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Abridgment

Economic Analysis of Highway Investment: Recent Developments in Great Britain

A. D. PEARMAN and K. J. BUTTON

ABSTRACT

The problem of evaluating and assigning priority to proposed highway investments continues to pose difficulties, especially in an era of constrained highway budgets and increasing environmental awareness. In this paper recent developments in the economic analysis of highway investment in Great Britain are described. In Great Britain in the late 1970s, a major government inquiry (the Leitch Committee) criticized several elements of the Department of Transport's investment evaluation procedures. Particular attention was given to traffic forecasting methods, the treatment of uncertainty, the use of design standards, and the balance between economic and environmental impacts. The nature of these criticisms is described together with changes they have induced.

Formal economic analysis has for some time been an important input to the decision-making process for highway investment decisions in Great Britain. It has not, however, been without its critics, and in the late 1970s the pressure of criticism grew so great that the government was forced to institute a committee of inquiry into the procedures adopted for assessing major highway proposals. The committee, chaired by Sir George Leitch and usually referred to as the Leitch Committee, has now published its findings (1). The purpose of this paper is to outline the questions asked by the Leitch Committee, to summarize the conclusions it reached, and to assess present British practice in light of the committee's views.

HIGHWAY INVESTMENT APPRAISAL BEFORE THE LEITCH REPORT

Since 1973 COBA, a computer software package for highway cost-benefit analysis, has formed the main underpinning of official appraisal procedures in Great Britain. COBA uses discounted traffic costs and benefits and probably represents the major regular application of cost-benefit techniques for public policy making in any sector in Great Britain. Despite its widespread use, COBA is by no means a comprehensive evaluation tool, a weakness that was particularly germane to the Leitch Committee's deliberations and to the continuing debate on highway appraisal procedures.

Within the framework of Department of Transport (D. Tp.) appraisal procedures, it is useful to identify two components: the inputs to the economic appraisal and the appraisal itself.

Inputs to the Economic Appraisal

There are two particularly influential inputs to the economic appraisal--forecasts of traffic levels and the specification of the scale and detailed design of the proposed highway. The latter depended at the time of the Leitch Committee's investigations on sets of design standards. D. Tp. policy was to plan for the forecast traffic levels 15 years after the opening of a scheme. Some changes have subsequently been made in the specification and use of design standards. These will be discussed in the third section.

The primary input to the economic appraisal is

undoubtedly the forecast of traffic levels, because they have a major influence on both capital costs and potential user benefits. Because of the complex planning and consultation procedures required by each scheme, which can take up to 15 years, and because economic appraisal is based on forecasts 30 years after opening, very long-run traffic forecasts are required. The controversy that surrounded those forecasts is discussed elsewhere (2).

Economic Appraisal

The structure of the software package COBA has not significantly changed in the wake of the Leitch Committee report. D. Tp. has taken the view that, apart from costs directly related to the construction process, the only impacts of a road scheme that can be estimated sufficiently accurately to justify their inclusion in a formal cost-benefit calculation are savings in travel time and vehicle operating costs and accident cost savings.

Time savings are separated in COBA into savings of working time and nonworking time. Together they constitute the major benefit for most interurban road schemes (typically about 80 percent of the total). Working time is valued at its cost (wages plus overhead) to the employer on the grounds that the time saved may be used to contribute to further output, thus benefiting the community as a whole. Savings on nonworking time cannot, of course, be directly evaluated. Before the Leitch Report, D. Tp. had concluded that it would be reasonable to use 25 percent of the average wage rate as a value for leisure time savings. No distinction was made between people with different wage rates. An "equity value" was used, implying the value judgment that all people's leisure time ought to be valued equally, irrespective of their income.

Accident cost savings are assessed on the basis of cost estimates for accidents of given grades of severity. They contain allowances for lost output; medical, ambulance, police, and damage costs; and a notional allowance for the pain, grief, and suffering of victims and relatives. The value of the output of those killed is taken as the discounted value of their expected future earnings. Before Leitch, the values incorporated for pain, grief, and suffering were "guesstimates," biased toward minimum values.

Vehicle operating cost savings include fuel, oil, tires, vehicle maintenance and depreciation (as it relates to use rather than time). Typically, however, operating cost savings do not contribute greatly to the overall benefit of a scheme.

Each scheme input to COBA is evaluated relative to a "do-nothing" alternative. COBA uses a test discount rate (currently 7 percent) fixed by government policy in valuing future costs and benefits, and selection between competing schemes is based on incremental cost-benefit analysis. Clearly there is a wide range, both of benefits and of costs, that is not reflected in the COBA appraisal framework. Some of these benefits and costs were, however, recognized and assessed, although not in the rigorous, quantitative fashion just described. The two that were explicitly considered were regional economic development benefits and environmental factors. The problem of environmental evaluation had been considered in 1976 by the Jefferson Committee (3). The committee argued that it was impracticable to include such factors formally within a cost-benefit analysis, but that D. Tp. should adopt a standard format for their presentation.

How the final priority ranking of schemes was done, given the formal economic analysis of COBA and the more qualitative assessment of regional and environmental impacts, was something of a mystery to the Leitch Committee. D. Tp. stated that the final assessments were made centrally by the department, that schemes with higher economic returns were given higher priority, but that this was by no means the only consideration.

RECOMMENDATIONS OF THE LEITCH COMMITTEE

Inputs to the Economic Appraisal

The committee made relatively little detailed comment about design standards, but it did recognize the important interdependence of design and appraisal. To this end, it expressed the view that D. Tp. should be less rigid in its use of design standards and more willing to use cost-benefit appraisal of alternatives as a basis for selecting highway designs. It was therefore important that the overall evaluation framework be consistent with both its use as a design tool and its use for guiding decentralized minor decision making--notably in terms of the running cost of the associated computer programs.

Numerous criticisms were received about the insubstantial theoretical backing for the use of a logistic time trend projection model for the crucial forecasting of car ownership, about the calibration technique employed, and about the continuing inconsistency between official forecasts of car ownership and actual ownership. In light of the evidence, the Leitch Committee stated that "the Department should as soon as it is practicable move away from the extrapolative form of model currently used towards basing its forecasts on causal models" (1). They recommended that in the future attention be given to the forecasting of car use instead of car ownership, and since then a number of attempts have been made to develop direct, single-stage models of use [see, e.g., (4)]. The committee also recommended that "the Department should indicate the likely range of uncertainties involved in the forecasts and demonstrate the consequences of selecting different values within that likely range" (1).

Economic Appraisal

The implication of this last recommendation for traffic forecasting was that the cost-benefit analysis, however it might be undertaken, could no longer rely on a single series of figures. This issue is discussed later. Of more immediate interest are the views of the committee on COBA and on the balance struck between the output of COBA and the regional and environmental assessments.

The committee recognized that much of the disquiet about appraisal procedures could be traced to the fact that COBA was a partial assessment procedure. The committee recognized, however, that many of the items relevant to a comprehensive assessment were beyond reliable evaluation in monetary terms for the foreseeable future. The committee argued therefore that the best solution attainable was to require that the impacts of each proposed scheme be set down within a framework of the planning balance sheet type, embracing both economic and environmental factors. Impacts would be assessed for five initial incidence groups--road users directly affected, nonroad users directly affected; those concerned with the intrinsic value of the area; those indirectly affected; and the financing authority. This would permit some (albeit crude) statements to be made about the distributive effects of schemes.

Within the framework, where an economic evaluation proved impossible, a numerical index, or a ranking across alternative schemes, or even a verbal description is inserted. In this way the comprehensive representation of all types of effects is encouraged. It was recognized that the preparation of a framework of this type would increase the cost of appraisal somewhat, but because design and appraisal typically accounted for only 3 percent of total scheme costs, it was believed that a small increase would not cause great problems and could yield considerable benefits. In principle it would be possible to use the entries in the framework to conduct a formal multiple criteria analysis. This was not believed to be a practicable proposition, however. Instead the committee argued that the framework should be used as a basis for judgment.

The Leitch Committee also made a number of other, more detailed comments about the economic appraisal process and about COBA in particular, which it did not intend to abandon but merely planned to subsume within the wider framework. It was believed that the specific inclusion of regional development effects was not generally justified. It was also the view of the committee that the "equity value" associated with nonwork travel time was inconsistent with the theoretical basis of cost-benefit analysis and should be abandoned. A distinction should be made, too, between savings of journey-to-work time and other nonwork travel time. Accident costs were regarded as properly treated in principle, except for the evaluation of pain, grief, and suffering. Here it was agreed that use of a minimum figure was inappropriate to a cost-benefit analysis. The minimum figure should be replaced by a central estimate.

CONSEQUENT CHANGES IN APPRAISAL PRACTICE

One significant change that has been made concerns car ownership forecasts. D. Tp. believes that, with the modeling capability currently at its disposal, it cannot realistically forecast a range of possible traffic levels that spans the next 30 years or more with probability assessments attached to different parts of the range. Instead it has published two separate traffic projections, one "high," one "low." The two sets of projections, although they have a foundation in formal modeling, are neither maximum nor minimum levels nor 95 percent confidence levels but merely figures against which it would be prudent to plan. These figures are based ultimately on the subjective views of D. Tp. officials. Although this state of affairs may be a tolerable short-term response to a request for a major change in official practice, it clearly cannot be held to be satisfactory in the long run.

In other respects D. Tp. has reacted more constructively to the Leitch Committee criticism of its failure to allow for uncertainty. One particularly interesting line of investigation (5) had as its aim the identification of the main sources of error in transport models. The implication is that once the more sensitive inputs can be identified, greater concentration can be placed on ensuring the maximum possible accuracy in those places in the modeling sequence where it matters most. The work was done using a Monte Carlo simulation exercise.

It was recognized, however, that the computational requirements of a Monte Carlo simulation were too great to permit its use as standard practice. What has now evolved (6) is a method, based on experimental design techniques, that is far more economical of computer time. Such a procedure would probably require a fourfold increase in processing time, which, relative to the overall costs of a highway investment, is not a great demand. Nevertheless, at present D. Tp. appears unwilling to make a commitment, arguing not only direct financial considerations but also lack of trained manpower.

In many respects it is impossible at this stage to assess the full impact of the Leitch Report on highway appraisal in Great Britain. This is in part because not enough time has passed, but it also reflects the fact that a change in government policy has switched emphasis away from some of the more contentious types of highway proposal toward generally less sensitive issues, such as bypassing small and congested historic towns.

Thus the highway debate has diminished in intensity, but arguably it is not the Leitch Committee that has dispersed the problems. It appears that a change in attitude toward greater openness and comprehensibility in planning procedures may have been instigated, but some would argue that the crucial question, which was not formally within the committee's terms of reference--how does society decide on the type of highways to plan--is the one that is really most needed and still needs to be answered.

CONCLUSIONS

A summary of a series of interesting changes in attitudes and practices concerning highway investment appraisal that are taking place in Great Britain has been presented. These stem in part from the deliberations and recommendations of the Leitch Committee, but they are also a reflection of the changing environment in which road planners in most countries now find themselves operating. In Britain the main developments taking place relate to uncertainty (both about future traffic levels and availability of investment funds) and to increasing concern with environmental and other qualitative consequences of highway investment. It is interesting to note that, although responses may differ, the perception of the problems is similar in Europe and the United States.

The potential for wider sharing of experience and cooperative technical work appears considerable and is not limited to the topics discussed here. Two areas stand out. The first concerns questions at the interface of highway engineering and highway economics:

1. The economic picture of the trade-off between pavement quality and vehicle maintenance costs is not as clear as it should be.
2. The relationship between initial construction cost and long-term highway maintenance cost would benefit from further research.

The second is concerned with more strategic matters:

1. How do we ensure that administrative decisions on speed limits, maximum truck weights, and so forth are correctly integrated with investment policy?
2. Is the transport system as a whole consistently appraised; particularly, are road and rail investments being assessed on an equal footing?
3. Are strategic decisions about highway development being subjected to as searching economic scrutiny as the more functional day-to-day decisions on highway design? If not, to what extent is it realistic to try to extend the scope of economic analysis?

All these are questions with significant technical content, which largely transcends national boundaries and administrative conventions. It is hoped

that growing international awareness, both within the European Community and across the Atlantic, can make a significant contribution to their solution.

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Highway Investment and the National Economy

STEWART E. BUTLER, WALTER E. GAZDA, RICHARD J. HORN,

RENE T. SMITH, HILMY ISMAIL, and ARTHUR L. WEBSTER

ABSTRACT

Analyses conducted by the FHWA have estimated empirical relationships between levels of highway expenditures; the condition of the nation's highways; and highway users' speeds, operating costs, and fuel consumption. In this paper these analyses are extended to explain and quantify the impacts of deterioration of highway performance on (a) the macroeconomic behavior of the U.S. economy and (b) specific industry sectors. The estimated macroeconomic and interindustry impacts are consequences of departures from a base-case, multiyear program of highway expenditures that, by 1995, would restore the physical and operating characteristics of highways to what they were in 1978. Against this base case, this study estimates the consequences of a program of much lower highway expenditures that corresponds closely to FHWA's projections to 1995. The movement from the 1978 service level base case to the low-investment scenario is described in terms of lower highway expenditures and taxes and estimated resultant changes in industrial productivity, motor vehicle depreciation, and highway use. The base case and low-investment scenario are then simulated and compared by a long-term macroeconomic model and by a dynamic input-output model. The macroeconomic impacts are higher prices and lower levels of production, employment, disposable income, consumption, saving, and productivity. Projected impacts on particular industries are diverse. The most adversely affected sectors are for-hire trucking and highway construction firms and their suppliers. Several consumer-oriented industries are also projected to decline because of the weakened state of the overall economy. Several industries closely related to highway use are expected to experience growth in output. These include truck, bus, and trailer bodies; metal stampings; tires; petroleum refining; motor vehicles; and crude petroleum.

Analyses conducted by the FHWA (1) have estimated empirical relationships among levels of highway expenditures; the condition of the nation's highways; and highway users' speeds, operating costs, and fuel consumption. The FHWA Investment/Performance Impact model estimated these relationships for (a) each functional highway class, (b) rural, small urban, and urbanized areas, and (c) four vehicle types. In this paper the FHWA analyses are extended to explain and quantify the impacts of decreases in highway expenditures and highway performance on measures of macroeconomic performance of the U.S. economy. Economic impacts on specific industry sec-