparison provides insights into the regional and sectoral dynamics driving economic value creation in Indonesia.

4.3 Employment Impact

The results of the Input–Output analysis for DKI Jakarta show that investment in the Mass Rapid Transit (MRT) project generates significant employment impacts across sectors, both in Phase I and Phase II of development. Total additional employment created amounts to 6.992.01 jobs in Phase I and 4.432.45 jobs in Phase II, indicating the strong role of transportation infrastructure investment as a driver of the urban labor market. On a sectoral basis, the business services sector records the largest increase in employment in Phase I, amounting to 2.145.73 jobs. This finding reflects the service-intensive and skill-intensive nature of MRT projects, particularly in planning, engineering design, construction supervision, project management, and consultancy services.

The dominance of the service sector in this company is in line with urban economics and input-output literature, which emphasizes that large-scale infrastructure projects in metropolitan areas tend to create high derived demand in the professional services sector ([Fujita & Thisse, 2013](#); [Miller & Blair, 2012](#)). In addition to business services, the construction sector also shows very significant employment impacts. In Phase I, this sector absorbs an additional 1.116.27 workers, and this figure increases in Phase II to 1.486.08 workers, making construction the sector with the highest relative contribution in the later phase of the project.

Table 6. Impact of Employment Increase in DKI Jakarta Province

No	Sector	Employment Impact			
		Phase I	%	Phase II	%
1	Agriculture, Forestry, and Fishing	1.57	0.006	0.77	0.003
2	Mining and Quarrying	20.56	0.120	8.23	0.048
3	Manufacturing	994.06	0.198	249.95	0.050

4	Electricity and Gas Supply	13.88	0.095	9.77	0.067
5	Water Supply; Sewerage, Waste Management, and Remediation Activities	2.27	0.012	1.59	0.009
6	Construction	1116.27	0.509	1486.08	0.678
7	Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1283.48	0.109	1243.45	0.105
8	Transportation and Warehousing	491.13	0.082	460.54	0.077
9	Accommodation and Food Service Activities	139.35	0.023	111.01	0.018
10	Information and Communication	136.47	0.108	83.95	0.067
11	Financial service and Insurance	315.92	0.151	278.01	0.133
12	Real Estate	70.43	0.074	51.08	0.054
13	Business Services	2145.73	0.768	315.31	0.113
14	Public Administration, Defence, and Compulsory Social Security	61.70	0.030	18.89	0.009
15	Education service	14.36	0.014	10.06	0.010
16	Health service and Social Work Activities	14.09	0.012	5.53	0.005
17	Other Services	170.73	0.037	98.22	0.021
Total Increase in Employment		6992.01		4432.45	

Table 6 show increase reflects the nature of the MRT project, which in Phase II focuses more on intensive physical construction activities, such as structural completion, system installation, and advanced civil works. This finding is consistent with Keynesian investment theory, which states that government investment spending in the construction sector has a large labor multiplier effect, especially during the project implementation phase ([Aschauer, 1989](#); [Chen & Haynes, 2017](#); [Ianchovichina, Estache, Foucart, Garsous, & Yepes, 2013](#); [Keynes, 1936](#)).

The wholesale and retail trade sector also experiences substantial employment impacts, with an increase of 1.283.48 workers in Phase I and 1.243.45 workers in Phase II. These impacts reflect indirect effects arising from increased consumption activity, goods distribution, and logistical needs during the construction period. In the context of inputs and outputs, the trade sector acts as a downstream sector that absorbs increased demand from the project's main sectors ([Papadas & Dahl, 1999](#); [Wang, Zhong, & Hunt, 2019](#); [Yu, Jong, Storm, & Mi, 2012](#)). Meanwhile, the manufacturing sector experiences a relatively large employment increase in Phase I, amounting to 994.06 workers, but this impact declines sharply in Phase II to 249.95 workers. This pattern indicates that demand for manufactured products such as construction materials, construction components, and equipment is more dominant during the early stages of development and decreases as the project transitions toward completion and operation. This phenomenon is consistent with empirical findings in infrastructure impact studies, which show that the employment effects of the manufacturing sector tend to be temporary and concentrated in the early phases of a project ([Banister & Berechman, 2001](#)).

Other sectors, including information and communication, transportation and warehousing, and financial services and insurance, also record positive but relatively smaller employment increases. These sectors function primarily as supporting sectors that respond indirectly to increased economic activity generated by the MRT project, especially through financing, logistical coordination, and project operation supporting service. According to [Miller and Blair \(2012\)](#), sectors with moderate but widespread labor impacts still play an important role in maintaining the continuity of the investment multiplier effect.

Overall, the pattern of employment impacts from MRT investment in DKI Jakarta demonstrates that the largest employment benefits are concentrated in urban service sectors and construction, while primary sectors such as agriculture, forestry, and fisheries receive only minimal impacts. This finding confirms that urban mass transit projects are highly localised and urban-biased in terms of output or employment generation ([Cervero & Landis, 1993](#); [Rosenthal & Strange, 2004](#)). Thus, the MRT serves primarily as a catalyst for increasing employment opportunities in high value-added sectors

concentrated in metropolitan areas, rather than as an instrument for redistributing labor across primary sectors.

5. Conclusions

5.1 Conclusion

This study aims to analyze the magnitude and pattern of economic spillover impacts arising from investment in the Jakarta Mass Rapid Transit (MRT) project using an Inter-Regional Input–Output (IRIO) approach. By combining realized investment from Phase I and projected investment from Phase II, this study is able to capture economic impacts comprehensively, including direct, indirect, and induced effects, while explicitly accounting for intersectoral and interregional linkages. The analysis results show that investment in the Jakarta MRT project generates significant economic impacts, but these impacts are highly concentrated in DKI Jakarta Province. In terms of output and gross value added, the construction sector, business services, wholesale and retail trade, transportation and warehousing, information and communication, and financial services are the main beneficiaries. The dominance of urban service sectors reflects the characteristics of MRT as a mass urban transportation infrastructure that strengthens high value-added economic activities in metropolitan areas.

From an employment perspective, MRT investment creates an additional 6,992 jobs in Phase I and 4,432 jobs in Phase II. The largest employment impacts occur in the business services and construction sectors, while the manufacturing sector exhibits a declining employment impact in Phase II as the project shifts from the early construction stage to completion and operation. Primary sectors such as agriculture and fisheries receive only very limited impacts. Interregional spillover analysis reveals that spillover effects to other provinces are relatively small compared to the local impacts in Jakarta. This is caused by the strong intra-regional linkages within the MRT project supply chain and the role of economic agglomeration that reinforces the concentration of production and service activities in the metropolitan core. These findings confirm that MRT primarily functions as a catalyst for local economic growth rather than as an instrument for interregional economic equalization. Overall, this study provides important empirical contributions by demonstrating that investment in urban transportation infrastructure generates large but localized economic benefits. Therefore, to enhance spillover impacts to surrounding and other regions, complementary policies are required, including interregional supply chain integration, procurement policies that involve non-metropolitan suppliers, strengthening regional logistics connectivity, and coordinated Transit-Oriented Development (TOD). Without such supporting policies, the economic benefits of MRT investment will remain concentrated in the core area of Jakarta.

5.2 Research Limitations

This study provides empirical evidence on the economic spillover impacts of Jakarta MRT investment using the Inter-Regional Input-Output (IRIO) approach. However, several limitations should be noted. First, the IRIO model assumes fixed production coefficients and linear relationships between sectors, which limits its ability to capture technological change, substitution effects, and behavioral adjustments in the economy. Second, the analysis focuses mainly on direct, indirect, and induced economic impacts, while broader benefits of MRT development such as improvements in accessibility, travel time savings, environmental benefits, and land value changes are not explicitly included. Third, the results depend on the aggregation level and availability of regional input-output data, which may mask variations across subsectors.

5.3 Suggestions and Directions for Future Research

Future research can extend this study in several directions. First, applying dynamic analytical frameworks, such as Computable General Equilibrium (CGE) or dynamic input-output models, would help capture structural adjustments and price mechanisms over time. Second, integrating spatial and urban economic analyses could provide deeper insights into how MRT development influences land use, property values, and Transit-Oriented Development (TOD) along MRT corridors. Third, future studies may incorporate environmental and social indicators, including congestion reduction, emissions mitigation, and improvements in urban accessibility.

Author Contributions

NN contributed to conceptualization, study design, and drafting of the manuscript. LK and JS contributed to drafting of the manuscript. KH performed data collection. RYYN reviewed and edited the manuscript. All authors read and approved the final version of the manuscript.

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