Chapter V

THE Benefit ratio or method of investment

Method 1

This is one method by which the benefit ratio or return on investment can be determined and it will be employed in the calculation of the return on investment for the Tunnel Road as well as for King Gates road.

In this method, the initial investment is assumed to take the form of a grant given by the Central Government to the local authorities and is therefore interest-free and not repayable. However, there is an implicit cost to this - opportunity cost. If the government were to lend to the local authorities, it would charge a rate of interest varying from 2% to 4%, depending on whether the loan is short-term or long-term. Highway projects are usually of a long-term nature and although in this case, investment is free, annual costs have to be incurred in maintaining and resurfacing the road. These continuing costs will be the same every year. Hence, they have to be reduced to present value and the appropriate rate to use is 4%, the long-term lending rate of the government.[1]

Benefits, however, will be discounted at the borrowing rate of the Development Bank, i.e. at 5%, to bring them to present value.

Calculations are made from 1966 onwards and not from 1964 because it is assumed that the new road, if accepted, will only be completed and opened to traffic in 1966. This means that benefits will begin to accrue from this year onwards. To simplify calculations, benefits are assumed to accrue only at the end of each

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[1]Discounting is necessary because people value the present more than the future: a dollar today will be worth less tomorrow.

year, for example, benefit in 1976 than in the year 1971 (although in actual fact they accrue daily to road users). Maintenance and resurfacing costs are also calculated from this year onwards.

It is important to note that maintenance and resurfacing costs here refer to the additional costs incurred as a result of the new improvement. In other words, they are the differences in maintenance costs between existing highways and the various roads in the case of project 1 and between existing highways and toll roads in the case of project 2. And it is because a comparison has to be made between these costs and the gross savings (which are the differences in road user cost when vehicles operate on the existing highway in one case and on an improved road on the other) for each of the two projects.

Total gross savings over 10 years less maintenance and resurfacing costs (also over 10 years) give the total net benefits which are then compared with the initial investment or construction costs to arrive at the total return on investment over 10 years, expressed in terms of percentage. From this, the average annual return on investment or the benefit ratio is obtained.

In comparing project 1 (Kumasi road) with project 2 (Kumasi-Yeji road) using this method of calculation, it is found that Kumasi-Yeji road has a higher benefit ratio. It exceeds the benefit ratio of the Kumasi road by about 7% (refer tables 1 and 2).

Method II

This is another method used in the determination of the benefit ratio. Here, the initial investment does not take the form of a grant but rather the form of borrowed capital and is therefore repayable. Since the analysis extends over a period of 10 years, the initial cost will have to be repaid by the end of the tenth year, i.e. one-tenth of the cost is repayable annually. This provides for the amortization of the initial investment.

Since capital is borrowed, interest has to be paid and the rate charged is 12% per annum, which is the bank lending rate of the government now used. The interest has to be included in the annual highway costs on a declining balance, i.e. in the first year, 1976, interest will have to be paid on the full amount of the initial investment. In the second year, 1977, however,

[illegible] 13

[illegible] - [illegible]

Initial Investment on Construction Cost = $3,975,000	[illegible] $	[illegible] $	[illegible]	[illegible] $	[illegible]	1971 $	[illegible] $	[illegible]	[illegible]	[illegible]
Annual savings, discounted at 5½% to present value, of operating costs of										
5-ton trucks	1,1[illegible],649	1,[illegible]1,240	[illegible]	2,2[illegible],715	2,[illegible],077	3,[illegible]	[illegible]	[illegible]	7,2[illegible]	7,[illegible]
6-ton trucks	521,233	[illegible],311	[illegible]	1,[illegible]7,7[illegible]	1,2[illegible]	1,[illegible]	[illegible]	2,[illegible]7	3,[illegible]	4,[illegible]
Vans	20,3[illegible]	2[illegible]	[illegible]	40,2[illegible]	50,[illegible]	63,302	[illegible]	[illegible]	12[illegible]	[illegible]
Buses	3[illegible],[illegible]	[illegible]7,1[illegible]	[illegible]	713,107	[illegible]	1,133,510	[illegible]	1,7[illegible]	2,[illegible]	2,[illegible]
Cars	537,[illegible]	711,[illegible]72	[illegible]	1,113,[illegible]	1,4[illegible]	1,7[illegible],003	[illegible]	[illegible]	3,[illegible]	4,41[illegible]
Taxis	[illegible]	7[illegible],020	[illegible]	113,107	1[illegible]	1[illegible],507	[illegible]	[illegible]	37[illegible]	[illegible]
Annual Gross Benefits	2,701,1[illegible]	3,[illegible]	[illegible]	[illegible],124,[illegible]	[illegible],173	8,3[illegible],118	[illegible]	[illegible]	1[illegible],720,3[illegible]	1[illegible]
Less Maintenance and resurfacing costs discounted at 4½% to present value	74,[illegible]	71,73[illegible]	[illegible]	[illegible],[illegible]32	[illegible]	[illegible],144	[illegible]7,[illegible]	[illegible]	[illegible]	[illegible]
Annual net benefits	2,[illegible],1[illegible]	3,[illegible]	[illegible],77,[illegible]	[illegible],275	[illegible],421,3[illegible]	8,334,974	1[illegible],[illegible]7,270	1[illegible]	1[illegible],[illegible]7,[illegible]	1[illegible]

Total net benefits over 10 years = $90,533,12[illegible]

Return on Investment = $\frac{9[illegible],121}{3,975,000}$ x 1[illegible] = 2,277[illegible] over 10 years

Average Return on Investment per year = 227.7[illegible]

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paid in the process of amortization in the previous year (1966), interest need be paid on the outstanding balance only.

The annual highway costs will therefore, not only include maintenance and resurfacing but also provide for amortization and interest payable on the borrowed capital.

In discounting, rehabilitation and resurfacing costs, a rate of 4% per annum will be used as it is said while benefits will be discounted at the rate of 5% per annum.

The benefit ratio or return on investment over the period of 10 years is determined by the formula:

$$\text{Return on investment} = \frac{\text{total net benefits}}{\text{initial investment}} \times 10$$

From this, the average annual return on investment can be obtained by dividing the result by 10.

In method II, results indicate that there is a preference for project II (King Gates - Tuff) because the benefit ratio for this project is 249.3% as compared to 214.7% in the case of the Lennox and Addington project, the former exceeding the latter by 34.6%. The same percentage is the case as in method I. Figures do not fit show the average annual return on investment under method II.

Comparison Results of the two methods

When methods I and II are compared, it is found that in the Lennox and Addington project, the ratio calculated by method I exceeds the ratio of method II by about 13%. Similarly, in the King Gates road project, the results of method I also exceeds that of method II by 13%. This difference is due to the fact that in method II allowance is made for the amortization of the initial investment and for the payment of interest and hence it can be expected that the average annual return on investment will be lower.

Whether method I or method II is employed in calculating the benefit ratio, results show that the King Gates road is to be preferred since its benefit ratio exceeds that of the Lennox road by about 7%. This means that in the competition for limited resources, project II should be given priority.

TABLE 20

[illegible] - TOTAL [illegible]

Initial Investment or Construction Cost = $3,37[illegible],000	19[illegible] $	19[illegible]7 $	19[illegible] $	1969 $	19[illegible] $	1971 $	1972 $	1973 $	1974 $	1975 $
Annual savings, discounted at 5½% to present value, of operating costs of										
5-ton trucks	1,1[illegible],649	1,[illegible]1,240	1,032,250	2,203,718	2,055,477	3,[illegible]24,010	[illegible],034,38[illegible]	5,72[illegible],57[illegible]	1,204,[illegible]	7,[illegible]
8-ton trucks	121,33[illegible]	[illegible]3,311	[illegible]	1,027,73[illegible]	1,270,06[illegible]	1,[illegible]	[illegible]	2,[illegible]	3,2[illegible]	[illegible]
Vans	20,33[illegible]	25,557	32,353	40,203	50,4[illegible]	63,302	7[illegible]	[illegible]	[illegible]	[illegible]
Buses	3[illegible],30[illegible]	[illegible]37,[illegible]	[illegible],237	710,147	802,709	1,103,013	[illegible]	[illegible]	2,204,[illegible]	2,037,2[illegible]
Cars	5[illegible]7,001	711,[illegible]72	[illegible]92,[illegible]75	1,118,[illegible]	1,40[illegible],[illegible]15	1,7[illegible],033	[illegible]	2,7[illegible]	3,[illegible]	[illegible]
Taxis	63,[illegible]	7[illegible],[illegible]20	[illegible],321	113,527	1[illegible],118	153,537	[illegible]	[illegible]	374,2[illegible]	[illegible]
Annual gross benefits	2,73[illegible],1[illegible]5	[illegible]	[illegible],2[illegible],812	[illegible],124,357	[illegible],[illegible],179	8,3[illegible],110	[illegible]	[illegible]	[illegible]	[illegible]
Less Maintenance and resurfacing costs										
discounted at 4[illegible]% to present value	74,[illegible]	[illegible]	68,[illegible]	65,682	62,259	60,144	57,[illegible]	[illegible]	52,7[illegible]	[illegible]
One-tenth of construction cost	337,[illegible]	[illegible]7,[illegible]	337,[illegible]	337,500	337,500	337,500	337,[illegible]	337,[illegible]	3[illegible]7,[illegible]	337,500
5½% interest on declining balance	21[illegible],[illegible]	[illegible],7[illegible]3	17[illegible],[illegible]	153,038	131,1[illegible]	10[illegible],313	57,450	[illegible]	42,[illegible]5	21,[illegible]
Total annual highway cost	6[illegible]1,0[illegible]1	[illegible],[illegible]3	[illegible],035	[illegible],[illegible]20	591,529	56[illegible],557	542,[illegible]	[illegible]	4[illegible]	4[illegible]
Annual net benefits	2,0[illegible]	[illegible],71[illegible]	3,652,777	5,508,737	[illegible],092,650	7,822,141	1[illegible],022,326	12,772,321	1[illegible],22[illegible]	1[illegible],[illegible]73,2[illegible]

Total net benefits over 10 years = $80,[illegible],681.

Return on Investment = $\frac{[illegible]}{3,[illegible]}$ x 100 = 2,1[illegible]% over 10 years.

Average Return on Investment per year = 21[illegible].7%

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TABLE 21

[illegible] OF [illegible] - KUALA LUMPUR

	1965	1967	1968	1969	1970	1971	1972	1973	1974	1975
	1	2	3	4	5	6	7	8	9	10
Initial investment on construction cost = $7,750,000										
Annual savings, discounted at 8% to present value, of operating costs of										
5-ton trucks	3,183,360	3,930,177	4,939,379	6,104,780	7,770,565	9,760,685	12,277,523	15,431,128	19,421,879	24,447,731
6-ton trucks	1,221,237	1,502,777	1,914,922	2,411,163	3,[illegible]	4,[illegible]	6,777,122	[illegible]	7,[illegible]	[illegible]
Vans	46,773	[illegible]	72,400	92,267	11,761	145,[illegible]	182,453	229,[illegible]	[illegible]	[illegible]
Buses	1,[illegible]	1,[illegible]	1,[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cars	1,227,[illegible]	1,[illegible]	1,[illegible]	2,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Taxis	150,[illegible]	[illegible]	2[illegible]	2[illegible]	3[illegible]	4[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total gross benefits	6,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Less Maintenance and renewals; costs discounted at 8% to present value	310,967	[illegible]	292,[illegible]	278,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
One-tenth of construction cost	775,000	775,000	775,000	775,000	775,000	775,000	775,000	775,000	775,000	775,000
8% on declining interest	387,500	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Total annual highway cost	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Annual net benefits	5,[illegible]	[illegible]	[illegible]	12,101,253	[illegible]	[illegible]	[illegible]	[illegible]	41,[illegible]	[illegible]

Total net benefits over 10 years = $[illegible],332,457.

Return on investment = [illegible],332,457 / 7,750,000 x 100 = 2,[illegible]% over 10 years.

Average Return on investment per year = 204.3%

Average Return on investment per year if existing highway is retained = 277.5%

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So far, it has been assumed that once a new proposal has been accepted and implemented, the existing highway (with which the new road is competing) would cease to be retained, i.e. it could be allowed to deteriorate to maintain it. This assumption is implicit in the calculation of the return on investment on both methods 1 and 2.

However, if it is felt that if Gates Road were to be built, existing highway A would have to be retained for the use of those vehicle operators who find it convenient or necessary to operate on this road. For example, traffic bound for Denton from Temerlon and vice versa will have no choice but to use existing highway A since Glen Gates Road does not enable traffic to reach Denton, and Denton traffic cannot be diverted. Moreover, traffic from the West Bend for Denton and vice versa may not require the use of existing highway A, especially when vehicles operate between Denton and those areas not accessible by Glen Gates road. In this case, when the government decides to continue maintaining existing Road A highway A, the return on investment on the Glen Gates project will have to be altered. Present value of the maintenance and resurfacing costs of the Bario highway will have to be subtracted from the total net benefits and a new return on investment calculated.

As can be expected, the return on investment after providing for the maintenance of the existing highway, will be lower. Tables 19 and 20 show that the new return on investment is changed by about 1%.

However, if the tunnel road were to be accepted and made ready for use, existing highway A will not be retained, since traffic to and from Denton can operate on the new road at no extra cost (in fact at less cost). Hence, no new return on investment covering for the maintenance of existing highway A as required in the case of the tunnel road.

Even after consideration has been given to the government's desire to retain existing highway A, the new return on investment for Glen Gates road still indicates that it should be given priority as compared to the return on investment for the tunnel road which does not provide for the maintenance of the existing highway.

Conclusion

Although the project for Glen Gates road involves a greater or the same amount of the project for the

channel flow, it is a more worthwhile alternative on the basis of the analysis made. This is not to prove that the cheapest project is not necessarily the one which has cost the least money for least money in this case, but the one which yields the greatest returns in proportion to the amount invested on it. This is an important point to note in the planning and design of highway facilities.

Interrelated projects such as the two under analysis, mean/ that if one is carried out, the other will not, unless an future years need demand dictates the realization of the latter project too. However, once one project is accepted and implemented, the other project cannot be considered a second best unless another cost and gain assessment is made to compare it with other alternative projects and will not be the feasible it is a more worthwhile project than the group of alternatives.

Transportation policy should not only ensure adequate growth of facilities to accommodate economic development but should also ensure that investment is made in each form of transportation in accordance with its potential contribution to an efficient overall transportation system. Government should evolve and keep current and comprehensive plans for its investments in all types of transportation facilities. With each type of facility, it should continue to develop adequate standards of analysis to compare costs with benefits for each project and a benefit-cost analysis provides a rather comprehensive method of comparison and evaluation.