Journal of Indonesian Economy and Business
Volume 27, Number 3, 2012, 293 – 302

INFRASTRUCTURE IMPROVEMENT AND ITS IMPACTS ON THE INDONESIAN ECONOMIC PERFORMANCE[1][2]

Tony Irawan

Department of Economics
Faculty of Economics and Management – Bogor Agricultural University
(tonyirawan@ipb.ac.id)

Djoni Hartono

Graduate Program in Economics
Faculty of Economics and Business – University of Indonesia
(djoni.hartono@ui.ac.id)

Ferry Irawan

Fiscal Policy Office – the Ministry of Finance
(ferry.irawan@depkeu.go.id)

Arief Anshory Yusuf

Faculty of Economics – Padjadjaran University
(arief.yusuf@fe.unpad.ac.id)

ABSTRACT

Indonesian government shows their big commitment on the improvement of infrastructure which is reflected in some regulations and policies made. It is supported by many empirical evidences that show the importance of infrastructure improvement on the economic performance. This paper developed a Computable General Equilibrium (CGE) model to analyze the impacts of infrastructure on the Indonesian economy by introducing several types of infrastructure and discussing the impacts of it on the poverty level. The results suggest that improvement on any types of infrastructure is expected to increase the economic growth, raise the government revenue, raise the factors' income and reduce the poverty level. Improvement on the public work of agriculture, land transportation and telecommunication are still being preferable options comparing to others. Interestingly, even though the public work of agriculture is usually located in rural areas, the model suggests that the improvement on this sector will result higher impact on the urban household rather than to the rural household.

Keywords: *infrastructure, CGE, policy, poverty*

---

[1] This paper is funded by Fiscal Risk Management Center - Fiscal Policy Office of Indonesian Ministry of Finance. The views expressed in this paper do not represent the institution where the authors are affiliated.
[2] All data presented in this paper can be used under the writers' permission.

INTRODUCTION

Infrastructure has been one of the main focuses of Indonesian government nowadays. In 2006, government introduced the infrastructure improvement policy via the Decree of the Ministry of Finance No. 38/PMK.01/ 2006. Moreover, in order to minimize the impacts of global crisis to the national economy, Indonesian government implemented fiscal stimulus in which infrastructure stimulus is one of the programs.

Government believes that good infrastructure will support economic growth; and higher economic performance needs more infrastructures. Moreover, any project related to infrastructure mostly employs many people and then reduce unemployment rate. These arguments are not only a government's perspective but it has been confirmed by many empirical studies. Aschauer (1989) found that capital accumulation on public sector improved productivity of private sector in United States. His econometric model shows that basic infrastructure such as road, airport, mass rapid transportation system, water and drainage has positive and significant causal relationship to the productivity level.

The positive relationship between infrastructure and productivity is also supported by Bonaglia *et al*. (2000). Using Italian data, Bonaglia *et al*. (2000) found that infrastructure does not only affect productivity but also the output and cost reduction. In term of types, improvement on transportation will give higher impact on the output comparing to the other types of infrastructure. Canning (1999) used panel data of fifty-seven countries in 1960 – 1990 to analyze the impacts of infrastructure on output. The study supports previous findings that suggest the positive impacts of the infrastructure on output. In detail, Canning (1999) found that electricity and transportation have high marginal productivity level as much as capital and even higher in developed countries. Interestingly, the research also found that telecommunication has the highest marginal productivity level comparing to the other types of infrastructure which is quite different from Bonaglia *et al*. (2000) but much more similar to Sridar & Sridar (2004). Moreover, Sridar & Sridar (2004) emphasized that the impacts of telecommunication on economic performance will be much larger to developed countries than to developing countries.

Infrastructure is important to increase a country's competitiveness. Having used the Senegal Social Accounting Matrix (SAM) and employed a Computable General Equilibrium (CGE) model, Dumont and Somps (2000) found that infrastructure have positive impacts on manufacture sector performance, both output and competitiveness. However, the magnitude of the impacts would depend on the size of the effect of infrastructure on domestic price and wage. Furthermore, different source of fund for infrastructure improvement will also determine the magnitude of impacts on output and competitiveness. The variety of sources of fund then becomes the focus of Estache (2007). Using a CGE model, Estache (2007) found that foreign aid could possibly result the Dutch Disease Effect. Consequently, the positive impacts of the infrastructure that is funded by foreign aid will be smaller than other source of fund since the Dutch Disease Effect phenomena will deteriorate the growth effect.

Esfahani & Ramirez (2002) added one more variable –institution- that will determine the impacts of the infrastructure on the economic performance. Since the country has institutions[3] that have capability and credibility in supporting the improvement on infrastructure, the investment will boost up and then result higher output growth.

Up to now, literatures analyzing the impacts of the infrastructure on the Indonesian economic performance are very limited. One of the studies on infrastructure was Parikesit

[3] In the study, institution is referred to government.

(2004) that analyses the impacts of road infrastructure investment on the economic and regional development. Parikesit (2004) employed a CGE model using Vehicle Operation Cost (VOC) as input indicators; while economic growth, investment benefit ratio, and labor force absorption as output indicators in the database. The study reveals that road investment in Java will have larger impact to economic growth than to other regions.

In conclusion, all the literatures above suggest that infrastructure has important role in creating better economic performance. However, the types of infrastructure that are needed to focus on as priority – due to its large impacts on the economy – will depend on the country itself. Setting priority will be important if the country does not have large flexibility on their budget which commonly happened in developing countries such as Indonesia. In this paper, a CGE model is developed to analyze the impacts of infrastructure on the Indonesian economic performance by introducing several types of infrastructure. It is expected that the model could give valuable information to the policy makers in setting the priority of infrastructure development; since the model could measure the impacts of particular types of infrastructure development on the Indonesian economy. Moreover, the CGE model is completed by the poverty module to measure the impacts of infrastructure improvement on the poverty level.

The paper is started by the introduction on the section one. Section two presents the CGE model. Section three details the structure of the database and simulations. Section 4 conveys the results and discussions. Finally, conclusions are drawn in section five.

CGE MODEL

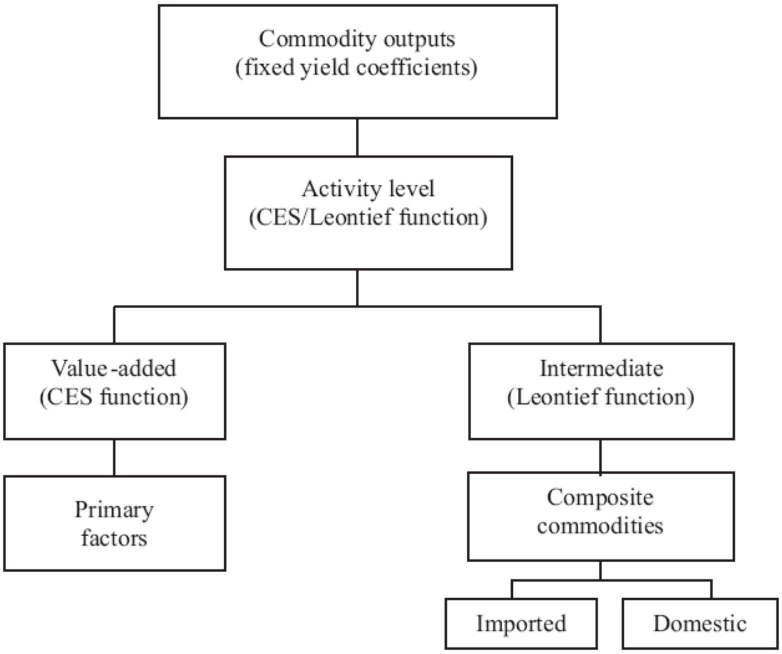
The origin of the CGE model developed in this paper was the standard model constructed by Lofgren *et al*. (2002). The standard model is designed for developing countries and has some basic features. The model has included consumption of non-tradable commodities, specification of transaction cost, and two different accounts for activities and commodities. The last feature is to analyse any production activity that produces multiple commodities and vice versa. In order to improve the standard model, a poverty module that links the CGE result with modified household data is included.

The concepts of the standard model that are used in this study will be briefly shown as follow. First, the production block. In this block, it is assumed that producer who is represented by the activities will maximize their profit subject to production technology. In this model, production functions are assumed to be Nested Constant Elasticity of Substitution (CES) over composite commodity. At the top nesting, Output is defined as CES function or Leontief function of Intermediate Input and Value Added. In the second level, intermediate input is a function of imported and domestic commodities which are used in the fixed proportion (Leontief function) and value added is a CES function of primary factors (see figure 1). Total output that is produced by each activity (sector) is defined as:

$$QA_a = ad_a.\left(\sum_{f\in F}\delta_{fa}^{a}.QF_{fa}^{-\rho_a^a}\right)^{\frac{1}{\rho_a^a}} \qquad (1)$$

where QA_a represents quantity of activity; ad_a is efficiency parameter in the CES production function; δ_{fa}^{a} is CES production function share parameter for factor f in activity a; QF_{fa} is quantity demanded of factor f from activity a; and ρ_a^a represents CES production function exponent. As previously mentioned, the model used Leontief function in order to capture the demand for intermediate input, hence:

$$QINT_{ca} = ica_{ca}.QA_a \qquad (2)$$



Source: Lofgrean *et al.,* (2002)

Figure 1. Functions in Supply Block

where $QINT_{ca}$ is quantity of commodity c as intermediate input to activity a; and ica_{ca} is intermediate input coefficient.

Second, the factor income block. In this block each activity will use the combination of the factors up to the point where marginal revenue is equal to its factors' price. The factors might be different across production activities due to the segmentation of market and the factors' mobility. There are some options of factors market closure that can be chosen – depend on the needs of the analysis. This model follows the default closure in which supply of factors and activity-specific wage are assumed fixed.

Third, the consumption block. In this block institution is defined as households, enterprises, government and rest of the world. The type of households that are used in the model follows the Indonesian SAM disaggregation. The households earn income from the production factors and transfer from other institutions. Then, the household use their income for consumption purposes, paying taxes, saving and transferring to other institutions, hence:

$$EH_h = \left(1 - \sum_{i \in ID} shrtr_{ih}\right)(1 - MPS_h) \times \left(1 - \overline{TY}_h\right)\left(YI_h - EXR.\overline{tr}_{rowh}\right) \quad (3)$$

where EH_h represents consumption spending for households; $shrtr_{ih}$ is share of domestic institution i in income of household h; MPS_h is marginal propensity to save for household; $\overline{TY}_h$ is direct tax rate for household h; YI_h is income of household; EXR is exchange rate; and $\overline{tr}_{rowh}$ is transfer from household h to rest of the world. The households consume both domestic and imported commodities following the Linear Expenditure System (LES) demand functions. It is assumed that there is no consumption by enterprises that allocate their income to pay taxes, save and transfer to other institutions. Meanwhile, the government uses their income from taxes and transfer to consume commodities and to other institutions.

THE STRUCTURE OF DATABASE AND SIMULATIONS

This paper applied the Indonesian Social Accounting Matrix (SAM) 2005 as a database of the CGE model. Technically, all the equations in the CGE model were formulated in order to model all the data in SAM table based on economic theories. Then, by using additional information such as elasticity, CGE model could reproduce SAM table. In line with the structure of Indonesian SAM 2005, the model contains twenty-four sectors which are defined as activities/commodities. Seventeen categories of production factors introduced: non labor (including land and capital) and the eight categories of labor (formal and informal agricultural worker; formal and informal manual worker; formal and informal clerical worker; and formal and informal professional worker) for both rural and urban. Moreover, the model also contains twelve categories of institution, i.e. enterprise, government and ten types of households[4].

In general, SAM disaggregation does not specifically define the infrastructure sectors. Almost all infrastructures (i.e. road, public work of agriculture/irrigation, port, etc) are included in the construction sectors along with various services supporting the sectors. Among the twenty-four sectors, four sectors are chosen to represent the infrastructure. Those sectors are electricity, gas and drinking water sector, construction sector, land-transportation sector, and water, air transportation and communication sector. The infrastructure improvement cannot be defined as the increasing of infrastructure related sector output – for instance land transportation sector – because the value of output in SAM table does not necessarily mean the length of the road or quality of the road which is the best measurement of infrastructure. Basically, the value of output in SAM table means the total value of land transportation services – that are not only determined by the length of the road but also the quantity of vehicles operated. Due to those limitations, the infrastructure improvement is defined as higher productivity, reduction in transport cost, and larger capital stock. Why productivity, transport cost and capital stock? Take a re-look at the findings by Aschauer (1989), Bonaglia *et al*. (2000), and Canning (1999). Empirically, improvement on particular infrastructure will impact positively on the productivity and reduce the transport cost. Moreover, Warr *et al.* (2009) also used shock on the transport cost to represent the infrastructure improvement on the CGE model for Thailand and Lao PDR. Aschauer (1989) shows that improvement on the infrastructure can be represented by the increasing of public capital stock by using a modified Cobb Douglas production function. Public capital stock is a part of total capital stock that exogenously will determine the level of output.

There are seven simulations that can be categorized into three groups in this study, i.e. productivity shock, transport cost shock, and capital stock shock. The magnitude of shocks on those three groups was intentionally chosen by the researcher based on personal judgment after some discussions and considering previous literatures. Those simulations are (1) improvement on land transportation infrastructure–represented by the increasing of productivity in land transportation sector by five percents; (2) improvement on water and air transportation infrastructure–represented by the increasing of productivity in water and air transportation sector by five percents; (3) improvement on public work of agriculture–represented by the increasing of productivity in agricultural sector productivity by five per-

[4] For detail definition see Hartono & Resosudarmo (2008).

cents; (4) improvement on land transportation infrastructure–represented by the reduction in transport cost of land transportation sector by twenty-five percents; (5) improvement on water and air transportation infrastructure–represented by the reduction in transport cost of water and air transportation sector by twenty-five percents; (6) improvement on electricity infrastructure–represented by the increasing of capital stock in electricity sector by five percents; and (7) improvement on communication infrastructure–represented by the increasing of capital stock in water and air transportation sector by five percents.

RESULTS AND DISCUSSION

Before analyzing the results of simulations, it is important to note that the simulations in this paper can be categorized into 3 groups, i.e. productivity, transport cost, and capital stock. Therefore, the differences between the simulations result across groups will be incomparable. In the first group of the simulations–infrastructure improvement is represented in higher productivity–improvement on public work of agriculture is expected to impact positively on the national output than the improvement on any type of transportation infrastructure. It is expected that investing more money in public work of agriculture by five percents will increase output approximately 0.7 percent. Moreover, improvement on public work of agriculture is expected to result higher impacts to the government income than to other options. Theoretically, better infrastructure will increase productivity which, then, will raise output. As a result, the government income that is collected from taxes will increase as well. The result strongly supported the current Indonesian government policy on infrastructure. Based on the National Summit 2009, Indonesian government will focus on the development of types of infrastructure that are not commercially viable but economically feasible. Public work of agriculture is one of the types of infrastructure that is not commercially viable but significantly needed by many people especially farmers and has significant impacts on the economy.

In the second group of simulations, infrastructure improvement that is represented by the decreasing of transport cost, the highest impacts on national output and the government income is resulted from infrastructure improvement on land transportation. Land transportation plays important role in the Indonesian economy, especially in the West Indonesia (Java and Sumatera). The distribution of nine basic commodities in the West Indonesia is significantly depending on the land transportation relative to air or water transportation.

Below is the comparison on the results of the infrastructure improvement that is represented by the increasing of capital accumulation. There are two scenarios defined: by increasing capital on electricity sector and telecommunication sector. Figure 2 suggests that infrastructure improvement on the communication sector is expected to result higher economic growth and increase government income than the improvement on electricity sector. The result is reasonable since the publication data shows that the number of mobile phone users increased significantly and even reached nearly half of total population in 2009. Moreover, internet users also increased substantially by more than 40% than to the previous year[5].

Here is the analysis on the impacts of infrastructure on the factors' income. Generally, most simulations will impact positively on the factors' income (see Figure 3). In the first group of simulations, infrastructure improvement on public work of agriculture is expected will result larger positive impacts on factors' income comparing to other scenarios; except for informal agricultural worker. Since it is assumed that the improvement on public work

[5] Based on Association of Internet Services Providers Indonesia (APJII).

of agriculture will result higher productivity on agricultural sector, farmers become more efficient on its production process. Thus, farmers will need less informal agricultural workers. Figure 3 shows that better public work of agriculture will not only affect workers who are involved in the agricultural sector but also give positive and even larger impacts to the non-agricultural workers. These findings imply that the improvement on public work of agriculture will result larger benefit to the off-farm workers (manual, clerical, and professional workers) than to the on-farm workers (agricultural workers).

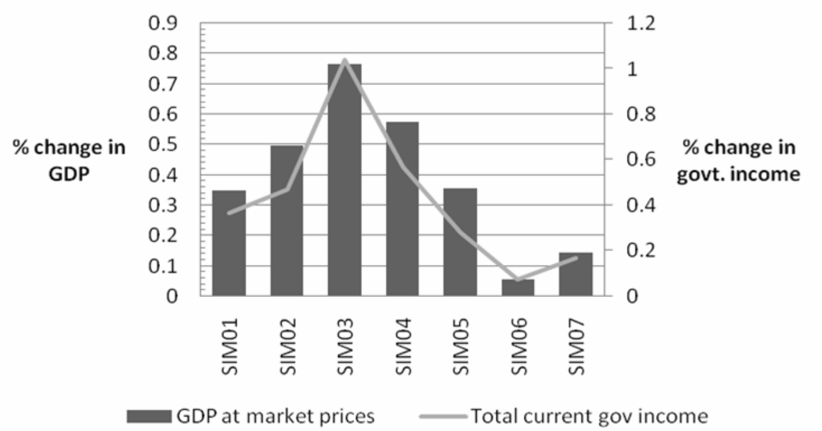


Figure 2. The Impacts on the Macro Economic Indicators

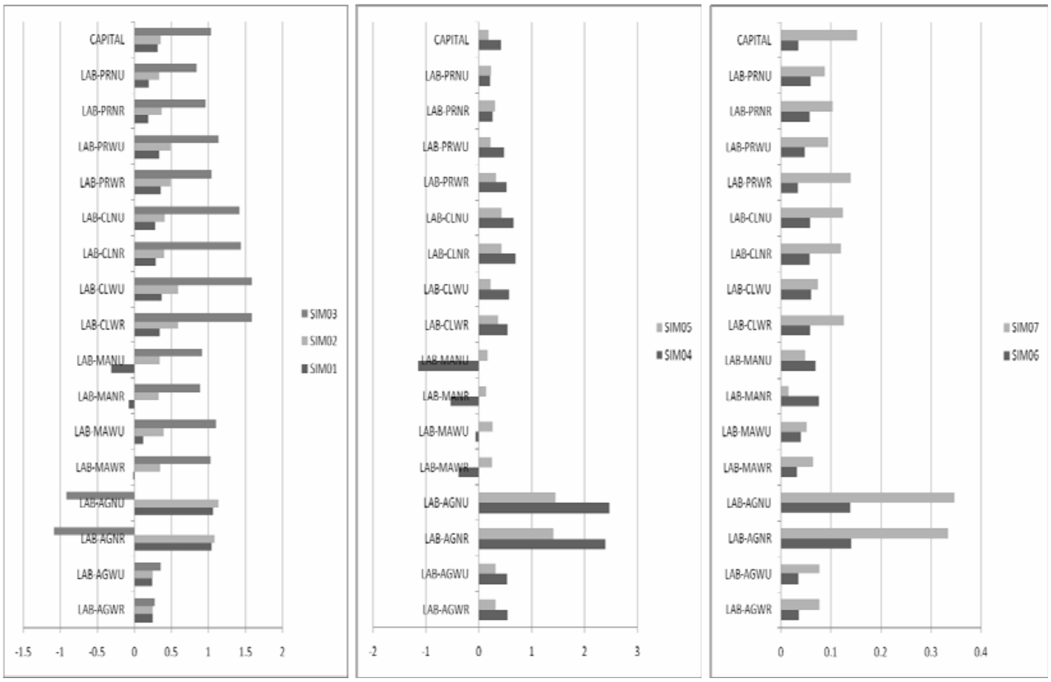


Figure 3. The Impacts on the Factors' Income (Percentage Change)

In terms of transport cost reduction, infrastructure improvement on land transportation will result bigger positive impacts on the factors' income than the improvement on water and air transportation. However, improvement on land transportation will impact negatively on the income of manual workers.

In the third group of simulations, infrastructure improvement on both electricity sector and telecommunication sector will impact positively on the factors' income. However the impact is very small in magnitude. It is expected that the increasing of capital by five percents will increase factors income by less than 0.4 percent for each category of factors.

Table 1 shows the impacts of infrastructure improvement on household's income. In general, the improvement on public work of agriculture, land transportation and telecommunication are still being preferable options within its group of simulations. Interestingly, even though public work of agriculture usually is located in rural areas, but the model suggests that the improvement on public work of agriculture will result higher impact to the urban household than to the rural household. As being mentioned before, the improvement on public work of agriculture is expected will give more advantages to the off-farm workers than to the on-farm ones. As a result, urban household will receive more benefit than the others.

The infrastructure improvement on land transportation is expected will impact larger to the agricultural farmers (small, medium, and large farmer) than to the other households. These might be due to the high dependency of agricultural farmers on land transportation to distribute their crops. Lower transport cost due to better infrastructure on land transportation will increase profit that will be accepted by agricultural farmers.

One of the strengths of the model that is used in this paper is the ability to measure poverty impacts due to the infrastructure improvement. Generally, improvement on any types of infrastructure that are measured in productivity, transport cost and even capital accumulation is expected to reduce poverty level on all types of households. Note that poverty level for large farmers and urban high income should be zero. Again, the improvement on public work of agriculture, land transportation and telecommunication are still preferable options within its group of simulation (see Table 2).

Table 1. The Impacts on the Households' Income (percentage change)

Type of Households	SIM01	SIM02	SIM03	SIM04	SIM05	SIM06	SIM07
Agricultural Employee	0.274	0.365	0.585	0.481	0.309	0.043	0.095
Small Farmer	0.471	0.584	0.315	0.935	0.586	0.072	0.162
Medium Farmer	0.449	0.580	0.545	0.834	0.545	0.068	0.162
Large Farmer	0.517	0.627	0.631	0.967	0.552	0.073	0.193
Rural Low Income	0.251	0.421	0.952	0.363	0.346	0.049	0.122
Rural Non-labour	0.350	0.498	0.523	0.594	0.459	0.064	0.144
Rural High Income	0.430	0.571	0.789	0.774	0.494	0.067	0.176
Urban Low Income	0.211	0.440	1.157	0.191	0.263	0.049	0.096
Urban Non-labour	0.322	0.509	1.274	0.478	0.312	0.054	0.122
Urban High Income	0.340	0.513	1.313	0.548	0.316	0.057	0.132

Table 2. The Impacts on the Poverty Level (percentage change)

Type of Households	SIM01	SIM02	SIM03	SIM04	SIM05	SIM06	SIM07
Agricultural Employee	-0.039	-0.028	-0.135	-0.062	-0.031	-0.003	-0.008
Small Farmer	-0.139	-0.121	-0.282	-0.239	-0.133	-0.017	-0.036
Medium Farmer	-0.038	-0.035	-0.086	-0.061	-0.035	-0.005	-0.010
Large Farmer	0	0	0	0	0	0	0
Rural Low Income	-0.177	-0.237	-0.614	-0.289	-0.205	-0.028	-0.075
Rural Non-labour	-0.213	-0.240	-0.428	-0.366	-0.230	-0.036	-0.076
Rural High Income	-0.331	-0.405	-0.552	-0.507	-0.373	-0.054	-0.140
Urban Low Income	-0.385	-1.017	-1.539	-0.579	-0.432	-0.076	-0.168
Urban Non-labour	-0.733	-0.814	-1.309	-0.921	-0.743	-0.114	-0.318
Urban High Income	0	0	0	0	0	0	0

CONCLUSION

This paper, using a CGE model and SAM data for Indonesia, has elaborated a comprehensive analysis on the impacts of infrastructure on the Indonesian economy. In addition, this paper also analyzes the link between infrastructures and the poverty. This study is expected to provide valuable information for policy makers to set priorities of the infrastructure development since the model could measure the impacts of particular types of infrastructure development on the Indonesian economy.

It should be noted that the study has weaknesses in terms of defining the sectors, as seen in the electricity sector and telecommunications. However, it is worth noting that only a few scholars and researchers have used the CGE model to discuss infrastructure issues in Indonesia. In general, the CGE model suggests that improvement on any types of infrastructure is expected to result higher economic growth, higher government revenue, and higher factors' income; meanwhile reduce the poverty level. By carefully taking into the account weaknesses of the model, some specific conclusions that can be drawn are as follows. First, if higher productivity is used as a proxy of better infrastructure, the improvement on public work of agriculture will be more economically preferable than the other options. Second, if infrastructure improvement is represented as lower transport cost, the improvement on land transportation infrastructure will result higher positive impacts relative to the improvement on water and air transportation. Third, if improvement of infrastructure is represented by the increasing of capital stock, investment in telecommunication sector is expected to result higher economic impacts than allocating more budget on the electricity sector.

REFERENCES

Annala, C.N., R.G. Batina, and J.P. Feehan, 2008. "Empirical Impact of Public Infrastructure on the Japanese Economy". *The Japanese Economic Review*, 59 (4), 419-437.

Aschauer, D. A., 1989. "Is Public Expenditure Productive?". *Journal of Monetary Economics*, 23, 177-200.

Bonaglia, F., Eliana. L., and Marcellino, M. 2000. "Public Capital and Economic Performance: Evidence from Italy". Mimeo, Bocconi University.

Canning, D., 1999. "Infrastructure's Contribution to Aggregate Output". *Policy Re-*

search Working Paper, World Bank, No. 2246.

Canning, D., and P. Pedroni, 1999. "Infrastructure and Long Run Economic Growth". *Presented in North American Summer Meetings of the Econometric Society Conference*.

Dumont, J.C., and S. Mesple, 2000. "The Impact of Public Infrastructure on Competitiveness and Growth: A CGE Analysis Applied to Senegal". *Working Paper*. University of Laval, Quebec.

Esfahani, H.S., and M.T. Ramirez, 2003. "Institutions, Infrastructure, and Economic Growth". *Journal of Development Economics*, 70, 443-477.

Estache, A., J.F. Perrault, dan L. Savard, 2007. "Impact of Infrastructure Spending in Mali: A CGE Modelling Approach". *Working Paper*, University of Sherbroke, No. 07-24.

Hartono, D., and B. P. Resosudarmo, 2008. "The Economy-wide Impact of Controlling Energy Consumption in Indonesia: An Analysis Using a Social Accounting Matrix Framework". *Energy Policy*, April 2008, 36(4), 1404-1419.

Lofgren, H., R. L. Harris, and S. Robinson, 2002. "A Standard Computable General Equilibrium (CGE) Model in GAMS". The International Food Policy Research Institute.

Perikesit, D., H. Purwanto, A. Wismadi, and D. Ardianta, 2004. "Assessing the Impacts of Road Infrastructure Investment on Economic and Regional Development". *Presented in the 6th IRSA International Conference*, Yogyakarta, 13-14 August 2004.

Sridhar, K.S., and V. Sridhar, 2004. "Telecommunications Infrastructure and Economic Growth: Evidence from Developing Countries". *Working Paper*. National Institute of Public Finance and Policy, New Delhi.

Warr, P., J. Menon, and A.A. Yusuf, 2009. "Regional Economic Impacts of Cross-Border Infrastructure: A General Equilibrium Application to Thailand and Lao PDR". *ADB Working Paper Series on Regional Economic Integration*, No. 35. ADB.