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THE IMPACT OF ROAD NETWORK LINKAGES FOR REGION SECTORAL GROWTH IN JABODETABEK AREA[1]

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ABSTRACT

Transportation infrastructures serve as one of the preconditions to improve a regions' economy. Transportation infrastructure may influence regional economic growth as well as the regions surrounding it. The objective of the current study is to analyze the influence of these infrastructures towards economic activity growth (total units, workers, and sector production) of a region as well as the regions surrounding it. Analysis is also conducted towards a number of policies of which act as basis for decision making concerning transportation infrastructure development in a region.

The area of study consists of Jakarta, Bogor, Depok, Tangerang and Bekasi or commonly referred to as JABODETABEK area. Time series data is used from the period 1990- 2006, and encompassing 4 economic activities including trade, transportation, home-construction and industry. Together with the data model, estimations are made by using Two Stages Least Squares (2SLS) prediction methods. A simulation model is then subsequently used with the SIMNLIN procedure.

The results of the simulation demonstrate that toll infrastructure investments in each region generally elevate regional economic growth (PDRB) and its surroundings, except for Bekasi. Conversely, road investment policies generally reduce PDRB growth in a region. Moreover, the results of the simulation indicate that the impacts of toll development increases growth in the home-construction sector in almost all regions. Conversely, policies to increase road investments would reduce growth in the home-construction sector in all regions.

Keywords: *Transportation infrastructure, interregional linkages, economic growth and JABODETABEK area*

INTRODUCTION

The regions of Jakarta, Bogor, Depok, Tangerang and Bekasi are often called JABODETABEK area. Geografically these areas bordered one and other. The interrelation of bordered areas becomes more solid through roadnet transportation infrastructure that connected them.

According to the President Instruction (Inpres) number 13 th 1976 has become the basic frame of development of the Jakarta with its neighboring the regions. The Inpres says that Jakarta as the capital city will be developed to the neighboring regions which function as hinterland. The hinterlands are Bogor (include Depok), Tangerang and Bekasi.

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With the Inpres the goverment built the Jagorawi toll road as long as 46 km which was operated in 1978. This toll road connects Jakarta, Bogor and the neighboring regions. The Jagorawi toll road has played an important role in developing the economy of the neighboring regions, especially to increase the output of several sectors in West Java (Bogor Dalam Angka, 1983).

The building of the toll road continous until now, one of them opening the Cipularang toll road as long as 129 km in the year of 2005. This new road connect the Cikampek toll road to the Jakarta outer ring road (JORR) and become the alternative short cut from Jakarta to Bandung and return. The Cipularang toll road is very useful because it connect Jakarta to Bekasi and to all other cities in West Java.

The existence of the road made the capital city of West Java grow very fast, the economic growth of Bandung in year 2005 reach 7.8% bigger than previous year which is 7.5%. The Product Domestic Regional Bruto (PDRB) increase 25% from Rp 34.8 triliun to Rp 43.5 triliun. The absorption of employment (labor) increases 30% and the level of unemployment decreases 10.3%.

Observing the explanation above we can assume that the building of the road will develop the economic activities of a region, which later will affect the neighboring regions. On the contrary, the existence of the toll road will also bring disadvanteges for some regions. This happen to saveral net road, for example Jakarta-Bandung road through Puncak. Before the building of Cipularang toll road this road has a lot of activities such as resting places, restaurant, shops which sold all kinds of necessities. After the was opened (Jakarta-Bandung, Bandung-Jakarta), the activities in Puncak decrease, even saveral bussiness are closed and move other region. This happen especially at Cipanas resort, the decrease of omzet for people who sell food and other things reach until 30-70 percent. (Indonesian Hotel and Restaurant Assco-ciation, 2006).

The same thing happens with Purwakarta. In the past this city was crowded, because many people used this road to go to Bandung and back via Padalarang. Now the activities in this town becomes slow. This city is now called *"the retired city"*. The economic growth drastically goes down, hundred of bussinessman especially in the informal sectors (restaurant, ceramic, kiost and saveral gas station) and other bussiness are closed because they are now almost no buyers (Nurlaela Munir, 2006).

The same thing happens with Cianjur, the condition of this city is almost the same with Purwakarta. The development and the opening of the road (roadway, toll road, railway) can bring strong effect, both positive or negative.

From the explanation above, this is phenomenon at appeared from the strong infrastructure of the road and the networking of the regions which formed by the road. So it is neccessary to analyze how the road impact in one region could effect the economic growth of the region and also toward the other neighboring regions.

Therefore, the questions for this research are: *First* how the roads infrastructure could effect the economic activities of one region and also the neighboring regions. S*econd,* which road infrastructure policy, could give the most effect to sectoral and the economic growth for every region in Jakarta, Bogor, Tangerang and Bekasi or JABODETABEK area.

THEORITICAL FRAMEWORK

A general formulation of a production function for sector *i* in region *r*, with various types of infrastructure is:

$$Q_{ir} = f_{ir}(L_{ir}, K_{ir}; IA_r, ..., IN_r) \qquad (1)$$

where:

Q_{ir} = value added in sector *i,* region *r*
L_{ir} = employment in sector *i,* region *r*
K_{ir} = privat capital in sector *i,* region *r*
$IA_r,...,IN_r$ = infrastructure of various types in region *r*.

Among the types of infrastructure distinguished are: transport, communication, energy supply, water supply, education, health services, and so on.

To analyze the effect of road network infrastructure to sectoral productivity, approached by putting capital stock value from the highway and street in Cobb Douglas production function in the formed of log linier which should with the following equation (Boarnet,1995) :

$$\log (GCP_{it}) = \alpha_0 + \alpha_1 \log (L_{it}) + \alpha_2 \log (K_{it}) + \alpha_3 \log (H_{it}) + u_{it} \quad (2)$$

where:
GCP = *gross county (region) product*
L = labor input (*employment*) in the region
K = privat capital stock
H = highway and street capital stock
i, t = indexes region, and indexes time

The production function later on wided by putting the *highway* and *street* capital stock from the neighboring regions. There for we can see the effect of the road network infrastructure of the neighboring to the regions production the area. There for the function became:

$$\log (GCP_{it}) = \alpha_0 + \alpha_1 \log(L_{it}) + \alpha_2 \log(K_{it}) + \alpha_3 \log(H_{it}) + \alpha_4 \log(W*H_{it}) + u_{it} \quad (3)$$

where :
W = is a neighbor matrix with elements w_{ij} .
w_{ij} = 1 if region "i" and "j" are contiguous, 0 otherwise
w_{ij} = 0

The variable W*H is the firts -order spatial lag of *higway* and *street* capital. It is the sum of *higway* and *street* capital in all neighboring region. In keeping with the hyphothesis that highway plus street capital is productive largely by shifting the economic activity from one region to another, we expect α_3 to the significantly positive and to α_4 the significantly negative.

From equation of the above we can estimate the relation between the road network infrastructure with the sectoral production in one region with it neighboring regions.

EMPIRICAL ANALYSIS

The effect of road network *i* in one region to sector activity growth was made equation model, the model was adopted from production function was made by Boarnet. The equation was made to analyze the sector activity in a certain region, one sector consist of saveral activity equation: number of unit, the total number of man power, and certain sector activity production.

First, the structural equation the number of unit is the function of the road network infrastructure (roadway, toll road, railway) from one region and the neighboring regions and others variable which was considered relevant. Road invesment determined by the related road characteristic with the certain sector characteristic. *Second*, the identity equation of the total number of unit is the equation function of the whole number of units in certain sector in one region. *Third*, the structural equation of the sector activity production is the function of the total number of unit, the number of man power in the sector and other variable which was considered relevant. *Fourth,* the structural equation of the region is the function of all the sectors production in the region.

The Equation Model: number of unit, sectoral production and PDRB regions

The following is the general equation model for Jakarta, Bogor, Tangerang and Bekasi. The equation model was made to analyze the activity according to the number unit, total of number unit, number of man power, and the sector production. Determination of the road category was based on the road characteristic and the characteristic activities of certain sector.

The Equation of the Trade Activity Unit

$$UPKL = a_0 + a_1\,IRdW_i + a_2\,IHW_i + a_3\,ITR_i + a_4\,IRW_i + a_5\,TITR_j + a_6\,TITR_{ij} + a_7\,PDRB + a_8\,POPU + U_1 \quad (4)$$

$$UGR = b_0 + b_1\,IRdW_i + b_2\,IHW_i + b_3\,ITR_i + b_4\,IRW_i + b_5\,TITR_i + b_6\,TIT_i + b_7\,PDRB + b_8\,POPU + U_2 \quad (5)$$

$$UHTL = c_0 + c_1\,IRdW_i + c_2\,IHW_i + c_3\,ITR_i + c_4\,IRW_i + c_5\,TITR_i + c_6\,TITR_{ij} + c_7\,PDRB + c_8\,POPU + U_3. \quad (6)$$

$$TUDAG = UPKL + UGR + UHTL \quad (7)$$

$$TKDAG = d_0 + d_1\,UMR + d_2\,GDAG + d_3\,PDRB + d_4\,LTKDAG + U_4 \quad (8)$$

$$QDAG = e_0 + e_1\,TUDAG + e_2\,TKDAG + e_2\,KRDAG + U_5 \quad (9)$$

where:

UPKL = the number of 'pedagang kakilima' (PKL) in region i
UGR = the number of whole seller, ritailer in region i
UHTL = the number of hotel region in i
TUDAG = the total of number of trade region in i
TKDAG = number of man power in trade sectors in region i
QDAG = production of trade sector in region i
KRDAG = credit trade sectors in region i
GDAG = goverment expenditure for trade sector in region i
LTKDAG = lag the total number of man power in trade sector in region i
PDRB = product domestic regional bruto in region i
UMR = upah minimum regional (regional basic salaries)
POPU = population in region i
$IRdW_i$ = street (jalan kabupaten) invesment in region i
IHW_i = roadway (jalan negara) invesment in region i
ITR_i = toll road invesment in region i
IRW_i = railroad investment in region i
$TITR_i$ = total invesment in region i
$TITR_j$ = total investment neighboring regions j
$TITR_{ij}$ = total invesment the region i and neighboring regions j

The Equation of the Transportation Activity Unit

$$UTP = f_0 + f_1\,IRdW_i + f_2\,IHW_i + f_3\,ITR_i + f_4\,IRW_i + f_5\,TITR_i + f_6\,TITR_{ij} + f_7\,PDRB + f_8\,POPU + U_6 \quad (10)$$

$$UTRK = g_0 + g_1\,IRdW_i + g_2\,IHW_i + g_3\,ITR_i + g_4\,IRW_i + g_5\,TITR_i + g_6\,TITR_{ij} + g_7\,PDRB + g_8\,POPU + U_7. \quad (11)$$

$$TUANG = UTP + URK \quad (12)$$

$$TKANG = h_0 + h_1 UMR + h_2 GANG + h_3 PDRB + h_4 LTKANG + U_8 \quad (13)$$

$$QANG = i_0 + i_1 TUANG + i_2 TKANG + i_2 KRANG + U_9 \quad (14)$$

where:

UTP = the number of passenger vehicle in region i
UTRK = the number of trucks unit in region i
TUANG = the number of total unit of transportation sector in region i
TKANG = the number of man power of transportation sector in region i
QANG = production of transportation sector activity in region i
KRANG = credit of transportation sector in region i
GANG = goverment expenditure for transportation sector in region i
LTKANG = lag of number of man power of transportation sector in region i

The Equation of the House-Building Activity Unit

$$URUM = j_0 + j_1 IRdW_i + j_2 IHW_i + j_3 ITR_i + j_4 IRW_i + j_5 TITR_i + j_6 TITR_{ij} + j_7 PDRB + j_8 POPU + U_{10} \quad (15)$$

$$TKRUM = k_0 + k_1 UMR + k_2 GRUM + k_3 PDRB + k_4 LTKRUM + U_{11} \quad (16)$$

$$QRUM = l_0 + l_1 TURUM + l_2 TKRUM + l_2 KRRUM + U_{12} \quad (17)$$

where :

URUM = the number of house-building unit in region i
TKRUM = the number of man power of house-building sector in region ii
QRUM = production of house-building sector sector in region i
KRRUM = credit for house-building sector in region i
GRUM = goverment expenditure for house-building sector in region i
LTKRUM = lag of number of man power of house-building sector in region i

The Equation of Industrial Activity Unit

$$UIBM = m_0 + m_1 IRdW_i + m_2 IHW_i + m_3 ITR_i + m_4 IRW_i + m_5 TITR_i + m_6 TITR_{ij} + m_7 PDRB + m_8 POPU + U_{13} \quad (18)$$

$$UIKC = n_0 + n_1 IRdW_i + n_2 IHW_i + n_3 ITR_i + n_4 IRW_i + n_5 TITR_i + n_6 TITR_{ij} + n_7 PDRB + n_8 POPU + U_{14.} \quad (19)$$

$$TUIND = UTP + UTRK \quad (20)$$

$$TKIND = o_0 + o_1 UMR + o_2 GIND + o_3 PDRB + o_4 LTKIND + U_{15} \quad (21)$$

$$QIND = p_0 + p_1 TUIND + p_2 TKIND + p_3 KRIND + U_5 \quad (22)$$

where :

UIBM = number of Big-Medium industries unit in region i
UIKC = number of small industriesunit in region i
TUIND = total of number unit of industries activities in region i

TKIND = number of man power of industry sector activity in sector i
QIND = production of industries activities in region i
KRIND = credit for industries sector in regional sector in region i
GIND = goverment expenditure for industries sector in region i
LTKIND = lag of number of man power of industries sector in region i

IMPACT OF NETROAD FOR SECTORAL GROWTH

The netroad infrastructure policy is the policy made by the Central Government or the Local Goverment (Pemda), but it can also be made by both Central and Local Government as well as by Private Company (especially the toll road). These policies are made to increase the growth of the region through the development of netroad , tollroad and railway.

The netroad infrastructure variable is approached (proxy) by investment value, a certain amount of nominal value stated by rupiah (million rupiah) which is used as an expenditure to develop the netroad infrastructure. The policy will increase 10 percent every category of the netroad in certain region.

The Impact of Increasing the Tollroad Investment Policy.

The policy to increase the investment of tollroad in every injection region generally will increase the economic growth (PDRB) of Jakarta, Bogor and Tangerang. On the

Table 1. The Impact of Tollroad for Sectoral Growth in JABODETABEK Area

Impact Regoins	The Impact of the Jakarta Tollroad for Sectoral Growth (%)				PDRB
	Trade	Transportation	House-Building	Industry	
Jakarta	3.34	**23.14**	0.29	3.70	2.60
Bogor	**1.42**	1.03	- 0.42	1.04	0.85
Tangerang	0.57	0.89	**17.09**	0.88	1.45
Bekasi	- 0.34	0.51	**9.87**	2.33	0.54
	The Impact of the Bogor Tollroad for Sectoral Growth (%)				
Jakarta	0.91	**3.76**	0.08	1.69	0.71
Bogor	0.22	- 0.25	0.19	**1.14**	0.62
Tangerang	0.17	- 4.24	**15.62**	4.41	2.77
Bekasi	0.09	- 0.28	**14.51**	1.31	0.55
	The Impact of the Tangerang Tollroad for Sectoral Growth (%)				
Jakarta	0.96	**3.37**	0.08	1.78	0.75
Bogor	0.57	- 0.43	0.45	**2.92**	1.59
Tangerang	0.71	- 4.24	**15.57**	4.37	2.75
Bekasi	0.06	0.03	**9.62**	1.24	0.47
	The Impact of the Bekasi Tollroad for Sectoral Growth (%)				
Jakarta	- 0.85	**- 3.25**	- 0.04	- 0.39	- 0.39
Bogor	**- 3.08**	- 1.75	0.05	- 0.86	- 1.20
Tangerang	- 0.56	- 0.23	**- 3.62**	- 0.58	- 0.61
Bekasi	0.03	0.07	**- 4.70**	- 0.49	- 0.16

contrary, giving injection to Bekasi region will decrease the economic growth (PDRB) of all the regions including Bekasi itself.

According to Reitveld, the existence of netroad infrastructure which connects one region with another could increase or decrease the economic growth of the region. The changes of the growth either positive or negative begin by the changes on the number of activity unit. This could happen because the transportation cost (from the trade occurred among the regions) will be lower compared to the difference of input and output price among the regions. (Reitveld et al, 2001).

Therefore the low transportation cost become an incentive for the businessmen (producer) in the sector of trade, transportation, house and building, and industry to move (mobility) to the neighboring regions which have the relatively cheaper input price. Table 1 shows the recapitulation of the policy of every region as well as their impact to the changes of sectors growth percentage

The Impact of Increasing the Roadway Investment Policy.

The policy to increase the roadway investment (Jalan Kabupaten dan jalan Negara) in every region generally has a negative impact (decreasing) the growth of PDRB) in the impact region.

The largest contribution on decreasing the PDRB in the region comes from the production of sectors which have the largest negative percentage in forming the PDRB in its region. Table 2 shows the recapitulation of the policy of every region as well as their impact to the changes of sectors growth percentage.

From the analyses which was made concerning the impact, it is necessary to study

Table 2. The Impact of Roadway for Sectoral Growth in JABODETABEK Area

Impact Regions	The Impact of the Jakarta Roadway for Sectoral Growth (%)				PDRB Regions
	Trade	Transportation	House-Building	Industry	
Jakarta	- 0.99	**- 4.24**	- 0.06	- 0.65	- 0.55
Bogor	- 3.69	**- 4.37**	- 0.13	- 2.14	- 2.09
Tangerang	- 0.53	- 0.23	**- 3.39**	- 0.35	- 0.47
Bekasi	0.06	- 0.16	**- 1.38**	- 0.59	- 0.14
The Impact of the Bogor Roadway for Sectoral Growth (%)					
Jakarta	**0.56**	0.46	0.02	0.36	0.21
Bogor	- 0.35	**- 2.78**	- 0.01	- 0.19	- 0.28
Tangerang	- 0.14	**- 0.57**	- 0.03	0.51	0.18
Bekasi	0.01	- 0.03	**1.78**	0.24	0.09
The Impact of the Tangerang Roadway for Sectoral Growth (%)					
Jakarta	- 1.82	**- 3.82**	- 0.08	- 0.77	- 0.73
Bogor	**- 11.34**	- 8.40	- 0.25	- 5.83	- 5.85
Tangerang	- 2.09	- 1.38	**- 12.0**	- 0.68	- 1.49
Bekasi	0.17	- 0.47	**- 4.05**	- 0.92	- 0.20
The Impact of the Bekasi Roadway for Sectoral Growth (%)					
Jakarta	**- 1.26**	0.05	- 0.04	- 0.40	- 0.94
Bogor	**- 7.75**	- 4.01	- 0.17	- 3.98	- 5.56
Tangerang	- 1.39	- 0.57	**- 8.60**	- 0.86	- 1.67
Bekasi	0.09	- 0.30	**- 4.24**	- 0.54	- 0.29

more the theory of Reitveld which says that the development of netroad will make the transportation cost cheaper than the difference of input and the output price among the regions. Therefore the development of netroad infrastructure becomes the incentive for the businessmen (producer) to move (mobile) to the regions which have relatively cheaper input price. (Reitveld et al, 2001).

The movement or mobile activities could only occurred if there is an assumption that the government does not interfere too much in determining the location of various activity centers including trade sector, industrial sector as well as house and building sector (Christaller in Pacione, 2001).

A COMPARISON WITH THE RESULT OF THE PREVIOUS RESEARCH

The similar research has been made in some regions in Germany. The research was made on several netroad infrastructures (high-way). The result of the research explained that there is a positive effect to the output result by the increasing number of manufactured regions (Bundeslander). The analyses used Cobb-Douglas production function, translog production function and growth accounting approach. All the approaches proved that there is a significant effect on netroad infrastructure to productivity in manufacturing sector (Stephan, 1997).

The similar invention was found by Aschauer. He said that the core base of infra-structure, roadway, airport, mass transportation constitute a strength (power) which could explain the creation of productivity. The result of the research shows that there is a relationship between infrastructure investment with the economic growth with the elasticity about 0,34 – 0,39 (Aschauer, 1989). The same thing happened with the research made by Calderon in several countries in Latin America. The result of his research shows infrastructure elasticity value to PDRB per manpower is as follows: telephone 0,156, electricity 1,63, main road 0,178. (Calderon, 2002).

In relation with the negative impact to the growth of PDRB, Boarnet in his research also found that the effect of highway capital to the increasing of productivity of the economic activity in the intra region is positive, while to the nearest neighboring region the effect is negative. Table 3 shows is the summary of several researches about the impact of transportation infrastructure investment to the economic growth which was made in several regions or countries.

CONCLUSION

The result of the estimation shows there is a significant effect of the road networ*k* infrastructure invesment in the one area to the economic activity of the region and the neighboring regions.

The operasional of policy is done through simulation, that is by putting shock variables into the equation model. The policy is to increase the invesment of a certain road network in certain region and, or the combination of a certain regions or more.

The policy of the toll road network invesment generally produce positve impact to economic growth of the region. Especially this policy has the most significant impact to house-building sector.

On the contrary the policy of roadway (jalan kabupaten, jalan negara) generally decreases the economic growth of the region. Especially this policy has the most significant impact to housing-building sector.

The observation shows that the sector man power generally effected by UMR (minimum regional wages) and goverment expenditure for certain sector and PDRB. Generally UMR was related negatively the absorption of man power. While PDRB and goverment expenditures for certain sector was related positively. This mean that the absorption of man power sector is high.

Table 3. Result from Studies of the Impact of Transportation Infrastructure Invesment on Economic Growth

Study	Type of Model and data	Effect of transportation Invesment	Output elasticity of public capital
Aschauer (1991)	Production function growth model (data USA)	1. Total transport capital effect on growth of K_p/L	0.166
		2. Transit capital effect on growth of K_p/L	0.384
		3. Highway on growth of K_p/L	0.231
Garcia-Mila and McGuire (1992)	Production function (USA data from the 48 contigous states)	Elasticity of GSP respct to highway capital	0.04
Munnell (1990b)	Production function (USA data from the 48 contigous states)	Elasticity of GSP with respct to highway capital	0.06
McGuire (1992)	Production function (USA data from the 48 contigous states)	Elastisity of output with respect to highway capital	0.121 – 0.370
		Elastisity of output with respect to highway capital-controlling for state effect	0.121 – 0.127
Haughwout (1996)	2 SLS spatial equlibrium model (USA data from the 48 contigous states)	Elastisity of output with respect to highway capital	0.08
Azis (1990)	The development of JLS (Trans Sumatera) bring benefit for trade between the regions. It is more dominant than within the region. The model use is *Analytical Hierarchi Process* (AHP).		
Kimpraswil (2003)	The development of road in Trans North Sulawesi give contribution use *Computable General Equilibrium* (CGE).		

The suggestion policy which will be chosen should be base on the policy which give the most significant impact to sectoral development (both positive and negative). Especially to the negative impact, the central goverment or local goverment should pay attention in order to anticipate is carried out. The negative impact can be interpreted as the potential of the netroad. The potential is to mobilize the economic activity in and out of the region which is inherent in the netroad.

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