SEMARANG-BATANG TOLL ROAD ECONOMIC VALUE FOR LOGISTICS AND INDUSTRIAL AREA DEVELOPMENT

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Abstract

This study analyzed the economic value of the Semarang-Batang toll road. Data used in this study were obtained through a literature review, a primary data survey of 140 respondents consisting of toll road users, arterial road users, and Micro, Small, and Medium Enterprises, and a secondary data survey. The methodology used was quantitative analysis, utilizing regression models and externality analysis. This study showed a 35.6% reduction in travel time, a 26.5% reduction in fuel consumption, and a 1,381 reduction in vehicle incidents and breakdowns. Furthermore, the toll road also provides positive benefits of IDR 32.6 billion per year due to increased land prices and reduced vehicle emissions.

Keywords: toll road; economic value of toll road; travel time; fuel consumption; vehicle emissions

Abstrak

Pada studi ini dilakukan analisis nilai ekonomi ruas jalan tol Semarang-Batang. Data yang digunakan pada studi ini diperoleh melalui studi literatur, survei data primer kepada 140 responden yang terdiri atas pengguna jalan tol, pengguna jalan arteri, dan pengusahaa Usaha Mikro, Kecil, dan Menengah, serta survei data sekunder. Metodologi yang digunakan adalah analisis kuantitatif, dengan menggunakan model regresi dan analisis eksternalitas. Studi ini menunjukkan bahwa terdapat pengurangan waktu tempuh sebesar 35,6%, pengurangan konsumsi bahan bakar sebesar 26,5%, dan berkurangnya kejadian dan gangguan kendaraan sebesar 1,381. Selain itu, terdapat pula manfaat positif jalan tol sebesar Rp32,6 miliar per tahun, akibat meningkatnya harga tanah dan pengurangan emisi kendaraan.

Kata-kata kunci: jalan tol; nilai ekonomi jalan tol; waktu tempuh; konsumsi bahan bakar; emisi kendaraan

INTRODUCTION

The keystone of national economic progress in Indonesia as developing country is robust transportation infrastructure project (Siswoyo, 2020). An example of the transportation project is the toll road, which is the key element to advance economic activity by enabling resourceful goods and people distribution (Beik, 2011). Government of Indonesia had initiated the major toll road network construction project in Java Island, so called Trans Java toll road. Enhanced regional economic growth and improved connectivity are the objectives of this toll road network (Sembiring and Anas, 2019). The critical part of this toll

road network is Semarang-Batang toll road, connecting Semarang City as the logistic hub with Batang Regency as the aspired integrated industrial estate (Pugara et al., 2022). Semarang-Batang toll road is believed to significantly stimulate industrial area development and affect logistics productivity.

Toll road economic value needs further justification, even though reduced travel time and cost as toll roads benefits are regularly emphasized. There have been related studies analyzing economic benefits of toll road investment in industry sectors and influence of transportation infrastructure on industrial development (Pugh and Fairburn, 2008). Yet, there is a critical point of view by comprehending the economic value of Semarang-Batang Toll Road on logistics and industrial area development to unlock regional economic prospects. This study aims to analyze the economic benefits of this specific toll road and the development of industrial areas around the toll road to link the current gap.

LITERATURE REVIEW

Toll Road Economic Value

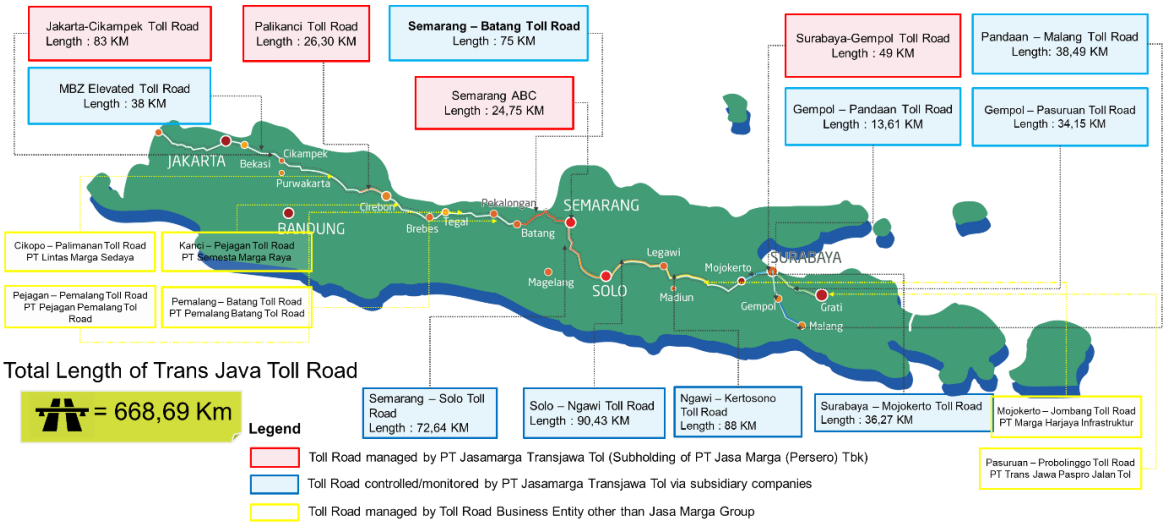
The road infrastructure investment has an important role in enabling movement and logistics for the manufacturing industry (Sembiring and Anas, 2019). Greater operating scale and accessibility economies, reduced freight transportation costs, and reduced logistics cost are important economic benefits from road investments. Toll road, specifically, is built to support regional development and economic growth by ensuring supply chain services of goods are efficient and effective (Ahmad, 2022). When the existing road capacity is already saturated, toll roads can be introduced. By constructing toll roads, there are several expected benefits, such as lower transportation costs, decreased travel time, reduced production costs, increased productivity, and increased market expansion. From this perspective, it can be inferred that low transportation cost affects consumer purchasing power and low production expense (Sembiring and Anas, 2019).

Positive influence of toll roads on economic development was presented from past studies. Positive development effect at sub-regional level was shown on M6 Toll motorway in the UK. The M6 toll was proven to create 265 new jobs and additional annual earnings over £5 million, totaling around £100 million as its economic benefit (Pugh and Fairburn, 2008). The same positive economic effect was similarly found in Central Java areas because of Trans Java toll road development (Ahmad, 2022). From these data, it is clear that the economic benefits from transportation infrastructure are consistent with the outcome.

Semarang-Batang Toll Road

The Semarang-Batang toll road is the central section of the Trans Java toll road, with a main section of 75 kilometers, as depicted in Figure 1 and Figure 2. It has been fully operational since January 14, 2019. The concession holder for this toll road is PT Jasamarga Semarang Batang, a subsidiary of PT Jasamarga Transjawa Tol, which is also a sub holding

of a leading toll road developer and operator in Indonesia. The concession will last for 50 years, until 21 July 2066. There are 6 toll gates, 6 interchanges, 3 type A rest areas, and 1 type B rest area. The Semarang-Batang toll road stretches across Semarang City, Kendal Regency, and Batang Regency. The Annual Average Daily Traffic for 2024 is 27,234 vehicles.



Source: PT Jasamarga Transjawa Tol (2022)

Figure 1 Trans Java Toll Road Map

Figure 2 Semarang-Batang Toll Road Map

Development Industrial Areas Around Toll Road

The transformation of regional industrial structures is significantly influenced by toll roads. Toll roads or expressways, are crucial for economic development because they provide logistical access for the industrial sector (Su et al., 2023). This can then reduce production costs, increase productivity, and expand markets. Well-developed toll roads give added value to the primary, secondary, and tertiary industrial sectors located throughout the surrounding area. The closer the area, the more positive the impact of industrial land development.

In another study in the UK, the effects of industrial land development were quantified. Areas within a 5-minute drivetime from the toll junction showed a statistically significant increase in industrial land development. Similar results were observed in areas within a 10-minute drivetime, although less statistically significant. However, there was no effect in areas more than a 15-minute drivetime (Pugh and Fairburn, 2008). These results demonstrate the importance of easy access and locational advantages of toll roads. It is proven that toll roads attract new industries to develop and expand. The manufacturing, retail, and service sectors depend on reliable transportation services.

METHODOLOGY

Data Collection

In this study, data were collected from literature, primary data, and secondary data. A total of 140 respondents, consisting of 40 toll road users, 48 arterial road users, and 32 Micro, Small, and Medium Enterprises (MSMEs), were recruited for this survey. Questionnaires were administered to all respondents through interviews. The secondary data used were land and property prices, annual average daily trips on toll roads and arterial roads, and vehicle emission factors. Table 1 shows the data required for the externality analysis.

Table 1 Data Collection Method for Externality Analysis

No.	Required Data	Data Collection Method
1	Land and property prices increase	Secondary data
2	Vehicle emission factor	Secondary data
3	Monetary value of noise impact per year	Literature review, FGD
4	Productive land area converted because of toll road project	Secondary data
5	Monetary value due to urban separation	Literature review, FGD
6	Revenue before and after toll road operations	Survey, FGD

Quantitative Analysis

In this study, 2 types of quantitative analysis were conducted, which are regression analysis and externality analysis. The independent variables for these regression models are distance in kilometers, vehicle capacity in CC, a dummy variable for toll roads as 1 and arterial roads as 0, and vehicle type dummy. Three regression models were analyzed. First, the travel time model (Ln) with travel time log as the dependent variable and distance, vehicle capacity, toll usage dummy, and vehicle type as the independent variables. The second model is the fuel consumption model (Ln) with covariates similar to those used in the travel time model. The response variable in this model is fuel consumption log. The Breakdown and Incident Model is the third model. The response variables are the number of breakdown and incidents per year, with the predictor variables are the same as those used in the first and second models. The effect of the use of the Semarang-Batang toll road on efficiency and safety can be evaluated after analyzing these 3 models.

The model specifications are:

$$Log(Travel\ Time) = \alpha + \beta_1(\text{distance}) + \beta_2(\text{vehicle capacity}) + \beta_3(\text{toll dummy}) + \beta_4(\text{vehicle type}) + \varepsilon \quad (1)$$

$$Log(Fuel\ Consumption) = \alpha + \beta_1(\text{distance}) + \beta_2(\text{vehicle capacity}) + \beta_3(\text{toll dummy}) + \beta_4(\text{vehicle type}) + \varepsilon \quad (2)$$

$$Breakdowns\ and\ Incidents = \alpha + \beta_1(\text{distance}) + \beta_2(\text{vehicle capacity}) + \beta_3(\text{toll dummy}) + \beta_4(\text{vehicle type}) + \varepsilon \quad (3)$$

The externality analysis began with a review of relevant literature to gather indicators that directly impact road users along the Semarang-Batang toll road. Next, Focus Group Discussions were conducted with policymakers, academics, and adjacent communities affected by the toll road project. Market price and non-market valuation approaches were used to measure the impact of externalities.

RESULT

The effect of using the Semarang-Batang toll road on travel time, fuel consumption, and damage and incidents as the three main variables is demonstrated using a regression model, and the summary of the results is presented in Table 2. The toll dummy coefficient is -0.356 with a p-value smaller than 0.01 in the travel time model, which means that travel time can be reduced by 35.6% when using the Semarang-Batang toll road compared to using arterial roads. Heavy Vehicles (HGVs) benefit from this reduction in travel time, as the usually longer travel time on arterial roads can be reduced. In addition, from the fuel consumption model, it can be seen that the toll dummy coefficient is -0.265, with a p-value smaller than 0.01. This result indicates that vehicles using the Semarang-Batang toll road consume less fuel, meaning that fuel consumption can be reduced by 26.5% when vehicles use the toll road. Finally, the toll dummy coefficient is -1.381 with a p-value smaller than 0.05 in the Breakdown and Incident model. This result shows that using the Semarang-Batang toll road can reduce the frequency of incidents, engine overheating, and tire blowouts by 1,381 incidents. Overall, it can be concluded that the Semarang-Batang toll road provides significant benefits in reducing travel time and fuel consumption, with a 99% confidence level. The toll road can also reduce the likelihood of breakdowns and incidents with a 95% confidence level.

Table 2 Semarang-Batang Toll Road Usage Impact to Travel Time, Fuel Consumption, and Breakdowns and Incidents Regression Estimate Result

Variable	Statistic Coefficient		
	Ln (Travel Time)	Ln (Fuel Consumption)	Breakdowns and Incidents
Toll	**-0,356*** **	**-0,265*** **	**-1,381** **
(1=toll | arterial)	-0,054	-0,044	-0,584
Distance	0,023***	0,020***	-0,065
	-0,002	-0,002	-0,047
Vehicle CC	0,000***	-0,265***	0,001***
	0	-0,044	0
Bus	-0,118	-0,143	-6,334**
(1=bus | private)	-0,152	-0,205	-3,135
Truck	0,424***	-0,009	-0,162
(1=truck | private)	-0,088	-0,151	-1,33
Travel	0,223***	0,084	-1,843*
(1=travel | private)	-0,076	-0,071	-0,961
Van	0,346***	-0,136***	2,241
(1=van | private)	-0,087	-0,035	-2,213
Constants	2,363***	0,336*	4,942
	-0,179	-0,181	-3,496
Observation	218	216	218

Robust standard errors in parentheses
*** p<0,01 (significant on 99% confidence level), ** p<0,05 (significant on 95% confidence level), and * p<0,1 (significant on 90% confidence level)

In terms of externality analysis, there are 4 indicators that form negative externalities. The largest negative impact is Rp311.46 billion per year due to the economic decline on arterial roads because of reduced traffic volume on non-toll roads. The next indicators are noise, with Rp30.96 billion, and land use changes with Rp27.05 billion, as negative environmental and social impacts. Furthermore, the separation of urban areas also has a negative impact on the community, amounting to Rp16.82 billion. Overall, the total negative externality of the Semarang-Batang toll road is Rp386.28 billion per year.

Conversely, positive externalities include increased land prices and reduced motor vehicle emissions. The construction of the Semarang-Batang toll road increases the economic value of the surrounding area due to increased accessibility and investment potential. This phenomenon has resulted in an annual increase in land prices of Rp409.44 billion. Furthermore, positive externalities also arise from reduced motor vehicle emissions, as the toll road is linked to more environmentally friendly transportation infrastructure. The value generated from these emission reductions is Rp9.44 billion per year. Thus, the total positive externality is Rp418.88 billion per year.

In summary, the Semarang-Batang toll road has a net externality of IDR 32.6 billion per year (see Figure 3). This result indicates that the toll road's economic benefits outweigh its drawbacks. However, PT Jasamarga Semarang Batang, as the owner of the Semarang-Batang toll road, should mitigate the negative impacts by supporting Micro, Small, and Medium Enterprises (MSMEs) on the arterial road and managing noise to achieve a sustainable toll road.

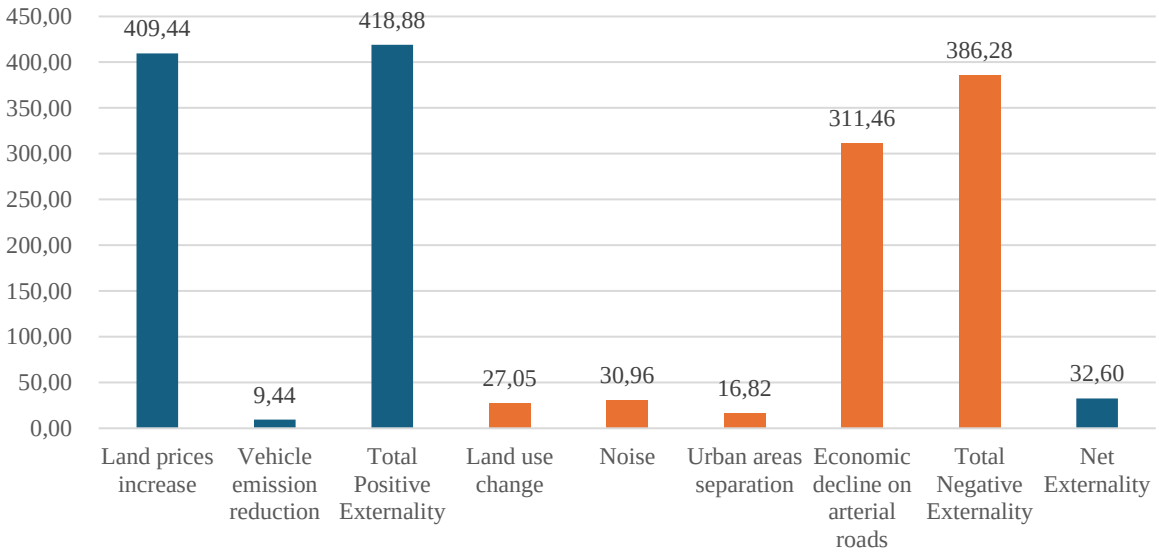


Figure 3 Average Externality Value Estimates per Year on Semarang-Batang Toll Road

Gross Regional Domestic Product (GDP) data from 2015 to 2023 shows that the transportation and warehousing sector in Central Java Province experienced significant growth after the Semarang-Batang toll road became fully operational (see Figure 4). This occurrence cannot be stated as casualty relationship, but it shows a growth of 73% in 2022 after the difficult years caused by COVID in 2020 and 2021. When looking at other sectors, such as Wholesale and Retail Trade, Real Estate, and Processing Industry, these sectors experienced relatively similar growth to the period before the Semarang-Batang toll road was operational. Only the Accommodation and Food and Beverage (F&B) sectors experienced a higher recovery, but still lower than the Transportation and Warehousing sectors.

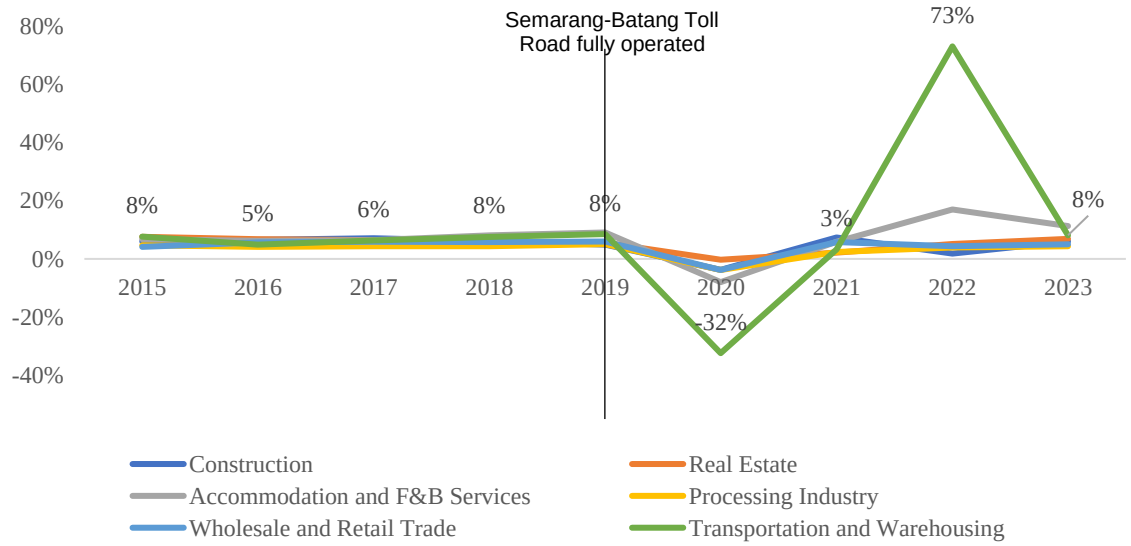


Figure 4 Gross Regional Domestic Product Growth to Sectors Affected by Semarang-Batang Toll Road

CONCLUSION

The Semarang-Batang toll road has positive economic value for the development of industrial areas around it. Travel time using the toll road is only 55.23 minutes, almost twice as fast as the 93.3 minutes on non-toll arterial roads. Average fuel consumption on this toll road section is 6.69 liters compared to 9.35 liters on non-toll arterial roads. The Semarang-Batang toll road has 1.31 times fewer breakdowns and incidents than arterial roads. These factors indicate that the Semarang-Batang toll road has the potential to reduce transportation costs and enable better industrial area development.

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