New Approach to Benefit Cost Analysis

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This paper is not a detailed economic or statistical analysis of present methods of calculating benefits and costs of highway construction. It is a short challenge to the basic premise frequently used that if each of two proposed roads will provide the same capacity, but one will yield greater cost reductions than the other, the road which will yield the greater savings in transport cost should be selected. It is the thesis of this brief paper that this conclusion may be false. The solution which requires the least total social (and in some cases social and private) costs for the benefits provided, is the solution to seek. If this solution does require a greater transport investment than some other solutions, but will decrease other costs more than it increases transport costs, it will benefit the community more than a solution with lower transport but higher other costs.

•THE CONVENTIONAL approach to assessment of benefits expected to result from highway construction in the United States uses a comparison of the costs of transportation as currently handled with the expected costs should the proposed construction be completed. The difference between the two calculations is roughly the estimated benefit. Included in the calculations are data on capital costs, operating and maintenance costs, accidents, time savings, and, increasingly, allowances for comfort and convenience. Refinements in the technique are of course legion—for instance, the use of marginal rather than average costs for parts of the calculations. But in essence the difference between the before and after unit costs times the volume of traffic which would move without the new construction plus one-half the additional volume projected as moving because of the lowering of costs and/or increases in capacity indicates the expected benefits, as generally calculated.

Studies of the effects of new transport capacities and of lower transport costs provided in developing countries are helping to create a new dimension to the concept of benefits created by new transport capacities. If a worker could climb palm trees and press palm oil all day long, but has no road, rail, water or air connection to markets, he produces only enough palm wine and palm oil for his needs and those of his wives, children, and any extended family members. He does not produce for sale or for transport to other areas. But once a road is built to his village and traders appear who will buy his palm nuts, palm oil, and palm wine, the subsistence economy begins to wane. Transistor radios, bicycles, clothes, trucks, schools, doctors, agricultural extension workers, even bankers, begin to appear. "Civilization" makes its appearance. Its effects cannot, however, be calculated by the technique which depended basically on multiplying previous traffic potentials by cost savings. No matter how many refinements are made to the marginal vs average cost concepts, how many adjustments are made to the proportion of generated traffic which should be multiplied by the cost savings, or what allowances are given to the comfort and convenience of chilled beer instead of warm palm wine, cost savings formulas do not work. The road has brought a breakthrough to the economy whose measurement requires entirely different techniques.

Those familiar with the economics of developing countries have recognized the existence of breakthroughs resulting from new transport, and other investments, and have learned to use an entirely different technique for measuring the effects of invest-

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ment. In essence, they are using an overall with and without approach: what was the economy like before the investment, what would it become without the investment and what would it become with the investment? With refinements, to be discussed later, the difference between the economy with and without the new investment represents the effects of the investment (benefits). The cost of the new capacities (with adjustments discussed later) can then be compared with the benefits anticipated. Benefit cost ratios, rates of return, and payoff periods can then be calculated, as desired.

A very obvious illustration of the use of this overall net benefit approach occurs in the U.S. today when a firm studies the wisdom of building an access road into a virgin forest. It calculates the gross revenue it expects to receive from the operation, and sets against this the costs it must incur, including the cost of building and maintaining the road. If the difference between the gross income and the gross costs, reduced to a comparable base, represents a high enough return on the investment, and the funds are available, the investment, including the construction of the road, is undertaken. The cost of the road is not examined as a separate item. The least expensive investment for meeting transport needs satisfactorily is decided upon, of course, but transport is only a part of the overall operation. Total revenues and total costs are considered. This is in essence also the approach that must be used in calculating the economic benefits and costs of putting a road into an underdeveloped area of a new developing nation.

The lessons being learned in the use of such an overall approach for the transport investment decisions of large companies, and of developing countries, may be applicable in considerable measure to benefit/cost transport studies for the highways of the United States.

The use of this approach already used in developing countries may become more difficult as the economic effects become increasingly diverse and hard to measure, and as the investments that accompany or follow the new transport capacity become more diverse and harder to measure—or even to foresee. Nevertheless it is a feasible method, and often the best method theoretically and pragmatically.

It is suggested, therefore, that the general rule should be that the total cost of the new investment required for the growing economy of the area must be matched against the value of the increase in the volume of production and services—the value of the growth in the area—as a first step. If, and only if, the value of the expected growth in the economy is greater than the cost of the total investment, is the proposed highway investment worth examination. If it is worth examination, the second step requires a judgment as to the difference between the value of the potential growth in the economy with and without the proposed road. If the development as a whole is warranted, and if the cost of the road is less than the value of the increase in the economy that will occur only if the road is built, the road is worth building. Whether another investment would be still better is another matter, and needs a separate analysis.

It may be that if transport capacity is provided in one area, a $7 million investment in roads and a $68 million investment in other fields would bring a benefit of $150 million; while in another area a $5 million investment in roads would require a $95 million investment in other utilities to bring a benefit of $150 million. A total new investment of $75 million including a $7 million road outlay would yield a B/C ratio of 2/1; an investment of $100 million including a $5 million outlay for roads would yield a B/C ratio of 1.5/1—though the road cost in the second case is only 5/7 as great as it is in the first case. If the transport analyst is asked to report on one of these alternatives, using this technique, he would report a 1.5/1 B/C ratio for the $5 million road cost and $100 million total investment cost, and a 2/1 B/C ratio for the $7 million road cost and $75 million total investment opportunity. He would report that while the second road cost more, ancillary costs would be less, and the total investment required would be less per unit of return in the second than in the first case.

This may be the opposite of a report based on savings in transport cost. In the second instance we could be dealing with a generally unbuilt area. It will require additional utilities, schools, housing, etc.; but that would be ignored if the analysis is based on transport savings alone. The analyst working on the first case would find that, in view of the fact that transport over the available poor road was, and would continue to be, expensive, the new road would cut present costs appreciably. As traffic increased, without a new road congestion would increase and costs would rise. So the new road would cut future costs even more. And, as the capacity of the existing road is limited, the increased volume of traffic on the new road would be very appreciable. An allowance for half the new traffic times the difference between the present costs (to say nothing of future costs on the existing road) and costs on the new road would increase projected benefits even more. The end result might be a return on the investment of 20 percent or more.

If this conventional analysis is applied to the first instance the analyst would find himself dealing with a neighborhood which has most of the needed facilities—factories, stores, houses, etc.—together with supporting facilities such as hospitals, schools, churches, etc. But he could find the area stifled by a bottleneck in transportation—the lack of a bridge, or a poor connection between roads. If the bottleneck is broken, the economy of the area will expand quickly. Breaking the bottleneck will cost $7 million. Traffic will increase about as much as in the first instance, but savings per unit of travel will be less, because, except at the bottleneck, the existing roads are good, and vehicle per mile costs are low. Savings per mile traveled, and for total traffic, are less than in the first case, and the construction cost is greater, so the return on the investment as calculated by the cost savings approach, is less. The return on the investment may be reported as under 10 percent. The difference between the two results is due of course to the fact that the transport saving approach does not take into consideration costs for things other than transport which are necessary to the local economy.

At first glance it may seem that the use of the total economy approach is too complicated, requires data that are not available, and while acceptable on theoretical grounds, is not a feasible method in the real world.

This need not be so.[1] In order to develop traffic forecasts for B/C analyses even as currently made, it is necessary to have forecasts of economic activity. This requires judgment on the production, distribution and consumption of goods in the area served by a proposed road. A given volume of production will require a given production capacity. If that capacity does not exist, it will have to be built. There are many sources of data on the relationships between investment and production, and investment and value added, in various industries.

The story is similar for distribution. A given figure for traffic involves purchases and sales. There are usable sources of information on sales per square foot, for various types of merchandise. Usable judgments as to the amount of additional retail and wholesale space that will be needed for the projected traffic can be developed from the premises that yield the traffic figures that would be used in a conventional highway feasibility study.

A given volume of traffic under specific conditions promises a given number of home-to-work, home-to-shop, social, and other trips, and therefore, the population and number of households involved and their income. From this can be developed judgments on the prospects for residential and other types of construction, and/or the trend and order of magnitude of the total area income. Expenditures per square foot for retail and wholesale trade, and per unit of production and value added, may be relatively constant within a region for each type of business and may not be difficult to compute.

Outlays for sewer, water, schools, for utilities and services in general, can vary widely per unit of services to be performed. A development in one part of the area may be able to take advantage of existing efficient sewer and water capacities. Elsewhere connections to existing capacities may be expensive, or even not feasible. Schools, churches, libraries, parks, etc., may be available to one part of the area but not available in another. If development proceeds where those services are not available, they will have to be supplied at a high cost.

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[1]For an illustration of how to study the impact of a location decision on a local economy see "An Analytical Technique for the Selection of Federal Employment Center Locations in the National Capital Regions," by Lestor Tepper and Frank Piovia, published by CEIR, Inc.

Alternative road proposals therefore may imply alternative utility and related costs which can be measured at least roughly. Even if the private investment figures for the area are inadequate, the utility and related cost figures should be usable.

If a judgment can be reached without the inclusion of information on private investment, should the analyst go to the time and trouble of trying to develop such information? The answer would appear to be no, except in two types of situations: (a) if it is clear that there will be a sizable difference in the private investment required for possible alternative solutions, and (b) if the case is a close one without the inclusion of data on the relative private investment requirements of alternative solutions.

The first exception could occur if one proposed route would lead through an area already relatively well developed and having unused efficient industrial, commercial, and other capacities, while the alternative route would go through undeveloped land and would handle little traffic until new factories, stores, housing developments, etc., were built. In such a case, the first road would appear to require much less in the way of private investment than the second.

A question may arise, however, about the quality of the existing private capacities—are they really efficient? It may be that existing capacities should be moved to reduce production and distribution costs, or that extensive remodeling of both the private facilities and the transport and other services will be required. This could be quite expensive—possibly more expensive than building a new complex from scratch. The choice between relocation and rehabilitation therefore may not be obvious. Should another 123 be built, or should the downtown be remodeled? The remodeling solution may be cheaper but not simpler. If it is the cheaper solution, it still may not be an acceptable solution because of legal, political, or institutional difficulties. If this is the case, however, it would seem that those making the decision should know how much more the 123 solution would cost than would the rehabilitation solution. But the decision may not require this knowledge.

The second situation in which an estimate of the private investment requirements of alternative solutions is desirable is that in which there is little to choose between the costs and benefits, or the return on the investment, of the public expenditures required under various alternatives. If it appears that the private investment required may differ appreciably, so that the totals will differ markedly between the alternatives, then at least the differences between the private investment requirements should be put into the equations.

The general conclusion, therefore, is (a) decisions should not depend on the differences between the B/C ratios or yields on the transport investment alone; and (b) while for a perfect analysis total investment requirements should be matched against total benefits, as a matter of practice the matching of total government outlays (not just highway outlays) against total benefits may yield enough data for the cases in which it is known that the differences in private investment requirements will not affect the decision.

This conclusion may seem to run counter to the concept that the beneficiary should pay for his benefit. If spending $2 million more on roads saves $4 million on water and sewer costs, this analysis suggests that we should spend the extra $2 million on roads. The highway user should, the logic implies, subsidize the users of the sewer and water systems.

This is a nice problem in external economics. It suggests one further reservation. If beneficiaries are clearly distinct, the costs and benefits should be linked; in this illustration a sewer and water tax, a special benefit assessment, should be levied to meet the additional $2 million road cost. However, if in general the beneficiaries of the sewer and water systems are the same as the beneficiaries of the transport system, it may not be worth the extra cost of setting up the special benefit assessment in order to achieve theoretically perfect equity.

This discussion is intended to be provocative and illustrative, not detailed and conclusive. I hope it will stimulate serious and meticulous discussion of the points it adumbrates.