

Working Paper
in Economics and
Development Studies



Department of Economics
Padjadjaran University

No. 201008

Infrastructure Improvement and Its Impact on Indonesian Economic Performance

Djoni Hartono¹

Tony Irawan²

Ferry Irawan³

¹ Graduate Program in Economics, Faculty of
Economics and Business, University of Indonesia

² Department of Economics, Faculty of Economics
and Management, Bogor Agricultural University;
InterCAFE-LPPM, IPB

³ Fiscal Policy Office – Ministry of Finance

December, 2010

Center for Economics and Development Studies,
Department of Economics, Padjadjaran University
Jalan Cimandiri no. 6, Bandung, Indonesia.

Phone/Fax: +62-22-4204510

<http://www.lp3e-unpad.org>

For more titles on this series, visit:

<http://econpapers.repec.org/paper/unpwpaper/>

Infrastructure Improvement and Its Impact on Indonesian Economic Performance¹²

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

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

Ferry Irawan
Fiscal Policy Office – Ministry of Finance
ferry.irawan@depkeu.go.id

Abstract

Indonesian government shows big commitment on the improvement of infrastructure which is reflected in some regulations and policies. It is supported by many empirical evidences that show the importance of infrastructure improvement on economic performance. In this paper, we develop a CGE model to analyze the impact of infrastructure on Indonesian economy by introducing several types of infrastructure and also discuss the impact of infrastructure on the poverty level. The results suggest that improvement on any types of infrastructure is expected will increase economic growth, raise government revenue, raise factor's income and reduce the poverty level. Improvement on public work of agriculture, land transportation and telecommunication are still preferable option relative to others. Interestingly, even though public work of agriculture usually is located in rural areas, but the model suggest that public work of agriculture improvement will result higher impact on urban household relative to rural household.

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 Correspondent address: Djoni Hartono, Graduate Program in Economics, Faculty of Economics and Business - University of Indonesia, Depok, West Java – Indonesia. Email: djoni.hartono@ui.ac.id or djoni.hartono@gmail.com and Fax Number: +62 21 788 49 154

1. INTRODUCTION

Infrastructure has been one of the main focuses of Indonesian government nowadays. In 2006, government introduced infrastructure improvement policy via The Decree of the Ministry of Finance No. 38/PMK.01/2006. Moreover, in order to minimize the impact of global crisis to 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 will needs more infrastructures. Moreover, any project that 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 on productivity level.

The positive relationship between infrastructure and productivity is also supported by Bonaglia et al. (2000). By using Italian data, Bonaglia et al. (2000) found that infrastructure is not only affect productivity but also output and cost reduction. In term of types, improvement on transportation will give higher impact on output relative to other types of infrastructure. Canning (1999) used panel data of 57 countries in 1960 – 1990 to analyze the impact of infrastructure on output. The study support previous findings that suggest the positive impact of infrastructure on output. On more detail analysis, Canning (1999) found that electricity and transportation has 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 relative to other types of infrastructure which is quite different with Bonaglia et al. (2000) but much more similar with Sridar and Sridar (2004). Moreover, Sridar and Sridar (2004) emphasized that the impact of telecommunication on economic performance will be much larger for developed countries relative to developing countries.

Infrastructure is important to increase country's competitiveness. Dumont and Soms (2000) did a research using Senegal Social Accounting Matrix (SAM) and employed a Computable General Equilibrium (CGE) model. The study found that infrastructure have positive impact on manufacture sector performance, both output and competitiveness. However, the magnitude of the impact would depend on the size of effect of infrastructure on domestic price and wage. Furthermore, different source of fund for infrastructure improvement will also determine the magnitude of impact on output and competitiveness. The variety of sources of fund then becomes the focus of Estache (2007). By using a CGE model, Estache (2007) found that foreign aid could possibly result the Dutch Disease Effect. Consequently, the positive impact of 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 and Ramirez (2002) added one more variable –institution- that will determine the impact of infrastructure on economic performance. Since the country has institution³ that has capability and credibility in supporting improvement on infrastructure, the investment will boost up and then result higher output growth.

Up to now, literatures that analyze the impact of infrastructure on Indonesian economic performance are very limited. One of the studies on infrastructure was Parikesit (2004) that analyses the impacts of road infrastructure investment on economic and regional

³ in the study, institution is refer to government

development. Parikesit (2004) employ a CGE model in which using Vehicle Operation Cost (VOC) as input indicators, and 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 relative to other regions.

To sum up, all literatures that are presented previously support that infrastructure has important role in creating better economic performance. However, type of infrastructure that we need to focus on as first priority due to its large impact on economy will depend on the country itself. Choosing priority will be important if the country do not have large flexibility to finance their budget which is commonly happened in developing country such as Indonesia. In this paper, we will develop a CGE model to analyze the impact of infrastructure on Indonesian economic performance by introducing several types of infrastructure. Thus, it is expected that the model could give valuable information for policy makers to choose priority of infrastructure development since the model could measure the impact of particular types of infrastructure development on Indonesian economy. Moreover, we will also complete the CGE model with poverty module which will allow us to measure the impact of infrastructure improvement on the poverty level.

The paper is structured as follows. After the introduction, Section II presents CGE model. Section III details structure of database and simulations. Section IV presents results and discussions. Finally, conclusions are finally drawn in Section V.

2. 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 will allow us to analyse any production activity that produce multiple commodities and vice a versa. In order to improve the standard model, we include poverty module that link the CGE result with modified household data.

Next, we will briefly show the concepts of the standard model that are used in this study. First, the production block. In this block we assume that producer who is represented by activity 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).

Second, the factor income block. In this block each activity will use combination of factors up to the point where marginal revenue is equal to its factor's price. The factor might be different across production activities due to segmentation of market and factor mobility. There are some options of factor market closure that can be chosen depend on the needs of the analysis. In this model we follow 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. 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 transfer to other institutions. 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 and enterprises allocate their income to pay taxes, saving and transfer to other institutions. Meanwhile, government uses their income from taxes and transfer to consume commodities and transfer to other institutions.

3. STRUCTURE OF DATABASE AND SIMULATIONS

In this paper, we use Indonesian Social Accounting Matrix (SAM) 2005 as a database of the CGE model. In line with the structure of Indonesian SAM 2005, the model contains 24 sectors which are defined as activities/commodities. Seventeen categories of production factors introduced: non labor (including land and capital) and 8 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 12 categories of institution, i.e. enterprise, government and 10 types of households⁴.

In general, SAM disaggregation do not specifically define infrastructure sector. Almost all infrastructures (i.e. road, public work of agriculture/irrigation, port, etc) are included in the construction sector along with various services that support the sector. Thus, among 24 sectors, we have only 4 sectors that represent infrastructure. Those sectors are electricity, gas and drinking water sector, construction sector, land transportation sector, and water, air transportation and communication sector. Here, we cannot define infrastructure improvement as the increasing of infrastructure related sector output -for instance land transportation

⁴ For detail definition see Hartono and Resosudarmo (2008)

sector- because the value of output in SAM table is not necessarily means 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 total value of land transportation services that are not only determined by length of the road but also the quantity of vehicles that are operated. Due to those limitations, infrastructure improvement is defined as higher productivity, reduction in transport cost, and larger capital stock. Why productivity, transport cost and capital stock? Let us take a re-look at findings by Aschauer (1989), Bonaglia et al. (2000), and Canning (1999). Empirically, improvement on particular infrastructure will have positive impact on the productivity and reduce the transport cost. Moreover, Warr et al. (2009) also use shock on transport cost to represent the infrastructure improvement on CGE model for Thailand and Lao PDR. Aschauer (1989) shows that improvement on infrastructure can be represented by the increasing of public capital stock by using a modified Cobb Douglas production function. Public capital stock is part of total capital stock that exogenously will determine level of output.

In this study, we run seven simulations that can be categorized into 3 groups, i.e. productivity shock, transport cost shock, and capital stock shock. Those simulations are (1) improvement on land transportation infrastructure that is represented by the increasing of productivity in land transportation sector by 5 percent; (2) improvement on water and air transportation infrastructure that is represented by the increasing of productivity in water and air transportation sector by 5 percent; (3) improvement on public work of agriculture that is represented by the increasing of productivity in agricultural sector productivity by 5 percent; (4) improvement on land transportation infrastructure that is represented by the reduction in transport cost of land transportation sector by 25 percent; (5) improvement on water and air

transportation infrastructure that is represented by the reduction in transport cost of water and air transportation sector by 25 percent; (6) improvement on electricity infrastructure that is represented by the increasing of capital stock in electricity sector by 5 percent; and (7) improvement on communication infrastructure that is represented by the increasing of capital stock in water and air transportation sector by 5 percent.

4. RESULTS AND DISCUSSION

Before we analyze the results of simulations, it is important to note that simulations in this paper can be categorized into 3 groups, i.e. productivity, transport cost, and capital stock. Therefore, differences between simulation results across groups will be incomparable. In the first group of simulation –infrastructure improvement is represented in higher productivity– improvement on public work of agriculture is expected would give the largest positive impact on national output relative to improvement on any type of transportation infrastructure. It is expected that investing more money in public work of agriculture by 5 percent will increase output approximately 0.7 percent. Moreover, improvement on public work of agriculture is expected will result highest impact on government income relative to other options. Theoretically, better infrastructure will increase productivity, and then will raise output. As a result, government income that is collected from taxes will increase as well. The result is strongly support the current Indonesian government policy on infrastructure. Based on 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 type of infrastructure that is not commercially viable

but significantly needed by many people especially farmers and has significant impact on the economy.

In the second group of simulation, infrastructure improvement that is represented as the decreasing of transport cost, highest impact on national output and 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 land transportation relative to air or water transportation.

Next, we will compare the result of infrastructure improvement that is represented by the increasing of capital accumulation. Here, we define two scenarios, i.e. by increasing capital on electricity sector and telecommunication sector. Figure 2 suggests that infrastructure improvement on communication sector is expected will result higher economic growth and government income relative to improvement on electricity sector. The result is reasonable since the publication data shows that number of mobile phone user increase significantly and even reached nearly half of total population in 2009. Moreover, internet user also increased substantially by more than 40% relative to previous year⁵.

Next, we will analyze the impact of infrastructure on factor's income. Generally, most simulations will result positive impact on factor's income (see Figure 3). In the first group of simulation, infrastructure improvement on public work of agriculture is expected will result larger positive impact on factor's income relative to other scenarios except for informal agricultural worker. Since we assume that the improvement on public work of agriculture will result higher productivity on agricultural sector, farmer become more efficient on its

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

production process. Thus, farmer will need less informal agricultural worker. Figure 3 shows that better public work of agriculture will not only affect workers who are involved in agricultural sector but also has positive and even larger impact on non-agricultural worker. These findings imply that improvement on public work of agriculture will result larger benefit for off-farm workers (manual, clerical, and professional workers) relative to on-farm workers (agricultural workers).

In terms of transport cost reduction, infrastructure improvement on land transportation will result bigger positive impact on factor's income relative to improvement on water and air transportation. However, improvement on land transportation will result negative impact on income of manual workers.

In the third group of simulation, infrastructure improvement on both electricity sector and telecommunication sector will result positive impact on factor's income. However the impact is very small in magnitude. It is expected that the increasing of capital by 5 percent will increase factor's income by less than 0.4 percent for each category of factors.

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

Infrastructure improvement on land transportation is expected will result larger impact on agricultural farmer (small, medium, and large farmer) relative to other households. These might be due to the high dependency of agricultural farmer 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 farmer.

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

5. CONCLUSION

This paper, using a CGE model and SAM data for Indonesia, has elaborated a comprehensive analysis of the impact of infrastructure on the Indonesian economy. In addition, this paper also analyzes the link between infrastructures with poverty. This study is expected to provide valuable information for policy makers to choose priority of infrastructure development since the model could measure the impact of particular types of infrastructure development on 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 will result higher economic growth, higher government revenue, higher factor's income and reduce the poverty level. By carefully taking into account weaknesses of the model, some of specific conclusions that can be drawn are as follows. First, if higher productivity is used as a proxy of better infrastructure, improvement on public work of agriculture will be more economically preferable relative to other options. Second, if infrastructure improvement is represented as lower transport cost, improvement on land transportation infrastructure will result higher positive impact relative to 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 will result higher economic impact than putting more money on electricity sector.

REFERENCES

- Annala, C.N., Batina, R.G., and Feehan, J.P. 2008. Empirical Impact of Public Infrastructure on the Japanese Economy. *The Japanese Economic Review* Vol. 59 (4).
- Aschauer D. A. 1989. Is public expenditure productive? *Journal of Monetary Economics* No. 23: 177-200.
- Canning, D. 1999. Infrastructure's Contribution to Aggregate Output. Policy Research Working Paper No. 2246. World Bank.
- Canning, D., and Pedroni, P. 1999. Infrastructure and Long Run Economic Growth. Presented in North American Summer Meetings of the Econometric Society Conference.

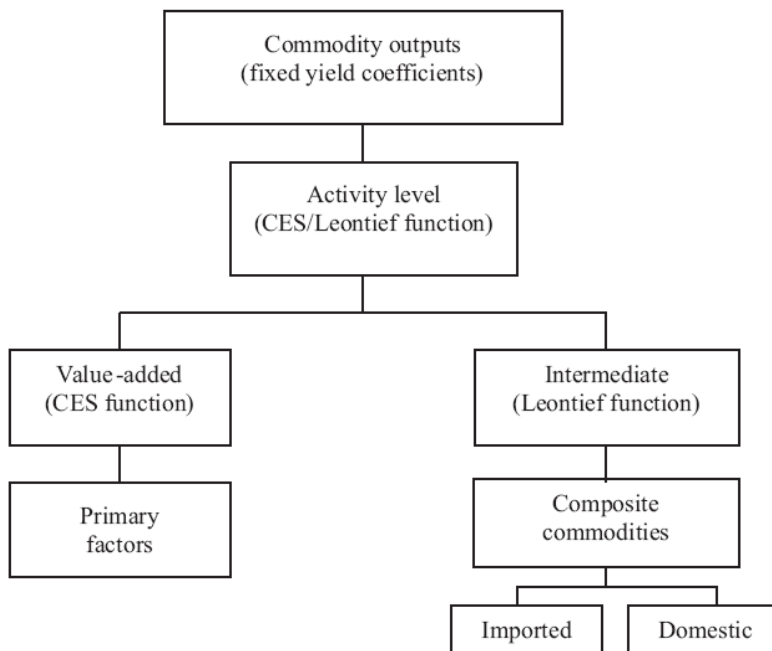
- Dumont, J.C., and Mesple, S. 2000. The Impact of Public Infrastructure on Competitiveness and Growth: A CGE Analysis Applied to Senegal. Working Paper. University of Laval, Quebec.
- Esfahani, H.S., and Ramirez, M.T. 2003. Institutions, Infrastructure, and Economic Growth. *Journal of Development Economics* Vol. 70: 443-477.
- Estache, A., Perrault, J.F., dan Savard, L. 2007. Impact of Infrastructure Spending in Mali: A CGE Modelling Approach. Working Paper No. 07-24. University of Sherbroke.
- Hartono, D., and Budy 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., Harris, R. L., and Robinson, S. 2002. A Standard Computable General Equilibrium (CGE) Model in GAMS. The International Food Policy Research Institute.
- Perikesit, D., Purwanto, H., Wismadi, A., and Ardianta, D. 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 Sridhar, V. 2004. Telecommunications Infrastructure and Economic Growth: Evidence from Developing Countries. Working Paper. National Institute of Public Finance and Policy, New Delhi.
- Warr, P., Menon, J., and Yusuf, A.A. 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.

Table 1. The Impact on Household's 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 Impact on 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



Source: Lofgrean et al, 2002

Figure 1. Functions in Supply Block

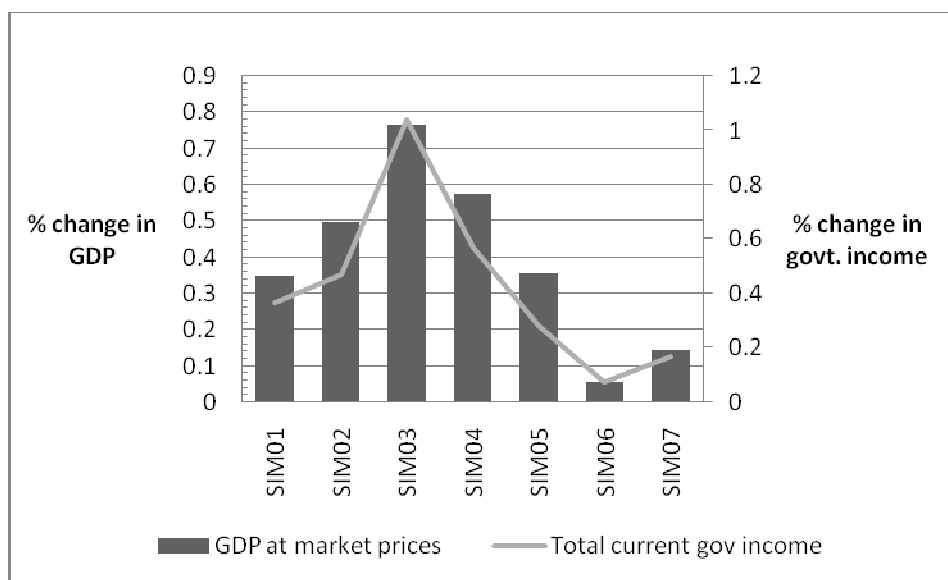


Figure 2. The Impact on Macro Economic Indicators

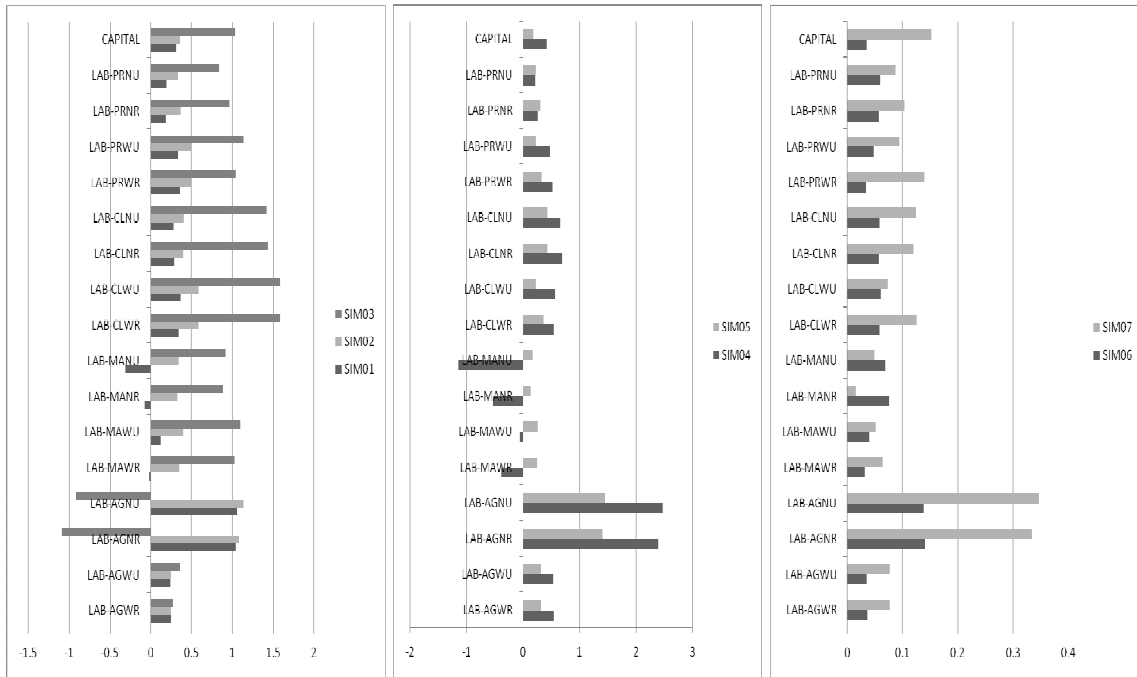


Figure 3. The Impact on Factor's Income (Percentage Change)