rather than to refined analyses of largely unimportant numbers. Revitalization of urban areas, more-efficient patterns of land use, and favorable redistribution of income are potential consequences of transit investment, but these impacts will occur only under nearly ideal conditions. Actions taken on the part of all the levels of government involved in a transit investment will have a greater effect on the outcome than will efforts to predict scientifically the exact impacts of each alternative investment, but careful analysis is still required.

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Lessons from an Economic Analysis of an Intercity Road in a Hypothetical Developing Country

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An economic analysis of a proposed intercity road in a developing country is presented. The case is hypothetical, but the data have been selected to be representative of several real-world nations. This analysis extends current efforts by considering pricing adjustments, including inflation, shadow-price premiums, and utility premiums. Results then are judged on the basis of seven economic indicators for three sets of conditions: (a) variations in inputs, (b) inclusion (or exclusion) of different pricing adjustments, and (c) alternative projects. The results lead to lessons for economic analysis, some of which have never been expressed before.

Part of a World Bank project to develop a set of guidelines for highway-project appraisal for training purposes involved creation of a hypothetical case study. This was intended to describe the joint use of many of the procedures currently in practice or proposed for the economic analysis of intercity road projects in developing countries. To my knowledge, these procedures have never been totally employed in any real-world project, so that a sample application, although hypothetical, might prove to have some useful lessons for both technicians and decision makers. It should also be noted that, although the example is hypothetical, the data are considered to be representative of conditions in some developing countries.

HYPOTHETICAL SITUATION

The case study proposed here involves the hypothetical country of Alfredo, which has a population of about 3 million. It is a relatively small country (about 250 km by 250 km). The middle part of the country is mountainous and has elevations up to 2000 m. Because of the elevation, the climate in the central area is moderate; temperatures range from 15° to 26°C. Hence a large proportion of the population has elected to settle in that area, which also is the location of the capital.

A major ocean port city is located about 100 km to the east of the capital (see Figure 1). The terrain between the two cities can be divided into two parts. The first 50 km from the capital is mountainous, but there is a gentle decline to sea level. The remaining 50 km is essentially flat and has many swamps and marshes. The climate in this comparatively sparsely settled region is tropical; the rainy season lasts about five months. As a result, there is some (although not severe) flooding during that time.

The main redeeming feature of the lower region is that, in those parts in which the soils are suitable (about 30 percent of the region), abundant crops, especially fruits, can be grown. These can be and have been marketed commercially.

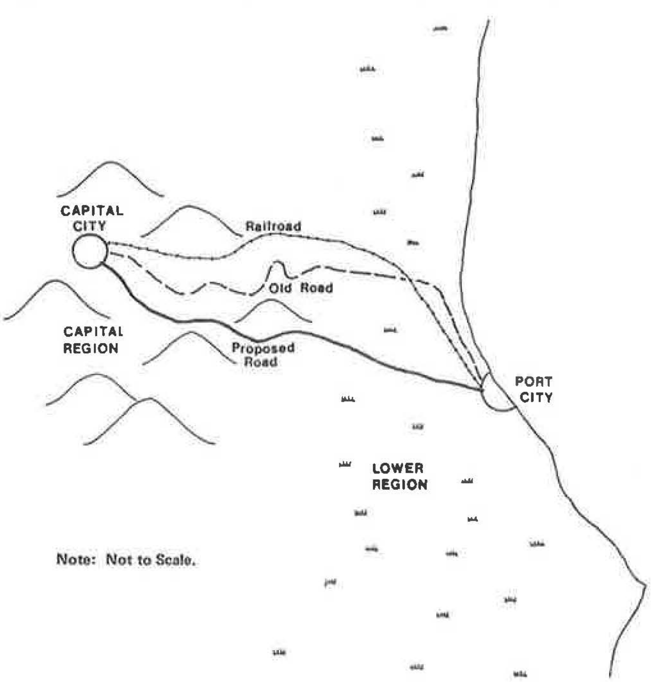
Mean per-capita income in Alfredo is about $700 (1975 U.S. dollars). Although the real gross national product (GNP) per capita increased nicely at about 4 percent/year up to 1974, it started to decline and perhaps became negative in 1975. This was due in great measure to large increases in the price of oil imports.

Transportation between the capital and the port is not the best. Through service is provided by the National Railroad Agency, which uses a narrow-gauge line built in the 1860s. It usually takes 7 h to cover the 110-km stretch of line. A slightly longer (120 km), more-circuitous road parallels the rail line most of the way. The road is graveled but has some steep slopes and hazardously sharp horizontal and vertical curves in the mountainous portions. The entire trip by road generally takes 3.5 h by automobile and 4.5 h by the average truck. Portions of the road are closed, however, during most of the rainy season, so it is difficult to make a trip at that time. The railroad is somewhat more reliable in this respect, since it is located on higher ground in the mountainous section.

A new roadway from the capital to the port city has been proposed. It would pass through an area in which many poor farmers now reside and would provide a market connection to the capital and the port. The proposed highway, which would be paved and more direct (only 100 km in length), would cut the city-to-city travel time by automobile from 3.5 to 2.5 h and by truck from 4.5 to 3.5 h.

There is a strong possibility of a Global Lending Bank (GLB) loan to help pay for the capital investment in the road (and also for some maintenance buildings and equipment). The loan would be made and repaid in U.S. dollars at the current interest rate of 7 percent/year, and repayments would start after completion of the highway.

Figure 1. Alfredo: main transport links between capital and port city.



ALTERNATIVES

Although the new road was assumed as a "given" in the analysis, several other complementary actions were possible. First, the GLB loan could be rejected and the project funded entirely by the government of Alfredo. Second, construction could be delayed for various lengths of time. Third, labor-intensive techniques could be employed for both construction and maintenance. Fourth, in conjunction with rural credit programs, loans and grants could be made to enhance vehicle ownership by the poor. These four alternatives were assessed in this study, and in addition sensitivity tests and risk analyses were made on certain inputs (e.g., prices).

ANALYSIS

Several goals and indicators for economic impacts were identified as being important. These are listed in Table 1. The first two impacts are of concern to the user, the third to the government agency that pays for the facility and its maintenance, the next two to the nation as a whole, and the sixth to the poor in the impacted region. An additional indicator, to be described later, is the overall net present utility (NPU) (1).

As a means of analyzing these indicators, those affected by the road were divided into four groups (2):

1. Government of Alfredo (various ministries),
2. Skilled workers (assumed to be the relatively rich),
3. Unskilled workers (assumed to be the relatively poor), and
4. "Foreigners" (those outside the country who were gaining or losing foreign exchange).

The ensuing analysis involved a process that had 11 main steps, as shown below (3-8) [the price unit in Alfredo was called the "numero," symbolized by the number sign (#)].

1. Estimate construction and maintenance costs (current #);
2. Estimate unit user costs (current #);
3. Estimate traffic levels (vehicle miles of travel);
4. Estimate loan costs (current #);
5. Estimate changes in technology;

Table 1. Goals and indicators for selected economic factors.

Impact Factor	Goal	Indicator
High cost of travel	Reduce cost	User costs (time, fuel, maintenance)
Low benefits	Increase benefits	Difference between amount users will pay and amount actually paid
High cost of transport facilities	Reduce cost	Construction and maintenance costs
Lack of foreign exchange	Increase foreign exchange	Net foreign-exchange funds
Lack of investments	Increase savings	Net savings
Low income	Increase income	Per-capita utility of income
Lack of overall value	Increase value	Net present utility

6. Estimate fuel-tax revenue (current #);
7. Estimate discount rate;
8. Estimate rates of inflation;
9. Establish shadow prices (premiums) for (a) skilled labor, (b) unskilled labor, (c) foreign exchange, and (d) savings (as opposed to consumption);
10. Establish utilities of income (premiums) for skilled and unskilled labor; and
11. Estimate economic indicators.

For ease in understanding, the exchange rate at the beginning of 1975 (the first year of the project) was set to be #10 = $1 U.S. The construction period was to be four years (1975-1979) and there was to be a horizon period of 20 years (1980-1999) beyond that.

In the analysis process described above, the first step was to estimate construction and maintenance costs in current numeros. This was a relatively straightforward and common task, as was estimating user costs and traffic levels (steps 2 and 3). In step 4, forecasts were made of principal, interest, and loss of foreign exchange associated with the proposed loan from GLB.

Step 5 involved guessing future vehicle fuel efficiencies as affected by new technologies. Similar rough estimates had to be made for technological changes in maintenance procedures. In fact, both were assumed (in the base case) not to change at all.

Given traffic levels, fuel efficiencies, and tax rates, it was then possible to estimate tax revenues (step 6). All this was done in current numeros. In the next four steps, however, attempts were made to adjust the prices from the previous steps by (a) discounting them according to the time in the future at which they occurred (step 7), (b) estimating inflation rates and subsequently changing current to constant numeros (step 8), (c) establishing shadow prices or opportunity costs for most of the price items (step 9), and (d) determining weights or utilities of the resultant incomes to each group described earlier (step 10). The final outputs (step 11) were scores for each of the seven economic criteria listed in Table 1.

Step 1: Estimate Construction and Maintenance Costs

Construction costs were divided into eight categories (e.g., cut/fill, bridges). Total cost (in current numeros) was estimated at #150 million for the 100-km, two-lane road, or approximately $150 000 U.S./km. Maintenance on the new road was expected to start at #2 million/year in 1980 and continue from #2.8 million/year in 1975 for the old road (which was assumed to be kept in passable condition).

Step 2: Estimate Unit User Costs

Three types of user costs were considered--fuel, time, and vehicle maintenance (9). These were computed for three kinds of vehicles--automobiles, trucks, and trains. Fuel costs for automobiles, for instance, were set to be #0.50/km on the existing road in 1975 based on an average fuel efficiency of 10.63 km/L and a cost of #5.31/L. Because of its improved geometrics, the new road was expected to reduce unit travel costs by 10 percent. In addition, the new road was 20 km shorter than the old one.

Step 3: Estimate Traffic Levels

Distance per trip for both automobiles and trucks was presumed to be reduced from 30 to 20 km by using the new road. This, of course, was associated with the more-direct routes and faster travel times (6,7). Traffic volumes, expressed as average daily traffic (ADT), were set at 1000 for automobiles and 1400 for trucks in 1975; growth was to be at 6 percent annually (regardless of any other conditions). It was felt that 95 percent of traffic on the old road would be diverted to the new and that an additional 20 percent of traffic would be made up of induced traffic.

Step 4: Estimate Loan Costs

The loan from the GLB was assumed to be paid in U.S. dollars; repayment was to be in that same currency. With Alfredo's numeros set to inflate at 13 percent/year and the U.S. dollar at 10 percent (step 8), the exchange rate in numeros per U.S. dollar would increase from 10 in 1975 to 19.07 in 1999. With a GLB loan of #75 million (half the construction cost), Alfredo would have to repay a total of #195.6 million. Of this, #75 million would be the principal; #66.6 million, interest; and about #54 million, loss on foreign exchange because of inflation of the numero relative to the U.S. dollar. Note that the third value almost equals the interest and is more than 70 percent of the principal (5).

Step 5: Estimate Changes in Technology

In the base case no changes were assumed in vehicle-fuel technologies or in road-maintenance procedures. The former may be unrealistic, given recent improvements in engines, but then fuel efficiency is already high in most developing countries.

Step 6: Estimate Fuel-Tax Revenue

Given the fuel-tax rate on a numero-per-liter basis, we can forecast revenue in each year R(t) by using the following equation:

$$R(t) = \sum_{m=1}^{M} \sum_{f=1}^{F} [365A(m,f,t)K(m,f,t)T(t)]/E(m,f,t) \quad (1)$$

where

M = total number of modes,
F = total number of facilities for a given mode,
A(m,f,t) = ADT of mode m on facility f in year t,

K(m,f,t) = mean trip length of mode m on facility f in year t,
T(t) = tax rate (#/L) in year t, and
E(m,f,t) = fuel efficiency (km/L) of mode m on facility f in year t.

Step 7: Estimate Discount Rate

Estimation of the discount rate is always a difficult task. However, since rates of return on many World Bank projects range from 10 to 20 percent, a value of 15 percent was felt to be reasonable (5).

Step 8: Estimate Rate of Inflation

Estimating the rate of inflation was another difficult, yet important, task. Price rises in petroleum assuredly will continue at a high rate, whereas those for, say, aggregate for subbase construction may increase much more slowly. Subsequently, rough estimates of annual charges in percentage per year (presumed constant into the future) were made for each input item, as shown below:

Input Item	Rate (%)
Skilled labor	16
Unskilled labor	12
Machinery	10
Land	17
Petroleum	20
Aggregate	5
Other materials	10
Overall	13

Step 9: Establish Shadow Prices

Four types of shadow prices were set, as indicated in the list above. Skilled laborers, generally considered underpaid in developing countries, were given a premium of +20 percent of their wages. Unskilled laborers, usually overpaid relative to what they would receive in a completely competitive environment, were assigned a premium of -30 percent. Foreign exchange, in great demand, was given a premium of +50 percent (1,4,10).

Since there is a tendency in developing countries to consume rather than to save (invest), a shadow-price premium for savings was needed. According to the United Nations Industrial Development Organization (UNIDO) Guidelines for Project Evaluation (4), this can be estimated from the following equation:

$$SPI = [(1 - RRMPRO)(RRMIPS)]/(SRD - RRMPRO*RRMIPS) \qquad (2)$$

where

SPI = shadow price for investments,
RRMPRO = rate of reinvestment of private-sector profits (40 percent),
RRMIPS = annual private-sector return on investment (20 percent), and
SRD = social rate of discount (15 percent).

By using the assumed figures (in parentheses), SPI turns out to be 1.71. Marginal propensities to save were set at 0.20 for skilled labor, 0.05 for unskilled labor, and 0.15 for government workers.

Step 10: Establish Utilities of Income

Establishing utilities of income was perhaps the most difficult task, since it is discussed much but rarely practiced (11). Almost everyone agrees that one unit of money is worth much more to the poor than to the rich. Consequently, we selected a utility premium of +50 percent for each added numero of income to the poor (unskilled labor). For the rich (skilled labor), the utility premium was -50 percent.

Step 11: Estimate Economic Indicators

Based on the preceding estimates, we were able to make forecasts of the seven economic indicators listed in Table 1. The net present utility (NPU) was the sum of the discounted income that accrued to each of the four groups of people combined with the weighting by the utility premiums identified in step 10. To carry out this process, we had to follow these procedures:

1. Take benefits as the consumer surplus under each demand curve (assumed linear),
2. Set the distribution of benefits and costs according to the group affected, and
3. Set the flow of income from one group to the other.

As an illustration of the latter two procedures, it was assumed that skilled labor (the rich) would obtain 100 percent of the benefits to automobile traffic and 70 percent of those to truck traffic, since they are predominantly the owners of such vehicles. Still, in the case of trucks, they must transfer some of these benefits to hired drivers (unskilled labor) in the form of wages and all the fuel-tax payments to government. Similarly, government must transfer money to both skilled and unskilled labor for payment for road construction and maintenance.

RESULTS OF ANALYSIS

Several sets of runs were made by using the analysis procedures described above. These runs were divided into three classes:

1. Sensitivity tests on inputs,
2. Inclusion (or exclusion) of various pricing adjustments (steps 7-10 above), and
3. Tests of project alternatives.

The results of these runs are presented in Table 2.

Base Case

If the decision were made to implement the project as initially proposed, it would appear to be highly advantageous as opposed to the "do-nothing" alternative (Table 2, base case). User travel costs would be reduced #1318 million, whereas the corresponding benefits would increase #892 million over the lifetime of the project. Relative foreign-exchange gains would be a wholesome #892 million (however, as it turns out, actual foreign-exchange deficits would continue to mount, although not so quickly). Investments by government and the public at large would rise by about #486 million, and the poor in the region would have their net incomes increased by #749 million. NPU would increase by 400 million utiles. The only economic indicator that showed a relative disadvantage was cost, since the new project obviously was going to entail additional expenditures.

Sensitivity to Inputs

Four tests were made on the sensitivity of the base-case results to changes in various inputs. In the first, the social discount rate (always difficult to establish) was assumed to be 25 percent rather than 15 percent as in the base case. None of

Table 2. Results of runs for variations in inputs, various pricing adjustments, and alternative projects.

Variable	Economic Indicator: User Costs (# 000 000s)	User Benefits (# 000 000s)	Project Costs (# 000 000s)	Available Foreign Exchange (#)	Investments (# 000 000s)	Income to Poor (# 000 000s)	NPU (millions of utiles)
Tests on Inputs							
Base case	1318	2024	175	892	486	749	400
Social discount rate, 25 percent	1318	2024	175	892	486	749	145
Traffic growth—4 percent automobiles, 5 percent trucks	1092	1450	175	737	359	600	334
Fuel efficiency—4 percent automobiles, 2 percent trucks	979	1886	175	611	410	666	332
Diverted trips, 90 percent; induced trips, 10 percent	1528	−164	175	1027	149	233	248
Pricing Adjustment							
A	1318	2042	175	892	486	749	400
B	709	1721	190	388	353	677	287
C	709	1721	190	388	353	677	191
D	1318	2042	175	892	486	749	477
E	1318	2042	175	892	486	749	365
F	1318	2042	175	892	486	749	565
Tests of Alternative Projects							
No base	1318	2042	175	892	486	749	400
GLB loan	1318	2042	191	878	483	749	330
Delay project	3162	4878	280	2212	1175	1738	561
Use labor-intensive techniques	1318	2042	192	906	483	790	427
Enhance vehicle ownership	1318	2042	175	892	374	1494	433

Notes: Monetary figures are in constant (mid-1975) numeros but are not discounted.
Pricing adjustments are as follows: A = inflation, shadow-price premiums (SPPs), and utility premiums (UPs); B = no inflation, no SPPs, and no UPs; C = no inflation but with SPPs and UPs; D = inflation, no SPPs or UPs; E = inflation, no SPPs, but with UPs; and F = inflation, SPPs, but no UPs.

the first six indicators changed, since they are reported in undiscounted form. NPU, however, dropped to 145 million utiles. Still, this indicates that the rate of return is more than 25 percent, which is acceptable in most circumstances.

Another trial involved lowering annual traffic growth rates from the estimated 6 percent for all traffic to 4 percent for automobiles and 5 percent for trucks. As can be seen in Table 2, this results in lowering most of the indicators by 20-30 percent. NPU is cut by about the same proportion, from 400 to 334 million utiles. These indices thus would seem to be marginally sensitive to traffic growth rates.

Another sensitivity test was conducted on vehicle fuel-use technologies. It had been assumed for the base case that engine efficiencies would not change over the life of the project. If (as might be the case) the kilometers per liter of automobiles were to increase 4 percent/year and that for trucks 2 percent, the consequence would be a reduction of NPU to 332. This occurs because reducing fuel consumption (and thus costs) through more-efficient engines leaves less room for user cost reductions through better roads, thus the lower NPU. Note, however, that available foreign exchange is less than if traffic were reduced, yet investments and income for the poor are higher.

A fourth sensitivity test involved alternating the percentage of trips diverted from the old road from 95 percent to 90 percent and lowering the percentage of induced trips from 20 percent to 10 percent. These two changes (but particularly the latter) actually made user benefits negative and reduced the NPU to 248 million utiles. (This result seems inconsistent but is in fact possible if construction and maintenance wages, for instance, flow to the poor.) This great change was disturbing because the figure for induced traffic is difficult to estimate and, based on other experiences, conceivably could be only 10 percent.

Inclusion of Price Adjustments

The second series of tests focused on the inclusion of various pricing adjustments in the analysis. What would happen if inflation were not considered (it rarely is in practice), if shadow-price premiums (SPP) were set to zero, and if utility premiums (UP) were not included (there are almost no examples in which they are)? In general, concern is for the veracity of the majority of current economic evaluation efforts, which do not take into account any of these price adjustments.

Row A under Various Pricing Adjustments in Table 2 is in fact the base case, in which all price adjustments are employed. We assume (grandly) that this is the way economic evaluation really ought to be done and that the established adjustment figures are correct. If no adjustments are made (row B), NPU is underestimated by more than 25 percent. Further, user costs and available foreign exchange are about one-half of their "real" value. Interestingly, if the inflation adjustment alone was left out (row C), NPU would be underestimated by more than 50 percent.

The remaining results in this section of Table 2 indicate that if SPPs alone are left out (row E), NPU is underestimated by about 10 percent. If only UPs are set to zero (row F), NPU is significantly overvalued. Finally, if both are ignored (row D), NPU is inflated by about 20 percent.

Project Alternatives

The results relevant to the four alternatives discussed earlier are displayed in the last section of Table 2. If advantage were not taken of the GLB loan, NPU would drop about one-fifth. The reason for this is that the loan provides an opportunity to defer the cost of part of the project to a later date. So, despite the increased costs (interest) and the high weighting given to the resultant additional loss in foreign exchange (down from #892 million to #878 million), the discounting over time would turn out to be a factor of much more consequence.

If the project were delayed four years, benefits would increase even more than costs (when discounted), so that all measures of overall economic viability (except project cost) would improve in comparison with the alternative of immediate construction. This appears to result from the fact that traffic volumes as well as user costs are rising even faster than project costs, so that benefits from reduction in travel cost increase more rapidly.

The labor-intensive construction alternative (8,12,13) led to some interesting results. Because of the anticipated higher construction costs (#228.8 million compared with #206.1 million), NPU would tend to drop somewhat. Yet because of the favorable impact on foreign exchange (less machinery needed) and on the income to the poor, the final NPU would rise to 427 million utiles. The impact from the alternative (14) to enhance vehicle ownership by the poor almost doubled the net income to the poor and raised NPU slightly more than the labor-intensive construction options did.

Lessons Learned

The preceding example, although hypothetical and not representative of conditions in many developing countries, still provides insights into the use of economic analysis in assessing intercity roads in some nations. Many of these lessons are not new, but they bear repeating in the context of a much broader example than has previously been employed. In reviewing these lessons, we must remember that they all are in comparison with the "do-nothing" situation.

1. NPU is, as expected, highly sensitive to the value selected for the discount rate. The selection problem is even more complicated here, however, because we are dealing with a social discount rate (which depreciates future utiles, not monetary benefits) rather than a more-explicit financial discount rate.
2. Fuel-efficiency gains reduce NPU as well as income to the poor and available foreign exchange. Decreased traffic growth also can do this but with less negative impact on foreign exchange and more on income to the poor.
3. Relatively slight changes in the proportions of diverted and induced traffic can have substantial effects on NPU and other economic indicators. This is particularly troublesome given the difficulty of establishing values for the former.
4. Neglecting pricing adjustments will lead to underestimation of most economic indicators.
5. Neglecting inflation alone can lead to substantial underestimation of the economic value of a project.
6. Neglecting SPPs alone has relatively little effect, but this is not so for UPs alone. Together they tend to cancel any effect, but far from completely.
7. Rejecting a partial loan on favorable terms from an international development finance agency will decrease NPU. Still, it should be noted that a major cost of a loan (usually not considered) is a loss in foreign exchange due to variations in exchange rates.
8. Delaying a project increases its value (assuming that traffic volume will continue to increase regardless).
9. A more labor-intensive construction project will increase its NPU, available foreign exchange, and income to the poor slightly.
10. Creating increased vehicle ownership among the poor will substantially improve their income, but NPU will rise about as much as for the labor-intensive project.

These lessons naturally cannot be proved with any certainty, but they should provide the basis for continuing analysis and debate, much of which could not take place in a systematic context without the kind of case study presented here.

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System-Dynamics Approach to Transportation Planning in Developing Regions

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Transportation is not merely a derived demand but a determinant of new production possibilities. To plan successfully for the development of a region, one must understand the possible causal relationships, feedbacks, and interactions among the different sectors of the region, including the transportation sector. In this study the impacts of three investment strategies for the Essequibo coastal region in Guyana are evaluated by using a computer simulation and system-dynamics methodology. The model consists of three main sectors: demographic, economic (primarily rice production and processing), and transportation. The hypothesized intersectoral relationships were first developed through causal diagrams, which were divided into submodels. Second, the submodels were synthesized to form a comprehensive system-dynamics model represented by approximately 230 equations to evaluate three investment strategies: (a) do nothing, (b) invest in roads only, and (c) invest both in roads and in drainage and irrigation. Sensitivity analyses were performed on the key socioeconomic variables to determine which variables most significantly influence regional behavior. The investment both in roads and in drainage and irrigation provided the greatest net benefit and the most favorable socioeconomic characteristics in terms of population level, regional income per capita, out-migration, and unemployment. Thus, given its financial feasibility, this strategy is recommended.

Transportation in terms of economic development is essentially a derived demand and is dependent on the plans and objectives of the other sectors of the economy. Thus, the correct task of transportation planning may be stated as the accomplishment of all necessary movements at a minimum overall cost to the economy.

However, transportation, once implemented, has a significant influence on the demographic and economic sectors of a region (i.e., it tends to regulate or determine the market mechanism and hence the eventual growth rate and specialization of a region). Transportation is therefore not merely a derived demand but a determinant of new production possibilities (1).

In developing countries, this concept of transportation as a determinant of new production possibilities and demographic change is no longer debated but accepted. The search over the past 20 years has been for "more appropriate" methodologies to evaluate the catalytic effects of transportation investments in already identified, resource-endowed regions in order to determine the priority of limited funds, skills, and equipment in less-developed countries (LDCs).

NEED FOR COMPREHENSIVE AND COORDINATED PLANNING

The premise of transportation planning has been that travel demand is repetitive and predictable and that the transportation system should be designed to meet this future demand. Almost invariably, the planning approach has been to solve capacity deficiencies with emphasis on short-term solutions and without due consideration of the long-term problems that might result from such solutions. It is believed that any planning effort focusing on components and not on the total system will more than likely deviate from the designed national goals and objectives. In addition, the very nature of the transport investment (i.e., high costs and difficult transferability) requires a systems approach if unwanted impacts are to be minimized and resource use maximized.

Each year at least 20 percent or as much as 40 percent of the budgets of LDCs is spent on transportation or transportation-related projects. There is a sincere belief that transportation is an obvious prerequisite to increased productivity and national integration. What is also important is that this trend is more than likely to continue in the foreseeable future.

In resource-scarce economies, ill-advised allocation of national funds in transportation can seriously affect the growth of other sectors of the economy, for example, housing, education, and health. Thus, it is absolutely necessary to ensure that the nation does in fact receive the maximum possible benefit from investments in transportation. From another point of view, international organizations and foreign governments are generally involved in the financing of major transportation projects, and these agencies require assurances (through feasibility studies) of the economic viability of the projects before their loans are approved.

Besides the financial constraints, compartmentalization of planning is also a problem. In LDCs, although intermodal transfers are often required before products reach their final destinations, unimodal planning is usually performed and only provides a partial solution to the mobility of resources.

Because a road, a rail, or a shipping route is built to stimulate economic growth, the appropriate basis of measuring benefits would seem to be the increases in production and services instead of rate of traffic flow per day. Thus, accompanying investments must also be considered, since a road or other transport facility by itself is not sufficient to increase production. In this view, the value of output and input that is possibly attributed to the road alone may no longer be of primary interest. Therefore, the overriding interest is the increase in total output (together with the accomplishment of other goals) that can be attributed to the integrated set of investments. Under these circumstances, the reason for estimating traffic volume is