THE DEVELOPMENT OF NATIONAL ROAD NETWORK UNDER BUDGET CONSTRAINT: A CASE OF INDONESIA

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Abstract: Indonesia has been using IRMS software to program national and provincial road maintenance. The system uses traffic volume and road quality to determine the treatment. The maintenance costs are combined with the benefits accrued from VOC and other savings to obtain the economic feasibility. It assumes no budget constraint to implement fully the maintenance program. The problem occurs since the country has a limited national budget, no instrument to demonstrate the contribution of road investment to economic growth and to justify the investment needs. To overcome the problem, a combination of a macro-micro economic model is required. The study used INDORANI software to estimate the parameters used for Computable General Equilibrium model. The software is employed to model the impact of road sector investment under an unlimited and constrained national budget. The result is iterated with the result of IRMS to produce five years road development program.

1. BACKGROUND

In many developing countries, road network is very essential in promoting country's economic development. Indonesia, at the beginning of 1993 has 65,350-km national and provincial roads and is expected to have an additional 10,000-km by the end of 1998. This figure has made the country's growth in road length as the second fastest in the Asia and Pacific region with 7.25% during 1985-1994. However the country's road density remains low (0.181 km/km^2 in 1995, ranked 14th among Asia-Pacific countries), showing the still increasing demand in the road supply. The need is also enlarged with the fact that there is a disparity of road quality between the Western part of Indonesia - which is relatively more prosperous, and the Eastern part.

The demand for a reliable road network is immense since the industry and agriculture production regard transport sector as their crucial factor that determines the end selling price of their products. One of the tools to determine the importance of transport and road sector is

by looking at the backward and it forward linkages. Backward linkage represents the ability of a sector to absorb the output of other economic sectors to be used as input. In other words, the magnitude of linkages demonstrates the contribution of transport and road sector to the growth of other sectors. Forward linkage on the other hand, represents the ability of a sector to stimulate the growth of other sectors.

Table 1. Backward and Forward Linkage of Transport and Road Sector

Year	*Sector*	*Backward*	*Forward*
1980	Road Construction	0.6226	0.0584
	Road Transport	0.4354	0.3368
1990	Road Construction	0.6135	0.0285
	Road Transport	0.3852	0.3884

Source: IO Table 1980, 1990

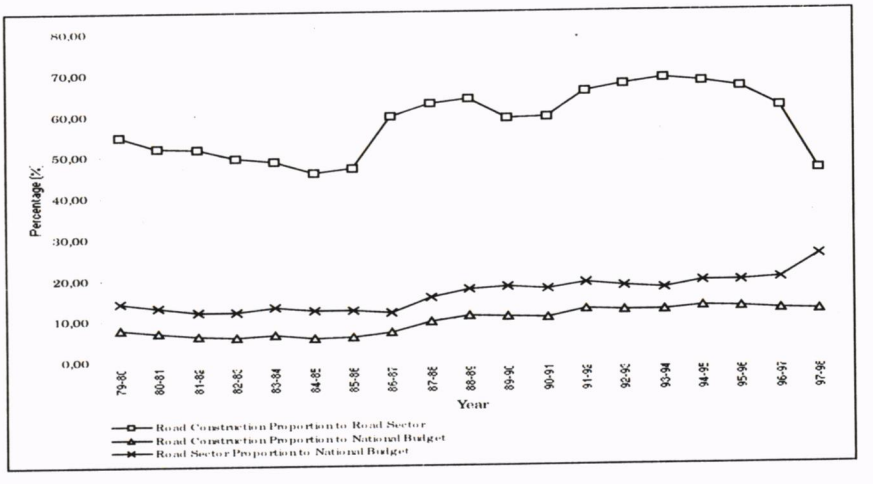


Figure 1. Budget Allocation of Road Sector, 1979-1998

In year 1980 the backward linkage of road construction sector is 0.6226 and its forward linkage is 0.0584. It means that the sector stimulates the development in other sectors which their output is used as input in road construction sector. Likewise is the road transport sector. The linkage of road is generally decreasing, relative to other sectors, demonstrated by the decrease of backward and forward linkages of both road construction and road transport. With such important role, it very essential that the government allocate suitable budget to further develops the country's economy. For the last 20 years, the proportion of road construction sector is ranging between 45 - 68% from the transport sector budget and 5.6 - 12.89% from the national budget (see Figure 1).

The budget allocation should represent the role of road sector to contribute the development of the national economy. With the current economic crisis, this question has become a national issue. Each development sector must be able to demonstrate its contribution to the economy. The statistical analysis demonstrated that the transport sector, which should be

stimulating the economy or output of production, shows the decline during 1980-1990. It is against the beliefs that as the economy develop; the role of transport sector becomes more important. Such question becomes more important when we deal with the limited budget available for the development.

2. CONCEPTUAL FRAMEWORK

The study presented in this paper is adopting two strategies. First approach assumes that there is no budget constraint to implement fully the maintenance and rehabilitation program. The problem occurs since the country has a limited national budget to be allocated to all development sectors. There has been also no instrument to demonstrate the contribution of road sector investment to the national economic growth and thus makes it difficult to justify the investment needs. To overcome the above problem, a combination of a macro economic model and a micro model is required. This is treated as a second approach.

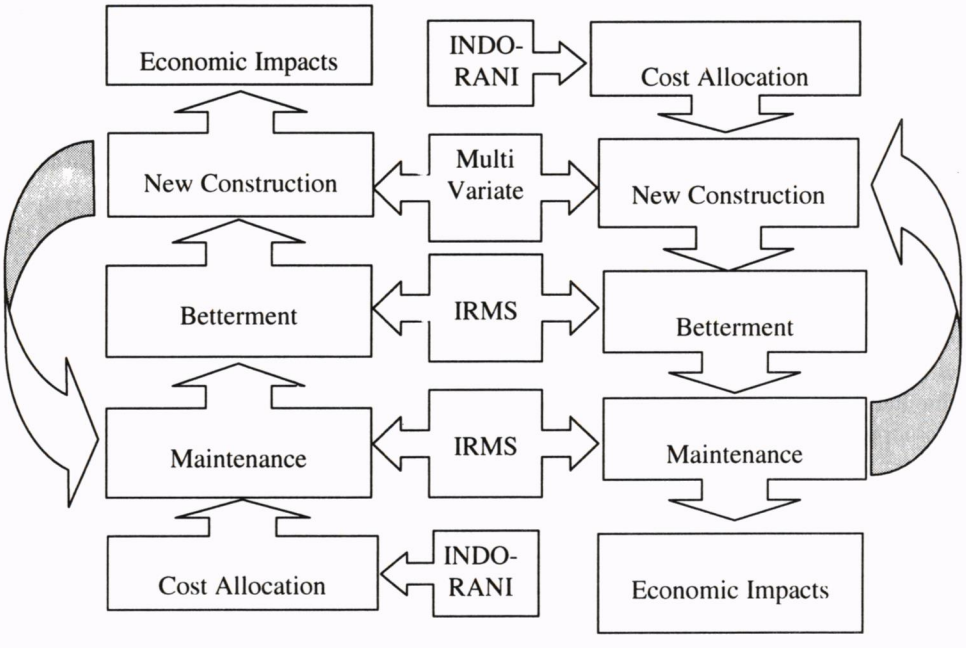


Figure 2. Modules Interaction

The Computable General Equilibrium (CGE) is a macro economic model of supply and demand for all economic sectors. The study used INDORANI software to estimate the parameters used in the CGE model. The software is employed to model the impact of road sector investment under an unlimited as well as constrained national budget. The result is then used as input for the already available software IRMS (Interurban Road Management System). IRMS has been used by the Directorate General of Highways from early 90's. However, the module is not able to estimate the needs of the road network, i.e. new roads. In order to carry out assessment for the needs of road network, a category analysis method using

multi variate regression is employed. All of the methods are used iteratively as seen in Figure 2. The right loop demonstrates the approach with unlimited budget situation whereas the left loop is the limited budget situation. The middle boxes show the model used in each process. By running the model iteratively, one could see that macro and micro economic approach to the road sector investment would converge and thus enable the model to demonstrate the justification of investment. IRMS and multi variate analysis are carried out at provincial level and the macro model is using the output of the aggregation of provincial budget to evaluate its impacts at the national level. If the economic impacts of road investment have not met the predetermined national target, the macro model will adjust the budget and redistributing them to provincial budget. This provincial budget is the used as inputs for budget constrained scenario.

2.1. Category Analysis with Multi Variate Regression

As stated above, this model is used to estimate the preferred quantity and quality of road network in a particular province. It determines normative criteria for a province to perform in its economic, social, geographic, and political context through defining its current road quantity and quality. It then estimates future needs based on the changes of its context. This requires the following assumptions:

a) The conditions and attributes of a road network contribute to the economic development based on its characteristics and potentials,
b) A region having particular characteristics and potentials can be used a model by other region, that is each region learns from other region's experience,
c) There is no budget constraint to achieve preferred road quantity and quality.

Regional characteristics are grouped into 4 categories. Road characteristics of a region are measured in terms of its quantity and quality. The quantity of the road in a region may be represented by its density, which can be measured by road length/km^2 or road length/population. This is specifically relevant to Indonesian case where there is a quite difference in the province areas and the population density. The road network quality of a region is represented by the weighted average of the International Roughness Index (IRI). Furthermore, it is also assumed that the road network characteristic is a function of economic considerations, social conditions, geographic characteristics, and government policy interventions. These factors will influence the road investment level of a region. Consequently, it will create different road densities and qualities among regions. Economic considerations are represented by the Gross Domestic Product (GDP) / area. It argues that the level of regional income determines the level of public investment including road networks. The number of people living in the region also characterizes the level of investment. The population density, therefore, is taken as the explanatory variable representing social indicators. Geographic conditions of a region are characterized by three variables, i.e. productive forest area in the region, type of a region whether the region is an inland or a part of islands, and the location of a region. These variables are indicating constraints of the road development. The government policy interventions are considered to be an important factor. The government has decided to develop growth poles in some regions where the government expects to get economic benefits through trickle down and spread effects. The intervention intensifies the investment level of public facilities in the regions. With such framework, the

road network requirement will be formulated through the relation between road network variable and its predictors:

$$Y_{1m} = \beta_{01}+\beta_{11}.Z_1+\beta_{21}.Z_2+.....+\beta_{n1}.Z_n+\sum_1 \quad (2.1)$$
$$Y_{2m} = \beta_{02}+\beta_{12}.Z_2+\beta_{22}.Z_2+.....+\beta_{n2}.Z_n+\sum_2 \quad (2.2)$$
$$Y_{3m} = \beta_{03}+\beta_{13}.Z_3+\beta_{23}.Z_3+.....+\beta_{n3}.Z_n+\sum_3 \quad (2.3)$$

With

Y1	: Ln (road density in km/km^2)	Z1	: Ln (GDP/area)m-1	Z5	: Inland (1) or island (0)
Y2	: Ln (road density in km/1,000inhabitants)	Z3	: Ln (Person/area)m-1	Z6	: Growth pole (1) or others (0)
Y3	: Ln (weighted average IRI)	Z4	: Ln (Percentage of productive forest)	Z7	: Eastern (1) or Western Indonesia (0)
				β	: constant

The equation indices are n (number of predictor variables) and m (years of observation. The result of model calibration is as follows:

$$\hat{\beta} = [\ \hat{\beta}_{(1)} \mid \hat{\beta}_{(2)} \mid \hat{\beta}_{(3)}\ ]$$

80,0985	76,4604	71,9748	Constant
0,1306	0,0030	-0,0452	Z1 = GDP/area
-0,0779	-0,0955	0,0289	Z3 = Population density
-1,3829	-0,1795	-0,0803	Z4 = Forest/area
-8,1815	11,4088	-6,0714	Z5 = Inland – Island
3,8890	-19,3447	-2,0684	Z6 = Growth pole – others
20,1002	31,4888	22,1804	Z7 = East – West

The result of model calibration demonstrated that as the economy of the region grows, the government tends to expand its road network and/or to improve the road quality. The lower the IRI value the better the quality of road network will be. The impact of population density must be interpreted carefully since it should be coupled with the impact of income to obtain sensible argument. If the population increase does not complemented by the increase in income than the quantity of road network and road quality will decrease. It is also clearly indicated that the development constraint represented by the forest area plays a major role in the road development. In the one hand, as the forest area gets larger the road network tends to be smaller and on the other hand, the road quality improves. The argument is that by a certain level of investment, the road investment unit will be higher as the road length decreases. Consequently, it will give a better quality of road network.

2.2. Interurban Road Management System

Interurban Road Management System or IRMS, is a standard tool and software for multi years road program used by the Directorate General of Highways. Its features are similar with the World Bank's HDM III (or its newer version of HDM IV). Indonesia has long been using

it, which is originally developed and used in western countries, for national and provincial road maintenance and rehabilitation program. The system basically uses traffic volume and existing road quality, represented by IRI value, to determine the treatment for a particular road segment or section. The maintenance and rehabilitation costs are then combined with the benefits accrued from Vehicle Operating Costs and other savings to obtain the economic feasibility of the investment. It uses a threshold principle to determine and evaluate the treatment required for a particular road segment or link (See Figure 3). Three available treatments are routine maintenance/holding, periodic maintenance and betterment. If a road receive a "holding" treatment, it means that the road has no budget allocated at a particular year and thus for that year, it receives a fund only to maintain its previous function and quality.

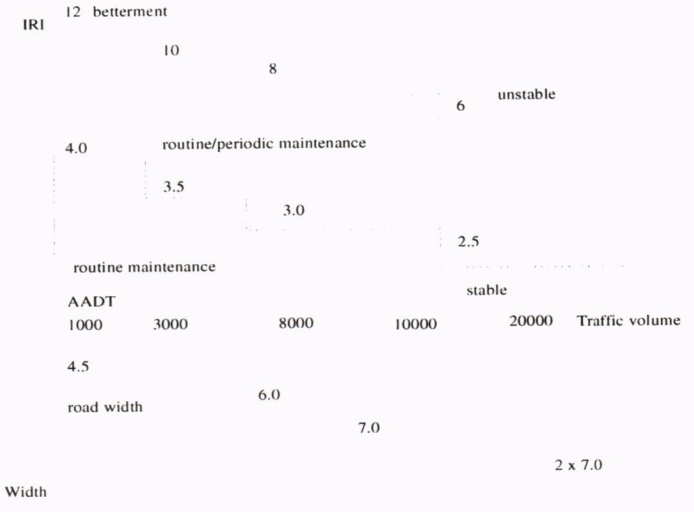


Figure 3. IRMS Engineering Treatment Criteria based on Mid Life Traffic

There are several issues related with the use of the software, among others are:

a) since it is a link based treatment, it fails to recognize the importance of a corridor of passengers as well as goods distribution or a network
b) its accuracy is very much dependent upon the quality of data that are inputted to the module
c) it can suggest treatment only for paved surface within a particular traffic volume; unpaved surface and road link/segment with traffic less and above the specified volume are excluded (or should be excluded) from the calculation

2.3. Computable General Equilibrium

CGE model is a macro economic tool to model demand and supply in the economy. Its principle is based upon the equilibrium of the capital and labor that are required to produce

goods and services on the one hand and on the other hand, the macroeconomic components that form the national economy. The components comprise from savings, investment, government expenditure, export and import. The principle of the model can be described as follows:

$$Y = S + I + G + (X-M) \quad (2.4)$$

$$Y = f(K,L) \quad (2.5)$$

$$aK + bL = S + I + G + (X-M) \quad (2.6)$$

S is savings, I represents investment and G is government spending. (X-M) is net export whereas K and L represent capital and labor. In short term evaluation, K and L is assumed constant, consumption is constant and the value of X and M are fixed. Therefore in an equilibrium situation what will occur is the change of I and G. It means that if government spending decreases then to maintain a constant Y, then there should be an increase in the investment. In the long term, K and L are not constant. If S, X and M are assumed remain unchanged, then investment will be determined by the change in K, L and G.

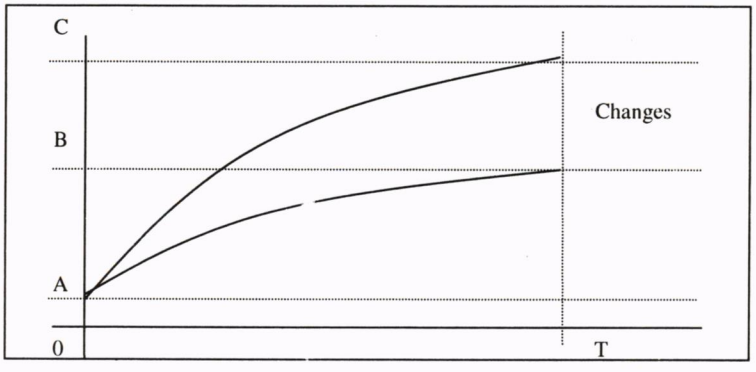


Figure 4. Interpretation of Simulation Result

Macro economic model used to test the impact of road investment is called INDORANI, an adopted ORANI Australia model with adjustment to Indonesian economic structure. INDORANI is designed to carry out a simulation in static-comparative manner. Its equations and variables are interpreted implicitly according to the time frame. This principle can best be described with the Figure 4. Figure 4 shows the relation between endogenous variable, i.e. added value (V) and time (T). A is a level of added value at the base period and B is a level of added value for a given macroeconomic treatment. The change (in %) in the added value can be estimated by measuring the value of 100 (B-A)/A. It is an indication on how the economy will react if a treatment or a set of treatments is introduced. With such feature, the model can be used to test and evaluate what would be the impacts of a certain investment to the change in the national economy. It is also possible to investigate level of investment in a particular sector for a given macroeconomic context, i.e. economic growth, inflation.

2.4. Development Scenario

Despite the importance of regency roads and urban roads, the study consider only national and provincial road network. There are two hypothetical situations assumed to occur. First is

the situation where the government has unlimited budget to be spent on road investment including new construction, betterment and maintenance. The money is then used to estimate the economic impacts of such investment. Second situation is when the government has a limited budget available for road sector. A given macroeconomic condition will determine the national budget as well as sector's budgets, including road sector budget. The estimated road sector budget is the allocated according to the following priority: maintenance, betterment and if there is still funds available, new construction. Under an unlimited budget, it is assumed that all proposed new roads are constructed. With a limited budget it is assumed that:

a) Short-term inflation is ranged from 17 and 23% and long term inflation is between 8 and 11%.
b) 12% reduction in the public spending
c) 15% reduction in real national budget
d) 35-40% reduction in export as a representation of the decrease in the world market for Indonesian products, i.e. textile, estate crops and plywood
e) 85% reduction in import due to higher price of imported product and import cost.

In order to evaluate the impacts of investment, several macroeconomic indicators are devised as follows:

a) Growth in GDP, consumption, investment and government spending
b) Competitiveness and Trade, represented by growth in export and import
c) Equity and distribution of the economic prosperity, growth in aggregate wages, growth in the number of employment opportunity
d) Stability, represented by the currency depreciation and inflation

3. Results of an Unlimited Budget

3.1 Estimated Length of Road Network

In unlimited budget condition, all necessary investment is available according to what the model suggested. New roads are constructed in accordance with the result of multi variate regression, using future estimated economic, social, demographic and political scenario. The calculation is based upon the assumption that the government must maintain or keep the existing road network. In other word, if the calculation shows that the required future road length is less than the existing length, the government has to be prepare to allocate funds to maintain them. Table 2 demonstrated the result of the regression. One can see that in most provinces, new roads are not necessary. In general, the existing road network can serve the dynamics of the province. In some cases, they even have more roads than what are necessary to support their development. This will of course increase the burden for maintenance road maintenance. If the government does not maintain them, the value of the assets will decrease.

Some provinces like Lampung, West Sumatera, West Nusa Tenggara, and South Sulawesi and Yogyakarta require new roads mainly because of their economic developments and population growth. In some other provinces that need new roads like East Nusa Tenggara want new roads because the existing road network was not able to support its regional development.

Table 2. Estimated Length of Road Network

PROVINCE	ROAD LENGTH IN 1995 (km)	ACTUAL ROAD LENGTH IN 1999 (km)	ESTIMATED ROAD LENGTH IN 1999 (km)	ESTIMATED ROAD LENGTH IN 2004 (km)	ADDITIONAL ROAD LENGTH 2004 (km)
DI ACEH	3.131	3.577	3.577	3.577	-
NORTH SUMATERA	3.937	4.825	4.825	4.825	-
WEST SUMATERA	2.293	2.314	2.427	2.567	253
RIAU	2.487	2.615	2.616	2.615	-
JAMBI	1.843	2.938	2.938	2.938	-
SOUTH SUMATERA	3.588	3.860	3.863	3.923	63
BENGKULU	1.552	1.939	1.939	1.939	-
LAMPUNG	2.987	2.907	3.177	3.368	461
WEST JAWA	3.407	4.365	4.365	4.365	-
CENTRAL JAWA	3.667	3.780	3.780	3.780	-
DI YOGYAKARTA	818	856	1.010	1.157	301
EAST JAWA	3.634	3.470	3.559	3.482	13
BALI	1.086	1.240	1.240	1.240	-
WEST NUSA TENGGARA	1.921	1.748	2.003	2.059	311
EAST NUSA TENGGARA	3.985	3.902	4.062	4.140	239
EAST TIMOR	1.590	1.415	1.612	1.623	209
WEST KALIMANTAN	2.975	3.290	3.290	3.290	-
CENTRAL KALIMANTAN	2.288	3.214	3.214	3.214	-
SOUTH KALIMANTAN	1.537	1.730	1.730	1.807	77
EAST KALIMANTAN	1.888	2.991	2.991	2.991	-
NORTH SULAWESI	1.859	2.729	2.729	2.729	-
CENTRAL SULAWESI	2.850	3.865	3.865	3.865	-
SOUTH SULAWESI	3.525	3.544	3.679	3.782	238
SOUTHEAST SULAWESI	1.491	2.061	2.061	2.061	-
MALUKU	2.132	3.133	3.133	3.133	-
IRIAN JAYA	2.625	2.894	2.894	2.894	-
INDONESIA	**65.093**	**75.203**	**76.581**	**77.365**	**2.162**

Source: Results of multi variate regression analysis

3.2 Budget Needs for Maintenance, Betterment and New Construction

Cost for building new road is assumed Rp. 288 Mio/km and therefore require Rp. 590,221 Mio. Besides the construction cost, all new roads receive Rp. 75 Mio/km every three years and Rp. 6 Mio/km-year. With unlimited budget, IRMS estimated that all roads received preferred treatment. No holding cost is necessary. IRMS module suggested that routine and periodic maintenance as well as betterment need the following investment:

Table 3. Summary, Unlimited Budget (Mio Rp.)

Types	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	Total
Routine Maintenance	229,184	252,372	254,072	257,387	346,250	1,339,265
Periodic Maintenance	377,431	204,785	126,966	148,590	206,525	1,064,296
Betterment	1,779,406	1,562,890	1,490,567	473,986	698,473	6,005,322
Total	2,386,021	2,020,047	1,871,605	879,963	1,251,248	8,408,883

Source: IRMS estimation with unlimited budget

Table 3 demonstrates that with unlimited budget, the money allocated for first up to third year accounts for more than 70% of the total budget. It means, most of the necessary budget is allocated to improve the road quality according to the traffic level. The figure clearly demonstrated that the largest part of yearly cost in the first three-year program is allocated to betterment. The money is required to upgrade most road segment, whereas in the year 4 and 5, betterment is only necessary for particular road segments.

3.3 Economic Impacts of Road Investment

Under an unlimited budget, all road segments and links receive the required treatment suggested by IRMS and there is also budget available for new road construction using multi variate regression equations. No road receives holding treatment, i.e. temporary budget for maintaining its condition until there is budget to improve it. The investment scenario is then tested with INDORANI/CGE model to examine its impact to the country's economy.

Table 4. Macroeconomic Impacts of an Unlimited Road Budget

Indicators	*Short Term Change (%)*		*Long Term Change (%)*	
	Optimistic	*Pessimistic*	*Optimistic*	*Pessimistic*
Growth				
• GDP	-4.53	0.48	4.51	3.82
• Consumption	-16.96	-24.16	3.39	-3.81
• Investment	-10.00	-10.00	2.91	-3.66
• Gov. spending	-11.67	-29.27	-8.89	-4.47
Competitiveness				
• Export	-24.534	0.97	7.21	4.46
• Import	-57.57	-85.98	-2.98	-14.49
Equity				
• Prosperity	-24.59	-35.67	4.91	-5.53
• Wages	-17.91	-24.26	12.57	-8.38
• Employment	-3.71	-6.14	13.00	2.45
Stability				
• Depreciation	10.03	9.23	7.85	31.54
• Inflation	17.00	23.00	11.28	8.05

Table 5. Impacts of Optimistic and Pessimistic Scenario to Road Construction and Land Transport in an Unlimited Budget Situation

No	*Indicator*	*Optimistic*				*Pessimistic*			
		Short Term		*Long Term*		*Short Term*		*Long Term*	
		RC	*LT*	*RC*	*LT*	*RC*	*LT*	*RC*	*LT*
1	Output	-7.10	-0.31	2.85	8.66	-10.55	-0.42	1.38	3.68
2	Investment (exogenous)	-	-	-	-	-	-	-	-
3	Employment	-16.76	-0.41	-5.03	14.01	-24.88	-0.57	-5.63	1.19

Note: RC is Road Construction/Maintenance
LT is Land Transport

Table 4 shows the impacts of unlimited budget investment to the national economy. For examining the impacts an optimistic and pessimistic scenarios are adopted. Pessimistic scenario is based upon worst macroeconomic condition and optimistic scenario will be dependent upon the better macroeconomic condition. Impacts of the unlimited budget to road construction and land transport sectors are shown in Table 5, where the investment level is set as an exogenous variable, that is the investment is a variable that determine the results of other variables, i.e. output of production and employment. From the table one can see that with such macroeconomic context, the road sector will not be able to maintain its employment at the current level. Land transport sector also receives similar consequences although at the lower extent. Even in pessimistic scenario, in the long term, the sector will survive. This is due to the result of higher competitiveness of Indonesian exported product. In the long run, land transport will gain its positive growth.

4. Results of a Limited Budget

4.1 Investments Allocated to Road Sector

Weak economic growth in Southeast and East Asia yields negative impacts in short and long term. Domestic demand will decrease which causes the reduction in investment and consumption not only for Indonesia, but also for the whole region. In a limited budget situation, it is assumed that the government will follow IMF scenario that would result in the following results. Using controlled inflation, the decrease in government spending and the decrease in the world market INDORANI estimates the other macroeconomic impacts and budget-allocation for each province. In the short term, the economic condition shows a worst situation. The economy will be in contraction; the competitiveness as well as the equity will be decreased in a worst situation. In the long run however, it will increase although at the marginal level.

Table 6. Macroeconomic Impacts of a Limited Road Budget

Indicators	*Short Term Change (%)*		*Long Term Change (%)*	
	Optimistic	*Pessimistic*	*Optimistic*	*Pessimistic*
Growth				
• GDP	-5.59	-8.04	3.87	2.55
• Consumption	-24.54	-26.53	3.18	-3.86
• Investment	-11.25	-12.65	1.14	-4.12
• Gov. spending	-16.94	-14.27	-8.70	-4.47
Competitiveness				
• Export	-34.02	-40.76	6.34	4.20
• Import	-85.98	-86.83	-3.88	-14.58
Equity				
• Prosperity	-35.59	-38.46	4.61	-5.59
• Wages	-24.68	-18.38	-12.16	-8.38
• Employment	-5.83	-11.00	12.44	11.89
Stability				
• Depreciation	15.59	12.03	7.31	31.20
• Inflation	17.00	23.00	11.16	8.05

The impacts of the budget to road construction and land transport sector caused a slightly bad impact in the output of production and becoming larger in the long run. With limited budget one can easily see that the employment level will drop quite substantially. In the long run however, it will increase the efficiency of the sector and increase the employment level.

The optimistic scenario showed that in short term, the budget available for road sector must be decreased by 4.69% in the short period and increase by average of 3.89% in the long term. With the 1995/1996 budget for physical work is Rp. 1,715,099 Mio and an assumed 1997/1998 budget for physical work is Rp. 2,075,270 Mio (a 10% yearly budget increase), it is estimated that 1999/2000 budget will be Rp. 1,977,940 Mio and 1999-2004 (long term) budget will be Rp. 11,651,939 Mio. This amount of money is then allocated to each province base upon the construction sector's share in GDRP.

Table 7. Impacts of Optimistic and Pessimistic Scenario to Road Construction and Land Transport in a Limited Budget Situation

No	*Indicator*	*Optimistic*				*Pessimistic*			
		Short Term		*Long Term*		*Short Term*		*Long Term*	
		RC	*LT*	*RC*	*LT*	*RC*	*LT*	*RC*	*LT*
1	Output	-7.76	-0.40	1.19	5.73	-10.45	-0.50	0.71	2.28
2	Investment (endogenous)	-4.69	1.24	3.89	7.45	-4.89	0.84	3.78	4.01
3	Employment	-28.49	-5.60	1.59	14.01	-34.85	-5.73	0.95	5.39

Note: RC is Road Construction/Maintenance
LT is Land Transport

4.2 Maintenance and Betterment Program

Maintenance is the first priority of funds allocated to province. IRMS suggested the program that can be summarized as follows:

Table 8. Summary, Limited Budget (Mio Rp.)

Types	1999/2000	2000/2001	2001/2002	2002/2003	2003/2004	Total
Routine Maintenance	363,531	348,840	334,256	313,811	368,359	1,728,798
Periodic Maintenance	182,661	169,619	164,814	215,158	207,093	939,345
Betterment	1,226,571	1,302,006	1,278,213	936,668	1,114,755	5,858,213
Total	1,772.763	1,820,464	1,777,284	1,465,637	1,690,208	8,526355

Source: IRMS estimation with limited budget

The initial INDORANI simulation has a tendency to steadily increase the allocation of funds but the IRMS estimated differently due to the mechanics within the module to allocate funds to the most profitable links/segments.

4.3 Funds Availability for New Road Construction

Once the maintenance and betterment costs have been allocated, the remaining funds can then be used to construct new roads. Not every roads proposed by multi variate analysis can be

constructed due to the funds availability. Following table shows the roads that can be can be constructed with the remaining available funds.

Table 9. New Road Construction with Limited Budget Situation

PROVINCE	NEW ROADS (km)	BUDGET AVAILABILITY		ADDITIONAL ROAD THAT CAN BE CONSTRUCTED	
		1999/2000 (Mio Rupiah)	1999-2004 (Mio Rupiah)	1999/2000 (km)	1999-2004 (km)
DI ACEH	202	201	45.622	-	158
NORTH SUMATERA	-	214	-	-	-
WEST SUMATERA	253	-	59.969	-	208
RIAU	-	40.948	255.410	-	-
JAMBI	-	-	14.352	-	-
SOUTH SUMATERA	63	54	117.303	-	407
BENGKULU	-	20.955	158.953	-	-
LAMPUNG	-	94	-	-	-
WEST JAWA	-	1.051	386.876	-	-
CENTRAL JAWA	-	-	-	-	-
DI YOGYAKARTA	301	34	26.685	-	93
EAST JAWA	13	204	151.978	-	528
BALI	-	66	3.367	-	-
WEST NUSA TENGGARA	311	1.349	5.932	5	21
EAST NUSA TENGGARA	239	24.185	296.799	84	1.031
EAST TIMOR	209	108	22.999	-	80
WEST KALIMANTAN	146	20.448	226.021	71	785
CENTRAL KALIMANTAN	-	42.827	317.063	-	-
SOUTH KALIMANTAN	77	206	35.461	-	123
EAST KALIMANTAN	-	8.605	165.790	-	-
NORTH SULAWESI	-	701	66.071	-	-
CENTRAL SULAWESI	-	3.248	159.814	-	-
SOUTH SULAWESI	238	270	7.667	-	27
SOUTHEAST SULAWESI	-	30.396	210.161	-	-
MALUKU	-	5.770	133.461	-	-
IRIAN JAYA	-	9.418	292.567	-	-
INDONESIA	**2.049**	**211.353**	**3.160.321**	**160**	**3.460**

From the above table, one can see that each province can be categorized into 5 cases:

a) Case I, Provinces with no new roads and no budget that can be allocated (in neither short nor long term). Those provinces are North Sumatera, Lampung and Central Java.
b) Case II, Provinces with no new roads but they have extra budget that can be used. Those provinces are Riau, Jambi, Bengkulu, West Java, Bali, Central Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, Southeast Sulawesi, Maluku and Irian Jaya.
c) Case III. Provinces with proposed new roads but have no funds. No province falls into this category.
d) Case IV. Provinces with proposed new roads but have fewer funds than required. Those provinces are DI Aceh, West Sumatera, DI Yogyakarta, West Nusa Tenggara, East Timor and South Sulawesi. In those provinces, new roads are constructed according to the available funds.
e) Case V, Provinces with proposed new roads and the available budget exceeds the requirements. Those provinces are South Sumatera, East Java, East Nusa Tenggara, West Kalimantan and South Kalimantan.

5. Budget Comparisons between Unlimited and Limited Budget Situation

Having calculated the investment scenario with unlimited and limited budget scenario, it is very important to investigate the difference in the budget pattern for each approach. Figure 5 and 6 below shows the difference between those two situations:

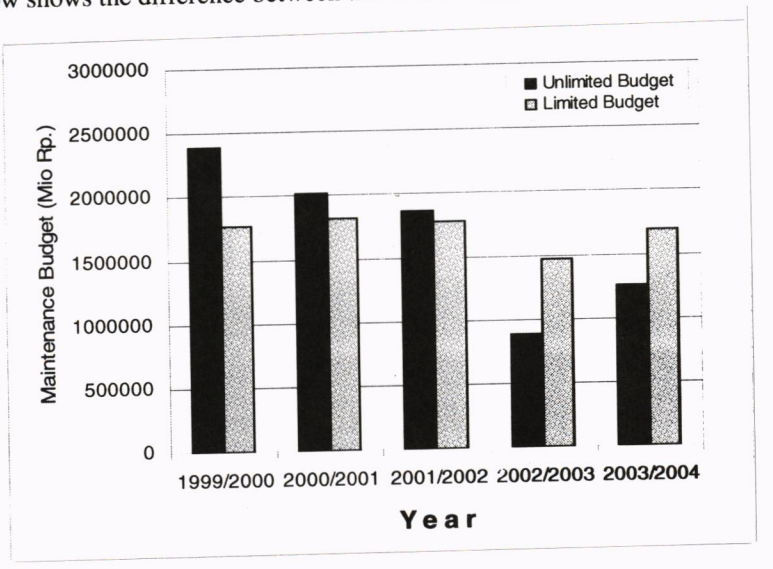
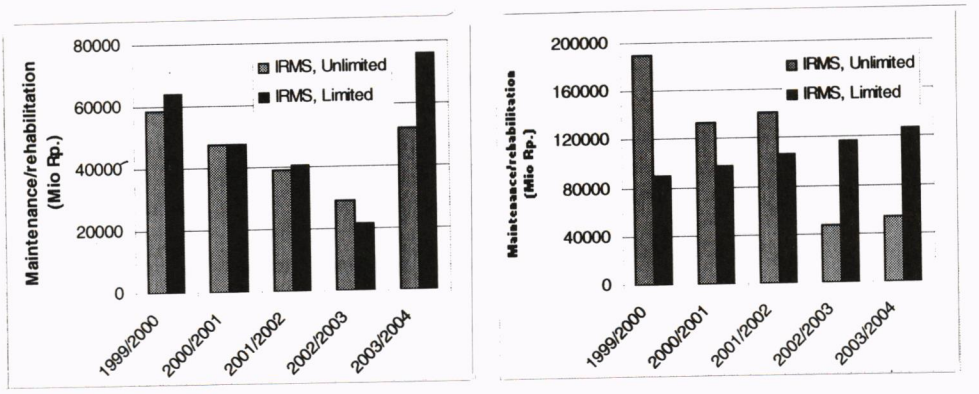


Figure 5. Comparison between Unlimited and Limited Budget Situation (IRMS result)



(a) East Nusa Tenggara (b) North Sumatera

Figure 6. Provincial Comparisons, Unlimited and Limited Budget

Those figures show that the significant difference between unlimited and unlimited budget allocation is in priority to invest in the first year. In unlimited budget, the investment is mainly used to improve the condition of roads that are previously received holding treatment. Investment level is very high but it is compensated with a low maintenance in the fourth and

fifth year. This is a very important aspect of budgeting policy. If the government is willing to spend more on the first two or three years, than it can be proved that the money that should be allocated at the following year could be reduced to a half or less of the yearly budget. Routine maintenance is after all a substantial factor in the road management. High cost of betterment and rehabilitation is mainly due to poor maintenance. The limited budget situation shows that when the required budget is not met than the burden to maintain the road condition is carried over to the next year, but at the higher level because of the necessity to invest on holding treatment or the continuing road deterioration. With limited budget situation, one can see that the country will always spend more money than in an unlimited budget situation after three years of investment.

The impacts of the model are also examined at provincial level as seen in Figure 6. The figure shows that in unlimited budget situation, the investment needs for the first three years for each province tend to be higher than the remaining period. It means that the investment will be required to meet the engineering standard based upon the traffic level and preferred road quality. If there are budget available, that such scenario will be an ideal situation. Comparing the result of provincial allocation, one can see that each region behaves differently. In North Sumatra for example, the budget is not available to meet treatment required. It means that the budget difference (between the preferred and the available investment) will be carried over or transferred to the following year. The amount transferred will be larger than previous year because road deterioration continues to take place requiring extra budget to be allocated. This is accumulated from year to year and creating an ever-increasing demand for budget. The other example is East Nusa Tenggara Province where the required maintenance budgets is lower than the budget available; even under contracted economy. It allows the province to spend the budget for other purposes like capacity expansion or even new road construction as suggested by multi variate analysis.

6. Concluding Remarks

The study has demonstrated that it is possible to justify the road development investment needs using a combined microeconomic and macroeconomic model. It is also possible to examine the macroeconomic and impacts of road investment during the current economic crisis to road and land transport sector. Current budget allocation practice shows that the government overlooked the long-term investment strategy since much lower investment needs will be needed if maintenance costs for the first two-year can be fully covered. On the other hand the macroeconomic model will allocate the national budget according to the most economically efficient sector to meet the predetermined growth.

Further study and research must be directed to response the following issues:

a) Integration of a corridor based investment strategy. The study has not been able to identify the investment need for regency and municipality roads although in practice they are often the bottle necks in the distribution system
b) The assumption that the current economic system operate in perfect equilibrium. In developing countries the equilibrium may not exist and some distortion occur. Therefore the model should be refined to reflect the current state of the market.

c) For new road investment, the study has not been able to identify the location of new roads to be built. There is also no standard requirement of road density. It may vary according to the characteristics of the region.
d) The model has not identified clearly the impact of the quality of maintenance works. Since each project has different construction quality, it is important to recognize the economic impacts of "good" and "bad" quality construction works.

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