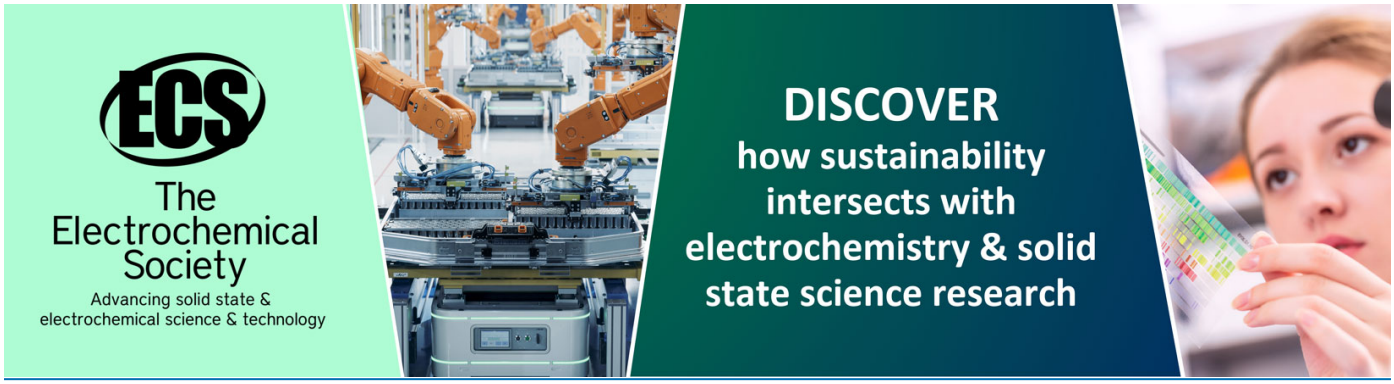
The economic benefit of toll road investment on the performance of the industry sectors in West Java Province



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The economic benefit of toll road investment on the performance of the industry sectors in West Java Province

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Abstract. Toll road infrastructure investment will affect the production sector, where the role of transportation is to be the logistics function of the manufacturing industry. The government policy based on the acceleration of toll road investment is expected to boost production performance. The local government is expected to provide support by increasing the economic potential of the region along with the policy. This research tends to describe the contribution of the toll road infrastructure investment in the Manufacturing Industry Sector in West Java Province. The empirical data result shows the difference of the significant efficiency level of the Manufacturing Industry Sector from connected district areas/cities compared to the areas that are not connected to the toll road (+ 6%). With the T-test Pair analysis, there is a significant difference against the value of efficiency level for the areas that are connected to the toll road from the Manufacturing Industry Sector once the Cipularang Toll Road begins to operate (+ 4%).

1. Introduction

One of the advantages of road infrastructure investment in the production sector is that it acts as a function of mobility to distribute goods. This investment, in turn, expected to encourage the regional economic growth. Mobility has become a fundamental aspect of economic activities where transportation performance will affect the production sector [1]. Whether it is smooth or not, the distribution of goods will significantly affect the production sector, high transportation costs will also increase production cost, resulting in high selling points where this will affect the purchasing power of consumers.

The performance of transportation infrastructure will affect the production sector. Since the high transportation cost will increase the production cost, it will result in weak competitiveness of the economic sector in Indonesia. The following points are the economic benefit of a road infrastructure investment to the manufacturing sector, among others [2]:

- Reduced freight transportation costs;
- Reduced inventory/logistics costs;
- Greater operating scale and accessibility economies

According to the No. 38 decree in 2004, the toll road operation in Indonesia is targeted to improve the effectiveness and efficiency of goods distribution services in order to support the improvement of economic growth. The toll road investment can improve the performance of dry land transportation, with decreasing travel time and transportation costs. This will increase productivity, distribution of

goods, efficiency level and competitiveness in the production sector. Therefore, the transportation sector cannot be separated from the development and economic growth of one region.

The construction of toll roads in Indonesia is still considered to be very slow. From 1978 to 2008, there has only been 684 km of toll roads in Indonesia. This number is small compared to Malaysia and China with 1,500 km and 40,000 km of toll roads, even though both countries started the construction of toll roads in 1980 and 1990.

In this research, there will be a discussion on how toll road investment in the manufacturing sector in West Java is improving the efficiency level of the manufacturing industry sector. How much influence given by toll road infrastructure investment to the manufacturing sector is indeed difficult to calculate. Hence, this research aims to provide an empirical analysis by using the T-Test and T-Test Pair based on the effect of Cipularang Toll Road investment in the manufacturing industry sector in West Java in terms of the efficiency level of the particular sector.

2. Literature review

2.1. Development of toll roads in Indonesia

The history of toll roads in Indonesia was started in 1978 with the operation of Jagorawi toll road with the length of 59 km (including access road), this toll road connects Jakarta, Bogor, and Ciawi. The purpose of the toll road development is to smoothen the traffic in the developed areas, improve the distribution of goods and services, and to support economic growth [3]. In 2005 with 27 years of toll road development, only 600 km of toll road has been built in Indonesia.

Table 1. General plan of toll road network in Indonesia.

NO	TOLL ROAD	OPERATED	PLAN	TOTAL
1	Sumatera Island	43 km	2,805 km	2,848 km
2	Java Island	750 km	1,650 km	2,400 km
3	Kalimantan Island	-	84 km	84 km
4	Bali Island	10 km	-	10 km
5	Sulawesi Island	17 km	39 km	56 km
	TOTAL	820 km	4,578 km	5,398 km

Source: BPJT, 2014

Table 1 shows the total length of toll road plans and the operating toll roads in Indonesia. Compared to China, up to 2000, China has built 17,900 km [4]. To encourage the growth of toll road development in Indonesia, the government encourages the construction of 28 toll road projects which include the JORR II and the Trans Java Toll Roads.

To smoothen the flow of goods distribution and services and reduce the logistics costs in Java, the Government targets the operation of Trans Java Toll Road in 2019, with total length of 498.23 km and total investment cost of Rp 44.19 T. So far, 368 km of the toll roads have been operating from the original development plan (49% out of 745 km).

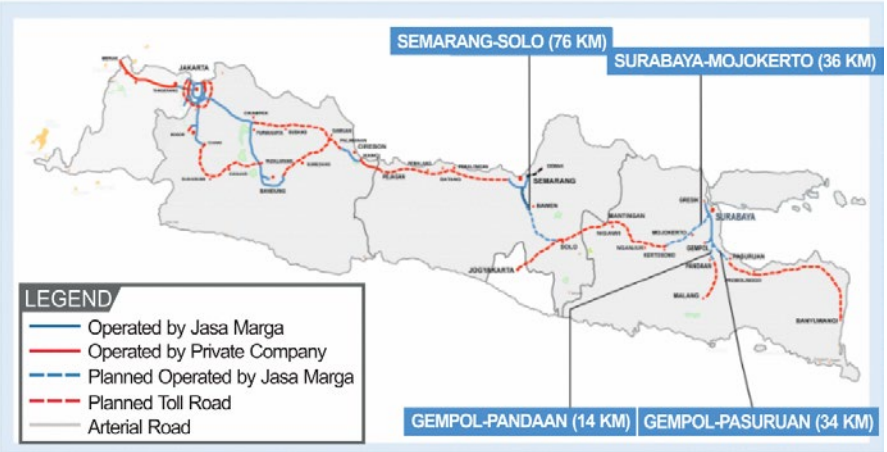

Figure 1. Trans Java Toll Road.
source: Jasa Marga, 2014.

A toll road that connects Cileunyi-Sumedang up to Dawuan was developed in West Java. This toll road has become the access supporting freight transportation to the Cirebon Port and is expected to bring change on the development orientation of Eastern Bandung City.

3. Transportation sector's contribution to manufacturing industry sector

The transportation sector needs to be able to provide benefits to the industry sector by providing access and to be a function of logistics (transporting raw material; manufacture to consumer). Hence, the road infrastructure investment will give a positive impact by reducing the travel and logistic cost, and in turn, improve the operating scale and accessibility to the economy.

The unavailability of proper road infrastructure will result in a lack of volume of transportable goods and increase the transportation costs to transport products. According to the Global Competitiveness Report 2009-2010, Indonesia's infrastructure competitiveness is ranked at 96 out of 133 countries. This condition is disappointing compared to China, Thailand, and Malaysia. The government has issued several policies related to infrastructure development, which is expected to be a stimulus for regional economic growth.

The addition of road capacity through toll road infrastructure investment will decrease travel time and reduce transportation cost, it is expected to increase productivity, market expansion, and reduce the production cost. Figure 2 illustrates the effect of road infrastructure on financing the production sector.

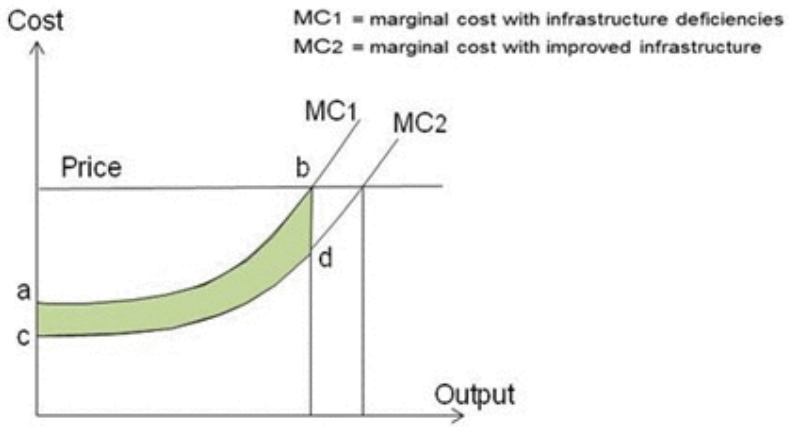

Figure 2. Infrastructure contribution against the reduction of production cost.

Figure 2 shows that the increased productivity and reduction of production cost are the effects of improved transportation performance. Poor road infrastructure performance can lead to a decrease in freight mobility that would increase transportation costs affecting the production cost of a commodity [5].

The pattern that is still currently happening in Indonesia is that inter-city goods transportation is still dominated by road transportation. This pattern has become one of the factors affecting the high transportation cost in Indonesia, where 90% of goods movement is conducted through road transportation.

Toll roads are one of the vital tools to improve the efficiency of the industrial sector of a regional economy [6]. The transportation sector in Indonesia is based on road transportation, so the toll road will boost the economic efficiency of the industry sector. When associated with the performance of the transportation sector, the toll road operation has an effect on the freight transportation cost of the industry sector in the region that is connected to the particular toll road. The low cost of freight transportation can increase the efficiency of the industry sector.

4. Methodology

4.1. Independent T-Test

Independent sample T-test is a type of statistical test that has a purpose of comparing the average of two groups that are not paired nor related to one another (different kinds of subjects).

In this research, both groups' data have equal variance, so the value of the Independent T-Test is interpreted as Equal variance. The formula from the Independent T-test with the homogenous variance is as follows:

$$F = \frac{S_1^2}{S_2^2} \tag{1}$$

where:

F = The calculated F value

S_1 = The greatest variance value

S_2 = The smallest variance value

The data is stated to have an equal variance when F-Calculated < F-Table, and vice-versa, the data variance is stated to be unequal variance when F-Calculated > F-Table. The form of the variance of both groups of data will have an impact on the value of standard error, which will eventually distinguish the test formula.

T-Test for an equal variance uses the manual formula of Polled Varians:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \tag{2}$$

where:

n_1 = total of sample 1

n_2 = total of sample 2

X_1 = average value of the first sample

X_2 = average value of the second sample

S_1 = the first sample variance

S_2 = the second sample variance

4.2 Dependent T-Test (paired sample T-Test)

The paired t-test sample is a t-test where the sample is interconnected between one sample with another sample. Paired samples are defined as a sample with the same subject but undergo two different treatments or measurements. An analysis of the particular subject often consists of two measurements with the same subject, before and after the introduction of treatment or stimulus.

As explained earlier, the Paired Sample T-Test analysis is a procedure that is used to compare the average of two variables in a group, which means that this analysis is useful to test two samples that are interconnected or a paired sample.

The purpose of this test is to test the difference between the average value of the paired samples. The paired T-Test sample is used to compare the mean value from paired samples. Paired samples are a group of samples with the same subject. However, it experiences two different treatments or measurements (this can be interpreted as the effect of before and after the toll road operation).

The equation from the paired sample T-Test is as shown below [7]:

$$t = \frac{\sum d_i}{\frac{\sqrt{N\sum d_i^2 - \left(\sum d_i\right)^2}}{N-1}} \tag{3}$$

where:

d = the value difference after and before (post-pre)

N = the number of samples

5. Analysis result

As a whole, the total number of manufacturing industries in West Java in 2010 (741 industries) has increased compared to 2009 (722 industries) (Department of Cooperatives, SMEs Industry and Trade District of Bandung), the industry sector, in total, donate more than 40% PDRB of West Java (Central Statistic Bureau of West Java, 2012).

The following data are parameters of the manufacturing industry sector of West Java that were used in this validity test model:

- Input Cost
  Input cost is all cost used to produce a product, such as raw material, fuel but does not include salary, indirect taxes and land rent.
- Output Value
  Output value is the total output from the industry sector in West Java. It consists of the value of the goods produced, industrial services, electricity sold, stock of semi-finished goods, and other output.
- Added Value
  Added value is the difference between the received income as a result of producing goods with all the expenditures to produce goods.
- Level of Efficiency
  The level of efficiency is a comparison between the added value and the output value. This value of efficiency is often used to assess the success rate of a company in the production process.

The analysis conducted in this research is applied to the data of the efficiency level of the industry sector in West Java based on the Region/City in 2007 – 2010.

Table 2. The average efficiency level of industry sector in West Java Province.

NO	REGENCY/CITY	EFFICIENCY INDEX	$(x_i - \mu)^2$	p(x)
1	Bogor	0.516	3.234	3.234
2	Sukabumi	0.518	3.240	3.240
3	Cianjur	0.627	2.394	2.394
4	Bandung	0.585	2.964	2.964
5	Garut	0.621	2.496	2.496
6	Tasikmalaya	0.733	0.838	0.838
7	Ciamis	0.652	2.011	2.011
8	Kuningan	0.712	1.099	1.099
9	Cirebon	0.488	3.061	3.061
10	Majalengka	0.561	3.167	3.167
11	Sumedang	0.726	0.918	0.918
12	Indramayu	0.767	0.510	0.510
13	Subang	0.603	2.744	2.744
14	Purwakarta	0.612	2.616	2.616
15	Karawang	0.451	2.631	2.631
16	Bekasi	0.609	2.666	2.660
17	Bogor	0.609	0.006	2.666
18	Sukabumi	0.376	0.024	1.456
19	Bandung	0.648	0.013	2.070
20	Cirebon	0.805	0.074	0.267
21	Bekasi	0.604	0.005	2.736
22	Depok	0.597	0.004	2.818
23	Cimahi	0.644	0.012	2.129
24	Tasikmalaya	0.455	0.005	2.682
25	Banjar	0.778	0.060	0.429

5.1. Hypothesis independent test (parametric comparison)

A hypothesis test is a temporary assumption of the situation. In this research, the hypothesis discusses how the influence of Cipularang Toll Road investment policy towards the efficiency level of the processing industry sector differs from the region that is connected and not connected by the toll road. As an example, Cipularang Toll Road was operated in 2005. Therefore, the data used in this research from 2001-2005 is considered as the "before the toll roads/not connected" hypothesis, while the 2006-2010 data is considered as the "after the toll roads/connected" hypothesis.

The hypothesis in this analysis is formed as follows:

- Ho : no difference in the efficiency level in the region that is connected by the toll road
- Ha : there is a difference in the efficiency level in the region that is connected by the toll road

Table 3. T-test result of the average efficiency level of industry sector.

	Variable 1	Variable 2
Mean	0.30199061	0.369498601
Variance	0.003441825	0.004198623
Observations	15	6
Df	8	
t Stat	-2.214596643	
P(T<=t) one-tail	0.028833047	

	Variable 1	Variable 2
t Critical one-tail	1.859548038	
P(T<=t) two-tail	0.057666094	
t Critical two-tail	2.306004135	

From the analysis result, it shows that:

- The Mean column shows the average difference value of the efficiency level in the manufacturing industry sector between region/cities that are connected and not connected to the toll road.
- Due to the t-calculated > t-table (2,3161 > 2,093024) Ho is rejected as the valid hypothesis. Hence, Ha is accepted as a valid one. This means that there is a difference in the average value of efficiency level between regions that are connected and not connected by toll roads.
- The P value < 0,05 (α=5%), then the hypothesis result can be said is significant.

5.2. Paired hypothesis test (paired-samples t-test)

The hypothesis conducted in the model validity is to determine the effect of the operation of the Cipularang Toll Road on the effeciency level of the industry sector in the Region/City that is connected to the particular toll road.

The hypothesis in the analysis:

- Ho: there is no difference in the efficiency level between the before and after operation of the toll road
- Ha: there is a difference in the efficiency level between the before and after operation of the toll road

The high level of efficiency of the industry sector of a district shows an increasing contribution of the manufacturing sector to the Gross Domestic Product (GDP) of the region/city. The following table shows the paired test results from the areas that are connected to the Cipularang Toll Road.

Table 4. The average efficiency level of industry connected to Cipularang toll road.

	before	after
Mean	0.34323856	0.382526388
Variance	0.00257327	0.00397535
Observations	5	5
Pearson Correlation	0.905868885	
Hypothesized Mean Difference	0	
Df	4	
t Stat	-3.199337556	
P(T<=t) one-tail	0.016460798	
t Critical one-tail	2.131846786	
P(T<=t) two-tail	0.032921595	
t Critical two-tail	2.776445105	

From the analysis result, it shows that:

- The Mean column on the Paired-Samples T-Test table shows the average difference value of the efficiency level in the manufacturing industry sector before and after the operation of the toll road.
- Pearson Correlation has a value of 0.905, this shows that the relationship is very tight.
- p value (p = 0.004) < alpha 5% (0,05) or by looking at the |t-calculated| > t-table hence the decision is to reject Ho.

6. Conclusion

In addition to connecting people to the center of activities, transportation also functions as a part of the logistics system. In a production process, the cost of the transportation is one component of the cost that affects the production cost of a commodity, where the high cost of transportation will affect the efficiency of the industry sector.

The analysis result shows a significant difference from the efficiency level of the industry sector from the connected areas compared to the areas that are not connected to the toll roads. Furthermore, the hypothesis test will be conducted for the regions that are connected with the toll roads.

The analysis is conducted by taking a sample from regions that are connected to the toll road (Cipularang Toll Road) to determine the impact from the operation of the Cipularang Toll Road to the industry sector (before and after the operation of the toll road). From the analysis result, it can be concluded that there is a significant difference to the level of efficiency of the industry sector once the operation of the Cipularang Toll Road has begun.

With the presence of the investment policy of the transportation infrastructure (toll road), it is expected to boost the performance of the production sector. In regional autonomy, this sometimes serves as the momentum to start the implementation process of local economic development policies.

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