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A POSSIBLE U.S. POLICY TOWARDS INDIAN TRANSPORTATION: AN ILLUSTRATION OF IMPROVED SECTORAL POLICIES

Alan Carlin

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PREFACE

This RAND Memorandum was prepared for the Agency for International Development (AID). The report has both a narrow and a broad purpose. First, it is hoped that this report will stimulate discussion of AID's policy towards Indian transportation as set forth in a recent Long-Range Assistance Strategy document. Second, and more generally, it is hoped that this report will show how sectoral studies can be used in formulating improved sectoral policies. Thus, this Memorandum should be of interest not only to those concerned with Indian transportation policy, both in AID and the World Bank as well as the Government of India, but also to those interested in the AID programming process and in transportation policies in less developed countries.

The author wishes to thank RAND colleagues Michael Intriligator, William Johnson, Frederick Moore, Richard Nelson, and George Rosen for many helpful comments and criticisms. Also particularly helpful were Ralph Hofmeister of the Department of Economics of the University of Minnesota, and RAND consultant John Meyer of the Department of Economics of Harvard University.

NOTES ON UNITS USED IN THE STUDY

In this Memorandum, most values are expressed in terms of the Indian rupee. At the official rate of exchange, one rupee is equal to 21 cents, or Rs. 4.76 to the American dollar. The naya Paise is one-hundredth of a rupee, or .21 of a cent. The "ton" used here refers to the long ton, or 2,240 pounds.

SUMMARY

This RAND Memorandum looks at AID country programming and discusses the merits of the sectoral approach as a supplement to the program and project approaches in assessing the kind and amount of assistance that might be given to a less developed country. The Memorandum concludes that more sectoral studies are needed, and that more effort should be devoted to sectoral policy formulation. Where U.S. aims are mainly economic, useful sectoral policies can be developed by applying existing economic theory to those critical issues that dominate the allocation of resources within a sector. As an illustration of this method, the Memorandum draws on two recently completed detailed sectoral studies and develops a suggested U.S. policy towards Indian transportation, by mode.

In discussing a policy for the Indian Railways, this Memorandum emphasizes the relation of costs to rates. A case is made for basing Indian rates on average operating costs and incremental capital costs. Some inadequacies are pointed out in the existing studies of Indian rail costs (particularly in the India Coal Transport Study), more detailed cost studies are suggested, and more rapid changes in the rate structure are strongly advocated.

As to other modes of transportation, the development of road transport is found to be seriously impeded by government regulations that apparently serve little useful economic purpose. A future may be seen for coastal shipping and extra high voltage transmission in the long run, but these need more study in the near future.

Finally, a case is made for adopting a firmer and better coordinated policy for all U.S. aid to Indian transportation.

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I. ON SECTORAL POLICIES IN GENERAL

At present, AID country programming documents place principal emphasis on the program as a whole and on the individual project, and comparatively little on intermediate levels of aggregation.[1] A major opportunity for improving country programming lies in increased emphasis on these intermediate levels, particularly the sectoral level. The principal requirements for improvement are more and better sectoral studies as background material, and increased effort applied to the actual task of formulating such policy. Before suggesting the advantages of the sectoral level of aggregation, it is important to define just what is meant by a sector and a sectoral policy.

SECTORS AND SECTORAL POLICIES

The concept of a sector is not easily defined, and will be kept flexible for the purposes of this Memorandum. One of the few things that can be said is that a sector is a level of economic aggregation between a national economy and an individual project or firm. Usually it involves the provision of similar services or the production of similar goods. In a small and economically little developed country, AID might find it advisable to distinguish only two sectors, say agriculture, and commerce and industry. In a larger and better developed country, AID might usefully distinguish between a larger number of sectors such as power, transportation, fertilizer, irrigation, other agriculture, cement, steel, and nonferrous metals. The choice should be based on such factors as the organization of the economy and government, the percentage of AID funds in each area, the existing organization of the AID Mission, and the degree to which particular

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[1]The program as a whole is the subject of Parts I and II of the Country Assistance Programs (CAPs) and most of the Long-Range Assistance Strategies (LASs), while individual project discussion takes up most of Part III of the CAPs and the Capital Assistance Papers in the case of capital aid. Intermediate levels of aggregation are confined largely to the "goal plans" of Part III of the CAPs and the sectoral analyses in some of the recent LASs.

alternatives faced by individual projects or firms can more usefully be analyzed on a particular sectoral basis.

A sectoral policy is a statement of general guidelines for selecting projects in the sector concerned and for attempting to exercise U.S. influence over it.[1] The choice of which issues to use in exercising influence in any sector depends upon U.S. objectives in the country and the opportunities for exercising significant influence towards these objectives in the sector. In the case of sectors where the primary U.S. objectives are economic, the critical issues are the major alternatives that affect the allocation of resources in the sector.[2] These are usually found in the broad area where technology and economics meet. In every sector, critical alternatives involving the timing, location, scale, and technology of capital investments as well as economic policies affecting such investments will be found. The trick is to pick out those issues that have a substantial influence on the allocation of resources and where the choice might be significantly altered for the better by U.S. influence. Exercise of such influence can make as real a contribution to a country's economic development as the financial resources provided by foreign aid because it can result in more efficient use of existing or planned capital or other resources.

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[1]Because this study is primarily oriented towards economic objectives, the terminology used will be that of sectoral policies rather than "goals" as in AID parlance. For non-economic objectives, the term goal appears to be more suitable in some cases. If desired, the reader will often be able to substitute it for sectoral policy relatively simply in the text. Although not emphasized here, political objectives should often play an important role in sectoral policy making. In many cases, however, they should be introduced as compromises to the policy suggested by economic or other considerations, where these are also objectives.

[2]If, on the other hand, one of the objectives in a country were, for example, to prevent subversion by infiltrators from neighboring countries, the United States, as part of an "internal security" sectoral policy or goal, might want to consider various incentives to the government of the country to improve or expand certain portions of the border police force. The choice of which portions would depend on an analysis of the existing border patrol units and their potentialities, and the extent to which U.S. influence would be effective in helping the units chosen to achieve these potentialities.

Perhaps the best way to illustrate the types of alternatives mentioned here is to give some examples. Technological alternatives in the field of transportation that might usefully be examined can be illustrated from later sections of this Memorandum. There the relative economic advantages of various Indian transportation modes are examined (namely railroads, highways, extra high voltage power transmission lines and coastal shipping), as well as alternative ways to expand the capacity of individual modes, such as improved signaling and longer trains to increase the line capacity of the Indian Railways. In electric power, important technological alternatives include the choice among basic energy sources. Questions of location might include whether power stations would be more economically built at the energy source or load center or, more generally, whether an activity should be located near markets or raw materials. Considerations of scale in the case of electric power might include the trade-off between economies of scale and reliability in the choice of size of generating units.

The basic point to keep in mind is that what is of interest in a particular sector in one country at a particular time may not be of interest in the same sector in other countries and at other times. Only an expert in the field and sector concerned is likely to select the critical issues and then often only after considerable study.

Advantages of Sectoral Level of Aggregation

Once the principal alternatives have been distinguished, which often involves gathering extensive technical as well as economic data, the choice of U.S. policy involves first the application of economic theory, particularly cost-benefit analysis, to the alternatives presented. Consideration of these options on a sectoral rather than a project or firm basis enables the analyst to examine a number of alternatives not open to the individual project or firm. Yet the level of aggregation is sufficiently low that it is still fruitful to use cost-benefit analysis. A sectoral approach corresponds closely to the existing organization found in most governments and in AID

missions, thus making the applicability and operational usefulness of sectoral policies readily apparent. Finally, the identification of particular sectors with the corresponding technical subject matter makes possible considerable technical specialization in the preparation of sectoral policies.

More generally, sectoral policies have a very important potential role to play in the formulation of an effective aid program. They can form a bridge between the broad aims of the program as a whole and the individual project, making it possible to evaluate the project in its proper perspective and to relate it to the more general goals of the program. Without sectoral policies, it is very difficult to make a meaningful selection of either sectors for the concentration of U.S. aid or objectives and projects within a sector.

At present, there is often little relationship between the discussion of country program goals and the selection of individual projects in the country programming documents. The intermediate links, the goal plans, have too often consisted of a strange collection of statistics, history, rationalizations, and often extraneous comments with remarkably little relevance to the technical and particularly the capital projects in the sector concerned. Interviews with capital development officers, for example, suggest that they find the CAPs of little help in their work. To the extent that such specific orientation exists in the goal plans, however, the purpose seems more to be one of justifying on-going projects than of aiding in the selection of projects to be originated or continued by analyzing the problems of the sector in light of U.S. program goals.

Influencing Country Policy

A good sectoral policy should do more than identify the issues and suggest better solutions. It should also discuss how the influence necessary to bring about such solutions can best be exercised by the United States. There are at least three general methods of interest. The United States could:

(1) attempt to influence country policy in the desired direction purely by persuasion either (a) on a short-term basis through sectoral studies, preferably carried out with the cooperation and participation of the recipient country, or (b) on a somewhat longer term basis through technical aid projects;

(2) offer to make aid freely available, possibly on concessional terms, for desired projects that would otherwise face long delays or even a doubtful future at the hands of the recipient country; or

(3) pursue a more active policy by attaching conditions to aid projects desired by the recipient,[1] usually in the sector concerned, either (a) by using an indirect approach of attempting to obtain changes in the institutions responsible for policy making in the sector if they are believed to be responsible for the less than optimum choices of alternatives in the past, or (b) by directly attempting to change particular policies.

It is difficult to make general rules as to which of these three alternative methods of implementation should be followed in any given case. In general, however, the amount of detailed supervision time required of AID personnel and the possible hard feelings by the country concerned increase in the same order, so that it would seem best to resort to (2) and especially (3) only when the easier approaches fail and the problem is felt to be sufficiently important.

Clearly it is difficult to prepare a detailed sectoral policy for every sector of every country receiving U.S. aid, and impossible to do so every year. In fact, it is much better to concentrate those AID resources that can be made available for the preparation of sectoral policies on a relatively small number of sectors. One of the primary problems with the present effort is that talent and ability are spread too thinly. As the returns to quality are very high in such activities, the incentives producing the present emphasis on quantity should be reversed. A small but encouraging start towards

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[1]This categorization is somewhat complicated by the fact that a condition can often usefully be attached to capital aid in a given sector -- the condition that the country accept technical aid in the same sector that it would not otherwise willingly accept.

this goal is evident in the recent Pakistan Long-Range Assistance Strategy (LAS) and particularly in the Indian LAS, which emphasize much more careful and meaningful sectoral policy statements.

A start towards achieving an emphasis on quality rather than quantity would be to eliminate sectoral policy statements from the annual CAP submissions, which might be limited to brief statements of revisions needed in standing policy statements. The LASs could well form the vehicle for those standing statements.

SECTORAL STUDIES

As mentioned earlier, however, improved sectoral policies require more than bringing to bear more talent and effort to each statement; they also require many more in-depth sectoral studies. A sectoral study concerns the same types of issues as a sectoral policy, but is primarily intended to develop the relevant facts rather than to formulate policy. Such studies can be justified on other grounds besides their contribution to sectoral policy formulation, however.

They can, for example, make a substantial contribution to improved project identification and appraisal. One of AID's persistent problems has been to obtain enough capital projects. Some steps have been taken within the last few years to improve the flow (particularly in Latin America) through feasibility loans to develop the necessary engineering, economic, and cost analyses of proposed projects. Frequently, however, the basic problem is not developing the documentation for a useful project, but identifying it in the first place and persuading the concerned authorities or private firms to pursue it. Sector studies can often serve this function, as well as suggesting the relative priorities and urgency of the projects identified.

One example of a sectoral study that clearly led to a later AID capital project is the first U.S.-sponsored study of Indian transportation, that by Sanderson and Porter Co. of New York in 1956-1957.[1]

[1]This and other aspects of the study are reviewed and referenced in Alan Carlin, "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964, pp. 55-69.

One of their stronger recommendations was that the Indian Railways adopt centralized traffic control (CTC) on selected one track lines approaching capacity utilization. Although the Railways did not act on this recommendation for several years, they requested assistance for a CTC project (other than those specifically studied by Sanderson and Porter) as part of the Third Railway Loan from the Development Loan Fund, signed in 1960. The Sanderson and Porter Co. also strongly favored the introduction of diesel traction. Although this has ultimately been adopted,[1] and several U.S. loans have been made for diesel locomotives, the role of the S & P study in this development was probably much less important than in the case of CTC.

Once a project is identified, with or without the help of a sectoral study, the findings of sectoral studies are often of considerable aid in the analysis and appraisal of the project both in the country and by AID. Besides specific information on the project itself which may be contained in such studies, they often serve to suggest the interesting alternatives that may need to be examined in more detail. The alternatives to building an additional railroad track along the Southeast Coast of India, as will be suggested in later sections of this Memorandum, may range from enlarged coastal shipping capacity to the installation of improved signaling and introduction of diesel electric locomotives, or some combination of these. Many of these alternatives cannot be satisfactorily analyzed in the context of a single project due to limitations in the information and funds available for the preparation of a single project feasibility study, but can be efficiently analyzed along with a number of other related projects in a somewhat broader study approaching a sector in scope. A single project may not permit AID to obtain enough information to examine the interesting options without appearing to meddle unjustifiably in the host country's affairs. The coastal shipping authorities, for example, may see little reason to supply data in connection with a loan to the railroads. In these cases a somewhat broader sectoral study would seem to offer advantages by analyzing some of the alternatives common to a number of projects.

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[1] See below, p. 26.

Sectoral studies can also serve as a form of direct technical aid. Their preparation can provide high level, coordinated, technical and economic advice, one of the truly critical shortages in many less developed countries. Particularly if they are carried out with the cooperation of the relevant ministries of the government concerned, one of their most significant functions can be that of affecting opinion in the host country directly, rather than through the influence that the study will have on AID policy and hence may indirectly have on host country policies. Thus, such a study might suggest other technological possibilities in the sector concerned which the host country would adopt without further encouragement.

Despite these other uses of sectoral studies, it is clear that because of the personnel problems discussed below, AID's ability to carry out the large number of studies that would be needed to cover all sectors in all AID recipient countries is even more limited than its ability to prepare useful sectoral policy statements. Under the circumstances it would seem best to limit the preparation of such studies to the more critical sectors of the major aid recipients. A number of situations stand out as cases when they can be particularly usefully employed. One is the case already mentioned where a number of projects raise issues that cannot easily be settled in connection with individual project reviews. More generally, it would seem worthwhile to undertake such studies for any sector that is expected to receive substantial amounts of U.S. aid, whether or not specific problems can be identified ahead of time. The recent Indian transportation study[1] and the energy study[2] are examples of long needed studies that could have been justified in either way. Surely an expenditure of 1 or even 2 per cent of the aid funds to a sector for research

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[1] Surveys and Research Corporation and Coverdale and Colpitts, India Coal Transport Study, September 23, 1963 and June 1, 1964. Hereafter this Study is referred to as the ICTS. References to Volumes II through IV and Appendixes B through D will always refer to the June 1, 1964 version.

[2] Report of the Energy Survey of India Committee, Delhi, June 1964.

during a year would not be too much. Another case is a sector that appears to be promising but where there is very little progress. The purpose would be to suggest useful ideas for the development of the lagging sector, as by pinpointing profitable potential investment projects.

Still another case where sectoral surveys might prove especially useful is when there is a suspicion that policies in the sector may be seriously awry. The ICTS, for example, was undertaken in response to the coal transportation crisis of 1961-1962, but was soon expanded to a consideration of some of the long-term problems, such as comparative costs of various transport modes, which had long been questioned. In many ways it can be said that the coal transport crisis was used as an excuse for undertaking a study of a sector about which many had become uneasy. The 1962 loan to Iran to finance the preparation of master electrification plans for the ten largest load centers is another example of a sectoral study designed to suggest solutions to a problem observed in a particular sector, namely the chaos existing in the distribution of electricity in Iran. Many other sectors in many countries deserve similar attention for similar reasons, from transportation in Turkey to exports in India and agriculture in Chile.

PERSONNEL

Undoubtedly a major obstacle to the implementation of the proposals made here is the problem of obtaining the necessary personnel. Sectoral policy formulation requires the services of qualified economists, assisted by able technical specialists. As in a number of other AID functions, the shortage of economists, particularly technically oriented economists, is the most critical for it is they (rather than the technical divisions of the missions) who should play the leading role in such policy making[1] and who are in particularly short supply throughout AID. There are no simple solutions to this problem. All that can be

[1]At least in those sectors where the primary goals are economic.

recommended is a redoubled effort to hire and retain well-qualified economists as well as to make better use of those now working for the Agency.

The need for quality and the concentration of skilled economists on the critical policy issues has already been emphasized. One of the difficulties in retaining such personnel has been the emphasis on volume of work rather than quality of work. Another important factor in retaining skilled personnel is the extent to which their work is actually used. Certainly the economist responsible for a particular sector should be consulted during the approval process for both technical and economic aid projects in the area concerned.

While the sectoral policy formulation process must be carried out largely by AID personnel, although possibly with the help of some outside consultants with specialized knowledge in the area concerned, the preliminary sectoral studies (on which policy formulation is based) could probably be carried out under contract in most cases. This should not be thought of as a panacea, however, because AID must still find scarce personnel to formulate useful problems and to monitor the contracts.

It cannot be too strongly emphasized that the basic requirement for the preliminary sectoral studies is for integrated technical and economic talent, preferably with overall supervision in the hands of the latter. This is not easily accomplished, however, because most contractors hired by the Agency for such studies are either technical consulting firms (with little economic staff) or smaller economic consultants (with little permanent technical competence). One partial solution under present circumstances is to engage both an economic and a technical consulting firm to do a joint study. If an academic economist, preferably a man with some time to devote to the study and some experience in the technical field and the area concerned, is added as a senior consultant, the all-important economics of the study may be significantly improved.

Another but probably less desirable partial remedy for the problem of finding economists for preliminary sectoral studies would be to recruit carefully selected American graduate students in economics, to work (preferably under the guidance of senior faculty members) in the teams that undertake such studies. The potential advantages to AID are three-fold. First of all, by offering the chance for paid overseas work during the critical period when the graduate student is looking for ideas, data, and financing for his thesis, AID can obtain carefully supervised talent, albeit somewhat inexperienced. The student, it should be pointed out, would have a double incentive to produce something. The second advantage is that AID may in this way be able to induce these graduate students to work for the Agency after graduation. Third, such students would have much more time to examine the all-important details of the study than senior academic economists are likely to be willing to spend. The obstacles to such a plan are obvious, namely, the problem of guaranteeing the students that their work can be released for publication and the necessity of allowing them freedom from administrative duties. Some kind of independently administered fellowship program might be one way of handling these problems.

Finally, a few words might usefully be added about the mode of operation of those personnel engaged in sectoral studies. AID should insist that individuals spend a substantial period of time in the country -- enough to develop the contacts and weigh the various opinions that are necessary to write a meaningful report. Two or three months seem to be the minimum for any individual unless he is engaged in a very narrowly defined, technical subtask. If possible, the studies should be done in cooperation with the relevant groups in the country concerned. This will generally result in slower progress, but it will insure better data availability and a better chance for the technical aid aspects of the studies to be effective.

It would be possible to illustrate a number of points made in this section by specific horrible examples out of the past, pinpointing mistakes and assessing blame. It seems much more useful and constructive, however, to concentrate on developing an improved policy for one of the more crucial sectors in a major AID recipient as an example of what is needed, while pointing out some of the pitfalls encountered by some of the specific studies discussed in the process. One point that this approach may serve to emphasize is that sectoral issues are usually complex, frequently require sophisticated technical and economic analyses, and deserve much greater attention than heretofore.

The sector selected for this illustration, Indian transportation, is more readily analyzed than some because several of the most intensive sectoral studies have recently been made on it. Although most sectors in major AID recipients have received much less study, the analysis undertaken here will try to explain why much more is needed even in this case. Transportation is also one of the largest recipient sectors of U.S. aid to India. From the beginning of the program in Fiscal Year 1951 through 1962, the United States committed $296 million to transportation, or roughly 17 per cent of net commitments during the period other than surplus agricultural commodities under P.L. 480 and the 1951 wheat loan.[1]

The following sections will first discuss a number of the major problems brought out by the sectoral studies concerning the principal modes of Indian transportation and interesting alternatives to them, organized by mode. At the same time the implications of the discussion for U.S. policy will be brought out. Although references to more complete discussions of each mode will be given, only the analysis necessary to decide between conflicting views will be presented as this is not an attempt to do a new sectoral study. The more general aspects of an improved U.S. strategy towards Indian transportation will then be discussed, followed by a short recapitulation of the proposed policy as a whole as a specific illustration of the type of policy statements advocated here.

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[1]See Carlin, op. cit., pp. 36 and 48.

Appendixes B and C, among other purposes, can be used to illustrate some of the suggestions made in this section as to how not to carry out sectoral studies. Both review some of the findings of the ICTS, and suggest that important aspects of the Study appear to have been seriously hampered by a lack of economic sophistication, especially on the more detailed points of the analysis. Appendix B points out instances where this led to major errors in the railroad costing activities of the Study. It is also felt that the critical Volume III of the Study lacks an adequate treatment of the more theoretical aspects of Indian Railway rate policy. Section II of this Memorandum discusses some of these theoretical issues.

Interestingly enough, the organization of the ICTS staff incorporated many of the features suggested here in that it consisted of a largely technical consulting firm (Coverdale and Colpitts) and an economically oriented consultant (Surveys and Research Corporation), supervised in part by a senior academic economist. Despite this organization, the problems seem to have arisen in part because of a lack of integration between the various essential ingredients. At the same time, it is important to stress that however much one may disagree with some of its conclusions, the ICTS represented a major step in the right direction in that it undertook a detailed sectoral study of an important but long neglected sector.

II. THE RAILWAYS

RATES AND COSTS

A number of the recent sectoral studies of Indian transportation have raised questions as to the suitability of present Indian Railway rates and the level of Railway costs. The principal concern has been that present rates generate larger than desirable traffic in some low value commodities,[1] with all that implies for investment in railroad capacity and the allocation of resources. Some additional interest in railroad costs has been generated by attempts to evaluate the merits of new investments in alternative modes of transportation,[2] such as extra high voltage power transmission.

Any investigation of the proper relationship between railroad rates and costs should begin with a survey of the possible goals of an Indian Railway pricing policy. There appear to be two goals of central importance:

(1) To maintain the financial independence of the Railways, or perhaps even to permit a net contribution to Government revenue;

(2) To promote national goals of economic efficiency, development, and industrialization.

The rationale for the first goal is to avoid burdening the Government of India with meeting Railway deficits, and possibly for the Railways to help ease the Government's problem of finding revenue. Besides the difficulties and undesirable features of alternative sources of Government revenue, insistence on financial independence may have desirable effects on the efficiency of the Railways by creating an incentive for economy not found if the Government agreed to underwrite any Railway deficits.

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[1] See Louis Lefeber with M. Datta Chaudhuri, "Transportation Policy in India," Pricing and Fiscal Policies, P. N. Rosenstein-Rodan (ed.), London, Allen & Unwin, 1964, p. 97; also Carlin, op. cit., Ch. 3.

[2] This appears to have been the motivation of Surveys and Research Corporation and Coverdale and Colpitts in writing the ICTS.

The major problems of railroad pricing arise from the conflicting implications of (1) and (2). In a static context, (1) calls for revenue to equal or exceed total costs while (2) implies that rates should equal long-run marginal cost. Since railroads are generally decreasing cost industries,[1] these cannot be simultaneously achieved. The proper relationship between prices and costs in such industries has been the subject of considerable controversy among economists for a long time. Nancy Ruggles, summarizing the situation in 1949 at the peak of the marginal cost pricing controversy, concluded that

> ...the design of a pricing system must take into account the conditions which do exist in the economy. The various sectors of the economy differ from one another in the restrictions which they impose on the pricing system, and what is appropriate for one sector may be completely inappropriate for another. No one formula can be established which will be valid as a general principle. But one statement can be made: the search for a panacea, for a single rule by which to guide all conduct, is, because of the technological requirements of the different parts of the economy and because of the problems of redistribution, a vain search and even a foolish one. A set of tools is available with which to accomplish a complicated job. A better job can be done if each tool is used where it is appropriate, instead of throwing away all but one and expecting it to serve all purposes.[2]

The single tool often advocated by the economics profession, marginal cost pricing, is open to several fundamental theoretical objections on partial equilibrium grounds.[3] The issue is further

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[1]But usually subject to many significant irregularities in their short-run cost curves, due to the inherent lumpiness of much railroad investment. It may well be that when a significant proportion of line must be doubled, as has been the case in India in recent years, average cost is rising.

[2]Nancy Ruggles, "Recent Developments in the Theory of Marginal Cost Pricing," Review of Economic Studies, Vol. 17, 1949-1950, pp. 125-126.

[3]For a brief summary of some of them see James R. Nelson, "Pricing of Transport Services: Normative Prescriptions for Underdeveloped Countries," a paper given before the Harvard Transportation and Economic Development Seminar, April 1964.

complicated by the introduction of general equilibrium considerations, namely, the question of whether marginal cost pricing should be used in one part of an economy if it is not used in all parts.[1] In the extreme, it has been argued, "almost any old price which is not ridicu lously low or high is as good as any other."[2] This may be carrying the argument too far; but if above marginal cost pricing is believed to be prevalent in an economy, marginal cost pricing becomes less attractive, particularly in decreasing cost industries, the particular industries where it produces deficits.

In a more dynamic context, the case against strict marginal cost pricing becomes somewhat stronger. Although it is impossible to explore fully the dynamic implications of various rate policies, it would appear probable that an increase in Railway profits would have a positive effect on Indian development by increasing total Indian savings and Government revenues. Higher savings rates would result if higher Railway revenues led to an income transfer from consumers of Railway services with relatively low marginal saving propensities to the Indian Railways or the Government, with possibly somewhat higher marginal propensities to save. This will be the case, of cours only if it can be assumed that Government investment would be increase by all or part of the increased Railway profits. This is not obviousl so, however, for in the past Government investment appears to have been determined largely independently of the availability of revenue. Under these circumstances, an increase in the Railways' contribution to the Government would simply take the place of alternative new taxes (generally excise taxes) or deficit financing. The net effect on savings in this case would be difficult to determine but would probably not be great. This situation may well change, however, as tax rates become ever higher and the opposition to them mounts, and

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[1]The standard reference here is R. G. Lipsey and Kelvin Lancaster "The General Theory of Second Best," Review of Economic Studies, Vol. 24, 1956-57, pp. 11-32.

[2]M. McManus, "Comments on the General Theory of Second Best," Review of Economic Studies, Vol. 26, 1958-59, p. 222, as quoted by James R. Nelson, op. cit.

as inflation becomes an increasingly serious political problem, thus limiting the scope for deficit financing. When India reaches the point where Government investment is limited by the availability of revenue, an increase in the Railways' contribution to the Government would probably increase total national savings over what they would otherwise be. This, in turn, would presumably promote Indian growth.

In these circumstances, it appears best to fall back on Mrs. Ruggles' suggestion concerning a flexible approach towards pricing policy, and to consider a number of special normative and other considerations peculiar to India and transportation in general and the Indian Railways in particular. This can most easily be done by considering capital and operating costs separately. For the purposes of this discussion, the distinguishing characteristic is that the benefits from capital expenditures are realized over a number of years, whereas benefits from operating expenditures are realized almost immediately.

As the Indian Railways are a Government enterprise, it is not necessary for them to pay any particular set amount in capital charges to an external private agency. It is therefore possible in the case of an expanding railroad system such as India's to follow the economically more rational policy of ignoring past capital expenditures as a basis for computing capital charges since they are largely sunken costs that cannot be recovered. Rather, the important objective is to insure that rates reflect the additional capital costs of moving additional traffic.[1] If they do, only an amount of added traffic will be attracted that can pay the additional capital costs of its movement. In other words, optimum rates are those that reflect long-run incremental capital costs.

It should be pointed out that the use of incremental capital costs as suggested here would in all likelihood result in higher average rates than at present, so that no "deficit" would occur according to

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[1]This point has been developed by Marcel Boiteux. See his "Marginal Cost Pricing," Marginal Cost Pricing in Practice, James R. Nelson (ed.), Englewood Cliffs, Prentice-Hall, 1964, pp. 51-58.

present Railway accounting procedures. In simplified terms, the use of incremental capital costs results in higher than present historically based rates to the extent that there has been inflation. On the other hand, declining unit capital costs and technological progress work in the opposite direction. In the case of the Indian Railways, the effects of inflation plus the inclusion of internally generated capital (not now included in the Railways' capital base in computing capital charges), appear to more than outweigh the other two factors.

This leaves the question of the proper relation between rates and operating costs. A useful way to consider this question is by examining the alternatives, beginning with the largest choice between rates that cover only long-run marginal operating costs and those that meet full average costs. In other words, should all Railway operating costs be subsidized by the Government so that the Railways can offer marginal rates for all classes of service? The answer here would appear to be no. The general arguments against using marginal costs have already been referenced. One of these problems, that of financing the railroad's operating deficit, takes on particular importance in the Indian case in that marginal Government revenue must be collected largely through excise taxes, often on other than luxury items.[1] Thus, besides the questionable income transfers involved, the economic distortions arising from such taxation would appear to be at least as bad as those arising from the use of rates that cover total operating costs and probably much worse. It can even be argued on this basis that the Railways should be a net contributor to Government revenue, particularly if (as mentioned earlier) such contributions result in higher Government and national investment.

Price Discrimination

If rates are to cover at least full operating costs, rates must either correspond to average operating costs, or below average cost

[1] Recent price increases have made increased deficit financing politically less acceptable.

rates must be balanced by above average cost rates. To consider the latter possibility, perhaps the easiest way to proceed is to examine the case for below average cost rates for those classes of service that are most often mentioned for this treatment, that is, those for which there is a relatively elastic demand for transportation.

One candidate is the rates for the lower classes of passenger services, because a significant portion of such traffic would presumably not move at higher than present rates or would transfer to cheaper road transportation wherever possible. One of the more important characteristics of such traffic is that a considerable portion of it makes little contribution to national economic progress, being primarily associated with social, pleasure, and family activities.[1] Given the urgency of such progress, there would seem to be little case for continuing the present policy of subsidizing passenger traffic at the expense of freight traffic, which makes a much greater contribution towards industrialization and presumably economic growth. This circumstance would appear to outweigh a variety of other considerations (some of which are discussed below) to the extent that a strong case can be made for charging rates corresponding to more than average operating costs for passenger services. The best policy would appear to be to set rates corresponding to at least average operating costs, and as much more as the obvious political difficulties of higher passenger rates would permit.[2] Rates corresponding to more than

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[1] It can be argued that low passenger fares contribute to greater labor mobility, which aside from its economic benefits, might in the long run contribute to the breakdown of regional differences that at present burden Indian economic planning and threaten her national union. It can also be argued, however, that if employers find it profitable to bring particular skills to a different region they should pay the full costs involved, including allowances to cover the employees' periodic visits to their family homes required by Indian customs.

[2] Setting passenger rates corresponding to more than average operating costs would result in a possibly undesirable allocation of traffic between modes if bus fares were not similarly set above average costs. Given the present level of highway transport taxes, however, this would not be a problem even if Railway passenger fares were set at rates corresponding to considerably more than average costs.

average operating costs could be used either to make a net contribution to Government revenue or to reduce the incidence of fixed operating costs on freight rates, or both.

The other candidate for rates reflecting less than average operating costs is the low value, bulk commodity. The principal argument for below average cost rates is that they permit some goods to move which otherwise would not move, to the benefit of the economy and of Railway profits as long as rates reflect above marginal cost operating expenses.[1] It should be pointed out, however, that because it is not possible to distinguish between freight that would and would not move at rates corresponding to average operating costs within any freight category, there will inevitably be some traffic that will benefit from price discrimination, to the detriment of railroad profits.

The principal argument against such rates is that they lead to secondary distortions in the allocation process in the remainder of the economy. As transportation of freight is a kind of intermediate good, freight rates affect not only current production decisions but also have important effects on decisionmaking in a large number of industries. In a period in which many important investment decisions affecting the long-term development of Indian industry are being made, it is especially important that freight rates give the correct signals for such decisions as the location of plants and the choice between raw materials with varying concentrations of usable material per unit weight. The wrong decisions now as to the location of a given industry may well have the effect of influencing the location of future expansions and new plants in the same and related industries towards the same uneconomic location. The net effect will be to encourage industries to locate further from their source of raw materials and, in general, to increase the demand for and hence the investment in Indian transportation at the expense of more profitable investments elsewhere.

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[1] Lefeber considers some of the arguments (generally not very theoretically valid) heard in India against "rationalization" of the rate structure. Lefeber, op. cit., pp. 106-108.

There is yet another problem with discriminatory freight rates, however. Value of service pricing became popular for railroads during a period when there was no effective competition for high value traffic. Since the advent of trucking, however, all this has changed, at least in much of the rest of the world, with the result that railroad rates reflecting more than average operating costs would, other things being equal, push some high value traffic onto the highways despite the generally higher average costs prevailing there. Thus, general price discrimination on freight traffic has the additional disadvantage of misallocating such traffic between different transport modes, with a resulting higher transport bill for the economy as a whole. There are, of course, a number of ways around this, although these give rise to additional problems. One is the method now employed in India, namely, a combination of administrative controls and discriminatory taxation on road transport which greatly increases the costs of such service.[1] This course has little to recommend it, however, because of the costly inefficiencies arising from the administrative controls and the arbitrary nature of road taxation.

In summary, the case for general price discrimination on railroad freight appears to be weak in India. Unless special discriminatory measures with their own inefficiencies are used (as at present), its scope is severely limited by highway competition. And even much of that discrimination which would be possible without such measures would result in distortions in the remainder of the economy. This is particularly true in critical industrial investment decisions which are of considerable importance at this stage of Indian development. The best policy would appear to be to base that portion of freight rates corresponding to operating costs on marginal costs plus a uniform percentage sufficient to cover any fixed operating costs not met by passenger fares. At the same time, there may be many specific

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[1]See the discussion on road transport in Section III. See also Carlin, op. cit., pp. 113-121 and Section I of Donald N. McCloskey, "Road and Rail in India: An Institutional and Econometric Study," Discussion Paper No. 3, prepared for the Harvard Transportation and Economic Development Seminar, revised May 1964 (dittoed).

situations where deviations from this base may result in major gains in the utilization of existing capacity, particularly line capacity, such as by helping to balance loads both with respect to time and direction of flow. There would appear to be considerable merit in encouraging a somewhat flexible rate policy under which the rates could be varied away from the base suggested here to take advantage of these special situations.

One problem with the partial use of average costs advocated in the preceding discussion is that in a multiple product industry such as railroads, there is no unique way to assign the large fixed costs involved. The only costs that can be positively identified with any particular output are those that vary with outputs, that is, the variable costs. Thus, while rates should be based in part on some concept of average cost, costs must necessarily be based on marginal costs. To arrive at a basis for judging suitable rates, the best way of allocating fixed costs (except as noted in the case of passenger fares) would appear to be to set a base for all rates that corresponds to an equal percentage of long-run marginal operating costs, so as to avoid some of the locational and raw material choice problems outlined above. Appendix A expresses the relation between the rate base and costs suggested by this discussion in the form of symbols, which present a somewhat clearer and more exact picture.

One of the factors favoring the value of service pricing policies practiced on the Indian and most other railroads for many years has been the extreme difficulties of obtaining accurate cost estimates for specific Railway services. With the introduction of modern statistical techniques and controlled experimentation within recent years, however, many (but by no means all) of these difficulties have been overcome.[1]

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[1]See John R. Meyer, M. J. Peck, J. Stenason, and C. Zwick, The Economics of Competition in the Transportation Industries, Cambridge, Harvard University Press, 1959, particularly Appendixes B and C; also Government of Canada, Royal Commission on Transportation, Vol. III, Ottawa, July 1962, especially pp. 209-228.

With this short theoretical introduction, it is possible to assess some of the present problems with Indian Railway rates. Although Railway costing is in a very primitive state, what little evidence exists suggests that passenger fares are considerably below the rates suggested above. Low value freight rates, particularly for coal, are much further below those for high value goods than would appear to be justified by cost differences.[1] High value freight is clearly being carried at more than the suggested rates in many cases.

More extensive study has been made of coal shipping costs than of any other class of railway service. The two detailed studies made thus far, part of the ICTS[2] and the author's "An Evaluation of U.S. Government Aid to India,"[3] suggest rather different conclusions as to coal costs and therefore rate policy. Specifically, the figures developed by the ICTS seem to suggest that average coal costs may be as much as 15 per cent lower than average rates, while the latter suggests that coal costs are roughly 55 per cent higher.[4] Appendix B suggests that the ICTS greatly underestimated the capital charges involved, with the result that their computed total costs should be increased by almost 40 per cent. The remainder of the differences between the two studies are not so easily quantified and must be attributed to the basic assumptions made in the approximations themselves. A case can be made that these ICTS assumptions bias their cost figures downward and that rates should be somewhat above the revised ICTS costs. Appendix B develops these revised costs, discusses some of the other issues in detail, and suggests that present coal rates, despite recent increases, are probably still below those recommended here.

The major conclusions from this brief analysis of Indian Railway rates and costs are three-fold. The first is that there is an urgent

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[1] See Carlin, op. cit., pp. 84-96, and 103.

[2] ICTS, Vol. III.

[3] Carlin, op. cit., Ch. 3 and Appendix B.

[4] There are a number of difficulties in any such comparison, which are explained in Appendix B. The figures are derived from a comparison of lines 1a, 3, and 4b of Table 6.

need for better cost analysis. The United States should encourage and if necessary aid new costing efforts based on modern statistical techniques. Although highly refined estimates for each activity and service could well cost more than they would be worth, the present state of Indian Railway costing is such that a serious start towards developing railroad costs could serve a very useful purpose as a guide for rate making and investment decisionmaking.

At the same time, the Railways should be encouraged to raise passenger fares much more rapidly and decrease some of the rates for high value freight relative to those for low value. Since the current rate of return is undoubtedly lower than the alternative rate of return available elsewhere in the economy,[1] the United States should also encourage the Indian Government to insist on a substantially higher return on Railway capital.

Finally, many of these same objectives could be obtained by creating a more competitive atmosphere for the Railways. Strong competition from the highways, based on more freedom for highway users to offer rates and service reflecting their relative comparative advantages, would greatly encourage the Railways to adopt rates more closely reflecting costs. The measures required to bring about this atmosphere are discussed or referenced in Section II under road transport.

If these recommendations are carried out and if there is assumed to be some elasticity in the demand for railroad services, the rate revisions advocated here should substantially reduce the rate of growth of the Indian Railways over what they would otherwise have been, with consequently lower demands on U.S. and Indian resources for rail outlays.[2] While there would be some increase in investment in highway transport and perhaps ultimately in other alternative modes, the total demand for transportation would be lower than without the changes, and the traffic which is offered would be carried more efficiently.

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[1]See Carlin, op. cit., pp. 29-31 and 83-84. This conclusion is not affected by the 1964 change in the interest rate paid by the Railways from 4.5 to 5.75 per cent, although this is certainly a step in the right direction.

[2]This is discussed in somewhat more detail in ibid., pp. 108-113.

OPERATING PROBLEMS, TECHNOLOGICAL INNOVATIONS, AND TECHNICAL AID

Although the Indian Railways are certainly one of the best run Government enterprises in India, a number of studies suggest that the Railways tend to be somewhat conservative in introducing new technology, that more generally a number of major alternatives affecting the allocation of resources could usefully benefit from U.S. techno-economic studies, and that both of these objectives could be furthered if the Railways could be persuaded to accept technical aid.

Since 1957 three reports have been prepared by American transportation experts which deal with some of the operating problems faced by the Indian Railways.[1] The recommendations made are by no means identical, and are frequently contradictory. One point on which they are nearly all in agreement, however, is the need for improved signaling. More rapid introduction of centralized traffic control (CTC) on single track lines[2] and automatic block signaling on double track lines[3] would seem to be justified, for example, although a sophisticated economic analysis of particular projects remains to be undertaken. Preliminary analysis suggests that very substantial sums have been spent on second tracks in the last decade in cases where CTC could have been postponed long enough to more than repay the costs involved. Unless signaling is improved substantially, the coming decade will see premature additions to many more lines. Here as elsewhere the Railways' response to technical innovation has been slow and cautious. In a period of rapid traffic growth, however, the Railways must be encouraged to adopt technological changes more rapidly even if it means taking some risks and possibly making some mistakes.

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[1]The ICTS; Bessemer and Lake Erie Railroad Co., "Transportation for the Bokaro Steel Mill, A Study for U.S. Steel Corporation," Pittsburgh, January 15, 1963; and a series of reports for the Indian Railway Board by Sanderson and Porter Co., summarized in "Final Summary Report," New York, October 15, 1957 (typescript). See also Carlin, op. cit., pp. 55-69.

[2]Carlin, op. cit., pp. 58-69.

[3]ICTS, Vol. III, pp. 221-224.

A second major problem area raised by the reports is the question of long versus short trains, an area on which there is much less agreement. Briefly, the problem is that Indian freight trains are much shorter and lighter than in North America. It is evident that longer trains are more economical in terms of utilization of line capacity and crew costs, at least under American conditions. Whether this is the case in India is more questionable, however, because of the tremendous cost of installing new (to India) types of couplers, air brakes, and most important, lengthening nearly all the loops (passing sidings). Although the ICTS strongly favors the rapid introduction of heavier trains, no quantitative calculations of the costs and benefits are presented, but are surely very important if so sweeping a conclusion is to be taken seriously or if the Railways are to be convinced. The offhand dismissal by the ICTS of the efforts to design a 30-ton, four-wheel open car without a discussion of the load-length ratio is particularly unfortunate.[1]

The ICTS did attempt to be more quantitative in its analysis of another long standing problem -- the extent to which dieselization and electrification can be justified.[2] The United States and the World Bank have been giving substantial amounts of aid for both these purposes for a number of years without a careful analysis of the economics of the particular investments proposed. The ICTS calculations can be considered as a first but not very satisfactory attempt. The problems with the ICTS calculations stem from use of a theoretically questionable decision rule and a failure to consider the increases in line capacity resulting from electrification and dieselization (see Appendix C). Perhaps as a partial result of the ICTS conclusions, the Railways have decided to halt manufacture of steam locomotives by 1970-1971.[3] This will result in an eventual change-over to entirely

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[1] ICTS, Vol. III, p. 247. See also Carlin, op. cit., p. 56.

[2] Ibid., pp. 228-232. The earlier study by Sanderson and Porter Co., op. cit., also dealt somewhat with this issue.

[3] The Times of India, Bombay, November 16, 1964, p. 1.

diesel and electric traction. If the decision is based on the ICTS, it would seem rather premature if no further analysis has been done. Additional research would appear to be needed on this important issue, preferably before much more aid is committed for either of these purposes. It should be noted that such calculations will inevitably be quite sensitive to the exchange rate assumed, particularly in the case of dieselization because of the petroleum imports involved.

Still another problem concerns the appropriateness of Railway replacement policy. The ICTS suggests that both freight cars and steam locomotives are being kept in service too long, and should be retired even before their nominal retirement age.[1] While some element of subjective judgment must play a role in any decision as to the appropriate retirement age, it would probably be worthwhile to compute the appropriate retirement age for typical rolling stock from cost data[2] and to examine the specific procedures actually used by the Railways at present to determine which cars should be repaired and which replaced.

A variety of other major issues are raised by the various reports. The Bessemer and Lake Erie Railroad Co. study, for example, suggests that it might be worth investigating whether computers could be used profitably to keep better track of freight cars. No doubt numerous other issues would come to light if additional studies were carried out. This, combined with a substantial program of technical aid and continuous monitoring of Railway affairs should be made a substantial part of the U.S. program in the future.

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[1] ICTS, Vol. III, pp. 225-226 and 237-238. Rolling stock (as well as some other capital) is now generally kept in service considerably beyond its "normal" life.

[2] Specifically, this would involve calculating when the maintenance and operating costs in excess of a replacement, calculated over the economic life of the latter and discounted by the opportunity cost of capital, are equal to the cost of the replacement.

III. ALTERNATIVE MODES

ROAD TRANSPORT

One of the clearest cases of a mode of transportation not carrying the proportion of traffic suggested by its relative competitive position is road transport. Except in the case of passenger traffic, the problem does not stem from Railway rate policies because the prevailing higher than cost rates for shipping high value goods discourage the movement of such traffic on the railroads. Rather, road transport is prevented from achieving its natural competitive position by a series of restrictive regulations, high taxes, and a combination of light duty highways and overly restrictive highway use regulations.[1] There is no doubt that the Railways are actively encouraging the continuance of this overly restrictive approach to road transport, and that their position as a powerful ministry within the Government has greatly helped them to achieve this end.

U.S. policy should actively encourage the removal of the prevailing artificial restrictions that are preventing the development of road transport. Rather than by applying restrictive conditions to the aid to road transport, which is hardly responsible for present conditions, the problem must be approached on the basis of aid to the transportation sector as a whole. Simultaneous reduction in higher than average cost rates for high value goods, as suggested earlier, should prevent the loss of the less urgent, long distance, high value traffic by the Railways.

Indian policy towards road freight transport is one more instance where the Government has attempted to substitute administrative rules and regulations for the competitive allocation function of the price mechanism. The argument is seriously made that the Government should directly determine how much and where traffic should move by truck rather than leaving it to the price mechanism. As the cost of long

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[1] For a more detailed exposition, evidence, and further references, see Carlin, op. cit., pp. 93-95 and 113-121. See also McCloskey, op. cit.

distance freight traffic by road is believed to be greater than by rail, it is concluded that the Government should administratively insure that such traffic moves by rail. Such arguments ignore the value of moving goods rapidly, a service that the Railways do not offer, in part because of lack of competition.

It is claimed that a more efficient allocation of traffic between the two modes will result if railroad rates for high value goods are reduced to the level suggested earlier and the administrative rules and regulations (the permit system) are removed and taxes equalized between the two modes.

EXTRA HIGH VOLTAGE TRANSMISSION

One of the more interesting alternatives that has only recently been proposed is the use of long distance, extra high voltage (EHV) transmission lines as a substitute for transporting energy on the surface in the form of coal. While the Report of the Energy Survey of India Committee[1] is perhaps slightly more optimistic about the possibilities for EHV than the Coal Transport Study, both conclude that the use of EHV is sufficiently marginal even if large amounts of power were used that the choice between EHV and coal would be strongly affected by such factors as the relative length of routes and the need for transshipment between railroad gauges.[2] As suggested in Appendix B, however, the costs of shipping coal by rail are substantially higher than those computed by the ICTS. The revised ICTS costs for closed circuit coal movements (computed by applying the figures developed in Appendix B, Table 4, of this Memorandum, assuming a 10 per cent return on capital) are slightly higher than the minimum closed circuit costs assumed by the Energy Survey even after their adjustment in the rate of interest. If the revised ICTS costs are used, the effect is to make EHV competitive for a 500 mw line using the other (supposedly conservative) Energy

[1] Delhi, June 1964, hereafter referred to as the Energy Survey.

[2] ICTS, Vol. II, pp. 85-90, and the Energy Survey, pp. 132-136.

Survey assumptions.[1] On the other hand, there is some evidence that the costs of EHV may be higher than assumed by the ICTS, which supposedly used modified Energy Survey figures.[2] The Burns and Roe study of the Tarapur Nuclear Project for AID made estimates for a 345 kv line to carry 600 mw.[3] These estimates are roughly double those made by the Energy Survey for a 500 kv, 750 mw line on a per-mile basis. Burns and Roe explain that to some extent their figures represent a "conservative approach in costing the project" for reasons that might not apply in the case of other Indian EHV lines.[4]

On the other hand, the Energy Survey's estimates of EHV costs are based primarily on Swedish estimates to which some only partly explained adjustments in the rate of return appear to have been applied. The

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[1]Specifically, if line 14b, column (3), of Table 4 is used, line (2) on Figure 12, page 135 of the Energy Survey, would be slightly higher, coinciding very closely with the 500 mw line.

[2]It should be noted that the exact derivation of the ICTS EHV figures, particularly at the longer distances, is not clear, and the figures seem to be biased downward. The two sets of figures derived from Figure 12, page 135, of the Energy Survey, and Vol. II, p. 86, of the ICTS are as follows:

Distance (km.)	EHV Costs for a 1,000 mw Line (nP. per kwh)	
	Energy Survey	ICTS
400	.40	.45
600	.55	.60
800	.70	.70
1000	.85	.80

The ICTS claims that it increased the Energy Survey figures by adjusting for a 12 rather than a 10 per cent return and a 50 rather than a 33 per cent premium on foreign exchange. The 400 km. figures might be explained by ignoring the adjustment concerning the foreign exchange premium and assuming that roughly 70 per cent of the EHV costs represented capital charges. But that does not explain the figures for the longer distances.

[3]Burns and Roe, Inc., "Tarapur Nuclear Power Project Study," New York, June 17, 1963, Exhibit X.

[4]Based on correspondence from Dr. S. Brown of Burns and Roe to the author.

unadjusted Swedish figures themselves appear to be substantially below American costs and may not include land and clearing costs.[1]

The general conclusion from this brief review is that EHV is sufficiently interesting to deserve consideration whenever it appears economic to build a large power plant in an area outside the coal fields. As the ICTS and Energy Survey conclude, each case will probably have to be examined on its particular merits. Much more accurate general estimates of rail coal costs and EHV transmission costs will be necessary before much can be said even about individual cases, however, and would appear to be well worth undertaking. For longer distances, some thought should also be given to the benefits of direct current (DC) transmission. Calculations of benefits should also include some of the side benefits of EHV arising from the interconnection of regional systems. Such interconnections will usually result in the construction of larger, more efficient generating plants, the substitution of more for less efficient plants during off-peak periods, and the possibility of meeting the peak load by the transfer of power between systems with different load characteristics.

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[1]The Energy Survey figures (Table 142) are derived by a uniform 44 per cent inflation of the Swedish unit costs. This increase supposedly largely reflects an adjustment in capital charges. While the Swedish study (Sven Lalander, "The Economy of High Transmission Voltages" in The Swedish 380 kV System, Stockholm, The Swedish State Power Board, 1960) assumes a 6 per cent return on capital, the Energy Survey uses 10.8 per cent in this case. A few calculations will show that if this were the only adjustment made, the Survey would in effect be assuming that capital costs comprised roughly 55 per cent of the total costs. Reference to Table 141 will show that roughly 74 per cent of annual costs are assumed to be capital charges, not including "losses," which also include substantial capital charges on installed generating capacity. This suggests that some additional and unexplained downward adjustment has been made in the Survey figures for India (Table 142).

Reference to the chart following page 214 of the "Energy Survey of India, Draft Report," New Delhi, Dec. 7, 1963, will show that the Swedish figures appear to be very close to those derived by the Energy Survey Team from Indian data. Although Table 140 fails to show conductor sizes and may therefore be quite unreliable, it suggests that the Indian costs used by the Team are considerably lower than American costs. In fact, the American costs may be substantially higher than those shown in the Table for 500 kv (on which the Energy Survey figures

COASTAL SHIPPING

A third interesting alternative to the Railways is coastal shipping, which would seem to be a natural mode of transport for India.[1] The ICTS, however, concludes that coastal shipping could at best reduce the cost of shipping coal by rail to a few of the ports served by meter gauge rail lines,[2] and in any case these and other Western and Southern areas might better meet their future energy needs by importing fuel oil.

The ICTS analysis of the relative cost of shipping coal by the combination rail-sea and by the all-rail routes has two major shortcomings. As outlined in Section II and Appendix B, the cost of coal transport by rail is probably substantially higher than the cost used

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are based), even excluding land and clearing costs. Although the costs for the lower voltages are quite close to those in the Federal Power Commission, National Power Survey, "Advisory Committee Report No. 10 on Estimated Installed Cost for EHV Transmission Facilities," May 1963, the 500 kv figure is markedly lower.

Although Sven Lalander's study is not very clear on whether or not land and clearing costs are included in its costs, it appears that they are not as they are stated to represent "plant" costs (p. 14). These costs should certainly be considered in any analysis of Indian EHV costs, however.

In connection with Table 140, an argument can be made that there may be something closely approaching a constant differential between U.S. and Indian costs for comparable lines of different voltages. Labor and land (where Indian prices may be low) are relatively constant inputs in the construction of EHV transmission lines of varying voltages, while the unit costs of much of the equipment and insulators (where Indian prices are high) form an increasing proportion of the cost of higher voltage lines. If a relatively constant differential does exist, Indian costs for the higher voltages would be more than those shown in Table 140.

[1]Carlin, op. cit., pp. 121-132, presents a number of the arguments for this. Some observers have asserted that the Indian coast has few natural ports suitable for development. The present problem, however, seems rather to be that more ports are being developed than can be justified economically.

[2]ICTS, Vol. III, p. 202. Even in the case of ports served by meter gauge lines, the difference is shown as significant only when the proposed port at Haldia is assumed. As suggested below, this may not be a valid assumption, but it is certainly necessary if coastal shipping is to be made efficient.

by the ICTS in this particular comparison. At the same time there is reason to believe that, at least in the longer run, cargo handling costs and destination port delays could be substantially reduced below those shown by the ICTS at the non-lighterage ports if an effort were made to do so. Since the ICTS cost figures assuming the use of new 15,000 ton ships are very close to their all-rail costs,[1] any substantial upward adjustment in rail costs as suggested earlier would decisively shift the advantage to the rail-sea route in the case of the major ports (Madras, Cochin, and Bombay) as well as the minor ports. As stated by the ICTS, however, "with the [rail] projects underway there would be adequate route capacity to handle the added traffic without capital expenditures, except for equipment."[2] While it can be argued that some of this new route capacity, particularly along the Southeast Coast, could have been profitably delayed if centralized traffic control had been installed and at least the present quantity of coal continues to be shipped by sea, the decision to double has already been made in many cases so that the marginal cost of shipping by rail should not reflect the cost of this additional line capacity.[3]

At the same time, coastal shipping costs could undoubtedly be reduced below those given in the ICTS so that it is likely that an efficient coastal operation could compete with Railway movement. The ICTS contains a detailed and long needed analysis of the effect of port delays on costs. What is still needed is a detailed cost-benefit analysis of various methods of insuring that these delays do not occur at the principal destination ports.[4] Equally important would be a cost-benefit analysis of various means for reducing cargo handling costs (such as the use of self-unloading, bulk cargo vessels). In the

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[1] Ibid.

[2] Ibid., p. 203.

[3] Given the ICTS's treatment of Railway capital costs, it can be said that their figures probably do not reflect such a cost.

[4] The ICTS does indicate the main obstacles to higher unloading rates in the principal destination ports, many of which could apparently be overcome in the longer run.

case of existing ships, the Study appears to use existing coal handling rates,[1] while the basis used in the case of "new" ships is not given, although it is stated that "the costs of cargo handling have been calculated on the basis of the methods now being used at each port" except in the case of a few listed ports.[2] What these calculations mainly show is that inefficient cargo handling methods lead to high coastal shipping costs.

Further research might well suggest that the capital expenditures necessary to substantially reduce destination port delays and cargo handling costs could not be justified on the basis of the limited cargoes now available. The cargo available, however, is probably quite sensitive to the rates charged and to the passage of time.

The question raised by the ICTS concerning the advisability of substituting fuel oil for coal in Western and Southern India raises more serious questions. The conclusion that fuel oil presents an interesting alternative energy source in these areas appears to be sound to the extent that domestic refineries located in the market area produce fuel oil that would otherwise have to be exported. Beyond this, however, coastal-shipped coal might prove more attractive, depending upon the possibilities for reducing the costs of coastal shipping and the premium assumed on foreign exchange.

If, as stated by the ICTS, the opportunity cost of using domestically refined fuel oil is the potential export price of Rs. 47.36 per ton,[3] the cost including a foreign exchange premium of 50 or even 100 per cent would be Rs. 71 or 95 per ton. To compete, coal would have to cost less than Rs. 35 or 47 per ton at the refinery.[4] As the ICTS computes the cost of coal at the mine as Rs. 29 per ton,[5] it is clear

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[1] ICTS, Vol. III, p. 156. As rates vary at some ports according to the method used for unloading, it is not clear how these rates were determined.

[2] Ibid., p. 165.

[3] ICTS, Appendix C, p. 71.

[4] Using the ICTS assumption that one ton of oil is equivalent in energy value to two tons of coal.

[5] ICTS, Appendix C, p. 67.

that coastal coal cannot be made competitive in Western and Southern India at a 50 or even a 100 per cent premium.[1]

The question is rather how much surplus fuel oil will be available in these sections of India. Surplus oil in other sections must, of course, bear the cost of shipment to them. While these costs may be lower than the cost of shipping an equivalent quantity of coal, they would probably be enough to eliminate fuel oil as an interesting alternative. The ICTS estimates that there will be a surplus of 2.4 million metric tons of fuel oil in Western and Southern India in 1970-1971.[2] In comparison with this, ICTS estimates show that the demand for coal other than for Railways, bunkers, and exports is expected to increase by 11.7 million tons,[3] or about 5.9 million tons of fuel oil equivalent. This suggests that even with the substitution of the additional fuel oil refined in Southern and Western India, the total demand for coal in these regions is likely to increase rather than decrease.

There remains the question of whether fuel oil should be imported for use in Southern and Western India in place of domestically produced coal. The appropriate cost to use is that for importing fuel oil rather than crude oil,[4] namely, Rs. 112 at a 50 per cent premium on foreign exchange and Rs. 144 at 100 per cent.[5] These correspond with

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[1] If the cost of rail transport is taken as that shown in Table 6, line 2a (Appendix B), the cost of rail transport from the mines to Haldia would be Rs. 8.50 x 1.45 = Rs. 12. Subtracting the above Rs. 29 from Rs. 35 or 47 leaves at most Rs. 6 to cover all shipping costs.

[2] ICTS, Appendix C, p. 108. This estimate is critically dependent upon the percentage of fuel oil assumed to be produced by various refineries. The ICTS presents at least two different estimates (see Appendix C, pp. 161 and 194). Use of the more conservative ICTS estimate (p. 194) suggests a surplus of only 1.95 million metric tons. In order to be truly surplus, the fuel oil production assumed should be that consistent with the maximum production of the most critical products. This would suggest that the more conservative estimates should be used.

[3] Ibid., Appendix C, p. 96.

[4] In this case the other products that could also be refined from crude oil would be surplus, so that it would be cheaper to import fuel oil rather than crude oil to meet demand in excess of domestic refinery output.

[5] ICTS, Appendix C, p. 73.

coal prices of Rs. 56 and 72 per ton, which are high enough to raise the possibility of efficient coastal shipments.[1]

The real question concerning coastal shipping is not whether it can be made competitive with other means of delivering energy to Southern and Western India but rather whether the capital improvements necessary to make it an efficient operation can be justified at likely traffic levels. Because of the problem of segregating different grades of coal, the volume used by individual users affects the total volume that can be economically moved by sea. Indian coastal shipping of coal will never be efficient as long as an attempt is made to segregate individual shipments. It is unfortunate that the Railways, one of the largest users of a comparatively uniform grade of coal, will undoubtedly choose to move their coal shipments back onto the rails as soon as their second track along the Southeast Coast is complete. Therefore, the immediate outlook for coastal shipping and a justification for the proposed port at Haldia (south of Calcutta) based on coastal movements cannot be considered very good. What is required is further study of the possibilities of making coastal shipping economical, and if found to be justified, the coordinated development of all the facilities and the purchase of ships needed for an efficient operation, rather than hasty development of Haldia alone (unless it can be justified for international traffic).

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[1]The cost of coal is computed by the ICTS as Rs. 29 per ton. If the cost of rail transport from the mines to Haldia is taken as Rs. 12 per ton, as suggested in footnote 1 on page 35, and both are subtracted from Rs. 56, only Rs. 15 would be left to cover all shipping costs. Comparison with ICTS shipping costs (see Appendix B, Exhibit 73 and the chart facing page 167 of Volume III) will suggest that with efficient operation shipping costs might be reduced to this level at least in the case of the ports to the east of Cochin. At a higher and probably more realistic premium on foreign exchange, the case becomes clearer.

IV. THE GENERAL STRATEGY OF TRANSPORTATION AID

The conclusion from this analysis is that there are a number of important problems in Indian transportation that adversely affect the allocation of resources in the sector. One question that now arises is how the United States can best attempt to influence policy in this area. Perhaps the easiest way to tackle the question is in terms of the three categories outlined in Section I.[1]

Although more short-term sectoral studies[2] have been made of Indian transportation than in most other sectors, many more could certainly be usefully carried out, and might have some influence on Indian policy. Several of the more useful areas for such studies have already been indicated. There is clearly considerable need for longer term technical aid,[3] at least in the case of the Railways. The principal problem has been the long-standing reluctance of the Railways to accept such aid. The technical and economic competence in transportation that the Mission would have to develop to carry out such technical aid projects could profitably be used to help develop U.S. policy towards Indian transportation and administer aid to the sector. The absence of such competence represents one of the major shortcomings of U.S. aid to Indian transportation.[4] Any serious attempt to exercise such influence, as advocated here, requires a serious effort to find such personnel whether or not a technical aid program is undertaken.

The exercise of U.S. influence through offering aid, possibly on concessional terms, to desired but unpopular projects[5] clearly offers many opportunities in the case of Indian transportation. The World

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[1] See page 5.

[2] Category 1a on p. 5.

[3] Category 1b.

[4] Carlin, op. cit., pp. 68 and 135.

[5] Category 2.

Bank has already illustrated the use of this technique in its International Development Association loan for highway development. Other opportunities of exercising influence exist in introducing various technical innovations to the Indian Railways, coastal shipping, and possibly in EHV, if further studies should establish the merits of these modes.

The indirect approach[1] to attaching conditions to capital aid for transportation also offers some interesting opportunities for American policy by bringing about institutional changes that would ultimately result in a more rational solution of both the problems outlined here and those that will arise in the future. One of the organizational problems of Indian transportation suggested by the previous analysis is the power of the Railways to influence transportation policy in their own interests, for example, in the area of road transport. This power stems basically from their entrenched position as one of the more bureaucratically powerful ministries of the Central Government. Just why this particular Government enterprise should enjoy such a powerful position is not at all clear. And there is a strong reason why it should not -- namely, because it leads to development biased in favor of the Railways. One obvious way to improve Indian transportation policy making is to remove the basic responsibility for intermodal transport policy from those responsible for operating a particular mode, such as the Railways. One way of doing this would be to abolish the Ministry of Railways, transforming the Railways into a public corporation similar to other Government-owned enterprises, responsible in this case to the Ministry of Transport, which would assume limited policy direction over such matters as Railway rates. This would vest all authority for the formation of transportation policy in a single agency that hopefully would be able to put national interests ahead of those of any particular mode. Such a move would end the necessity for the creation of ineffective, long-lived interministerial committees to settle policy differences between the Railways and other modes of transportation.

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[1]Category 3a on p. 5.

There would obviously be substantial opposition to any American proposal for such an organizational change. On the other hand, such a change would probably ultimately accomplish far more than the exercise of U.S. influence on particular policy issues, with far less expenditure of scarce administrative, technical, and economic manpower on the part of AID.

This is not to say that AID cannot also usefully attempt to influence specific policies,[1] but only that other easier means should be pursued to the extent possible. Wherever the necessary studies have been completed, there would appear to be every reason for the United States to press for the adoption of improved policies that the Indian Government does not adopt of its own accord as a result of the studies. Besides additional Mission personnel, such an attempt to exercise influence over specific policies would require that the present semiprogram type of loans to the Railways be dropped in favor of more project-oriented loans that made a more serious effort of actually examining the cost effectiveness of individual investments (for example, diesel locomotives for particular lines). Such analyses are by no means impossible and in any case need to be carried out.

One final note needs to be added concerning the basic strategy to be followed to achieve intermodal reforms. The strategy favored by this paper is based on the recognition that the only effective way to initiate changes involving the competitive advantages of various modes is withholding, delaying, or attaching conditions to aid to the Railways. Attempting any of these actions to encourage reforms involving other modes of transportation will delay progress in these areas at the expense of further increased dominance by the Railways. In general, the Railways are sufficiently powerful so that the detrimental effects of withholding any particular aid to them will be much less than imagined because of their ability to obtain ultimate resources in a variety of other ways. This has greatest relevance in the case of attempting to remove the artificial hindrances to the development of road transport.

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[1]Category 3b on p. 5.

V. THE PROPOSED POLICY IN SUMMARY

The Indian Railways possess a dominance in the field of transportation that cannot be justified on economic grounds and has been exacerbated by unquestioning U.S. support of the Government of India's transport development programs. Further aid to the Railways should be made conditional on substantial progress towards removing the non-economic obstacles to the development of other modes where these offer economic advantages, as well as to substantial reforms by the Railways themselves.

To implement this policy, the United States should place considerable emphasis on encouraging a reorganization of Indian Government ministries dealing with transportation so as to divorce somewhat the policy making from the operating functions. It should also attempt to exercise more influence on specific policy issues and to provide some technical aid to the Railways with the help of additional Mission personnel in the transportation area. Specifically, the United States should press for the following policy changes and new studies.

RAILWAYS

1. The Indian Railways should be strongly encouraged to make a new start towards developing accurate cost estimates for various types of freight and passenger traffic. Long-run marginal costs should be computed directly, using multiple regression techniques. The services of qualified U.S. economists and railroad cost analysts should be offered to the Railways if such technical aid is desired. If the Railways fail to undertake the work within a reasonable time, an all-U.S. study should be made a condition of further U.S. (and, if possible, World Bank) aid to the Railways.

2. Further U.S. aid should be made conditional on substantially more rapid progress towards increasing passenger fares, reducing the differential between rates for high and low value goods, increasing marginal freight rates at longer distances, and increasing the rate of return on invested Railway capital. The ultimate goals of these

changes should be established by the studies undertaken under (1), but there is no reason why gradual adjustments cannot be made in the meantime.

3. Incentives (for example, concessional foreign aid terms) should be offered to the Railways to adopt new technological innovations where economically justified. More rapid introduction of improved signaling such as centralized traffic control and automatic block signaling is an important area that should receive early emphasis.

4. The United States should insist, either as part of technical aid, project reviews, or separate studies, on in-depth analysis of Railway problems likely to significantly affect the allocation of resources. Further study of the costs and benefits of a major shift to the use of heavier trains is one of the topics that should receive early consideration.

5. Further U.S. aid should be made conditional on acceptance by the Railways of significant amounts of U.S. technical aid in areas other than cost analysis. This should include a significant element of economic as well as technical advice.

6. The full arsenal of U.S. bargaining power, including both incentives and penalties, should be used to achieve the above goals each time a new loan is made. Less than desired performance can be penalized by delays, rejections, or reductions in loan requests. Detailed economic justifications of the need for each specific request, such as the need for diesel locomotives on specific routes, should be insisted upon rather than the semiprogram approach heretofore used. Each loan should be made the occasion for another major study.

ROAD TRANSPORT

Primary U.S. energies should be directed towards the three reforms listed below. Further U.S. aid to the Railways (not road transport or vehicle manufacturing) should be made conditional on significant progress by the Indian Government towards these goals.

1. Repeal or revise nuisance legislation regulating the number of trucks that may use any particular route and the distance or

territory over which a particular truck can travel. Only the number of firms offering common carrier service over any route should be regulated, and perhaps not even that.

2. Revise the relative burden of taxation between the Railways and highway transport so as to equalize the incidence on the two modes, after taking into account the cost of providing the services of the highways to road transport. Detailed studies of what equitable rates might be in each case should be undertaken, if necessary by U.S. personnel.

3. Liberalize restrictions on the weight, size, and type of vehicles using the highways. Any arbitrary restrictions that do not reflect real engineering and safety requirements should be removed. Country-wide surveys of existing regulations and legitimate requirements should be encouraged by truly independent groups as a basis for these changes. These studies should pinpoint routes where the regulations could be liberalized by comparatively small expenditures, and should prepare cost-benefit analyses of such improvements. The United States should be prepared to offer aid on concessional terms for projects found to be justifiable as a result of such studies and exert its influence for their early construction. At the same time, India should be encouraged to develop plans for the domestic manufacture of more economical types of trucks to take advantage of the relaxed regulations.

EXTRA HIGH VOLTAGE TRANSMISSION

The research done thus far suggests that EHV may be an interesting mode for transporting energy. The United States should encourage India to consider EHV whenever a suitable situation arises, especially as part of power projects proposed for U.S. financing. At the same time, there is a case for more detailed studies of EHV costs in India, together with the side benefits it may offer in terms of savings resulting from the interconnection of regional power systems. The offer of technical personnel and economists could usefully be made as an incentive to have such studies initiated at an early date.

COASTAL SHIPPING

The United States should encourage and if necessary finance a new and more detailed study of the costs and benefits of increasing the efficiency of the coastal shipping industry to see if there is any way that coal shipped by sea can be made competitive with imported fuel oil and coal moved by rail. Such a study would examine particularly the costs and benefits of improving facilities at the various destination ports so as to decrease the time required for unloading as well as alternative types of ships that might prove more economical.

Appendix A

DESIRABLE INDIAN RAILWAY RATES EXPRESSED SYMBOLICALLY

The suggestions outlined in Section II of the text concerning the desirable relationship between railroad rates and costs can be made somewhat clearer if expressed in terms of symbols. It should be kept in mind, however, as explained in the text, that actual rates should be established by using the rates suggested here as guidelines rather than by using inflexible standards. In simplified form, a suitable cost study would ultimately derive cost functions expressing total operating costs at time t (including replacement expenditures or "depreciation"), C_o^t, and incremental capital charges[1] between t-1 and t, or $C_k^t - C_k^{t-1}$, as a linear function of output variables, say net ton-miles of freight, x_1, and passenger-miles, x_2:

$$C_o^t = a_o + a_1 x_1^t + a_2 x_2^t$$

and

$$C_k^t - C_k^{t-1} = c_o + c_1\left(x_1^t - x_1^{t-1}\right) + c_2\left(x_2^t - x_2^{t-1}\right) , \qquad (1)$$

where the a_i and c_i are constants.[2] The computation of incremental capital charges in terms of costs in the recent past is taken as the most accurate method of estimating the cost of future expansion of capacity, the theoretically correct cost to use. The rate r_i for the ith output, according to the suggestions made above, would be

$$r_i = a_i\left(1 + \frac{a_o}{C_o^t - a_o}\right) + c_i\left(1 + \frac{c_o}{C_k^t - C_k^{t-1} - c_o}\right) .$$

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[1]Not to be confused with capital stock.

[2]Research might suggest that a lag should be introduced into this equation.

If it should prove possible to set passenger rates at a level corresponding to more than average operating costs, and r_1 represents freight rates and r_2 passenger rates, and if such revenue is used to reduce the incidence of freight rates rather than to make a net contribution to Government revenue, then r_1 and r_2 should fall within the following bounds:

$$a_1 + c_1 \leq r_1 < a_1\left(1 + \frac{a_o}{C_o^t - a_o}\right) + c_1\left(1 + \frac{c_o}{C_k^t - C_k^{t-1} - c_o}\right) ,$$

and

$$a_2\left(1 + \frac{a_o}{C_o - a_o}\right) + c_2\left(1 + \frac{c_o}{C_k^t - C_k^{t-1} - c_o}\right) < r_2 \leq a_2 + c_2 + \frac{a_o + c_o}{x_2^t} .$$

A more precise treatment of the rate formula derived in the text would distinguish between the line haul and terminal components of each type of service, which might be designated as x_i^t and y_i^t, respectively, and between a large number of different services, such as various classes of passenger service and the transport of various types of freight having different cost characteristics, such as bulk minerals foodgrains, and other freight, which might be designated by subscripts $i = 1, 2, 3 \ldots n$. Then

$$C_o^t = a_o + \sum_{i=1}^{n} a_i x_i^t + \sum_{i=1}^{n} b_i y_i^t$$

and

$$C_k^t - C_k^{t-1} = c_o + \sum_{i=1}^{n} c_i\left(x_i^t - x_i^{t-1}\right) + \sum_{i=1}^{n} d_i\left(y_i^t - y_i^{t-1}\right) ,$$

so that line haul rates r_i would be given by the formula in the text and terminal rates s_i by

$$s_i = b_i\left(1 + \frac{a_o}{C_o - a_o}\right) + d_i\left(1 + \frac{c_o}{C_k^t - C_k^{t-1} - c_o}\right)$$

where s_i would be expressed in terms of say naye paisa (nP.)[1] per ton.

Some further refinements are necessary for actually computing $C_k^t - C_k^{t-1}$. First of all, not all capital expenditure is for the purpose of accommodating an increased volume of traffic. Rather, a significant proportion is used to reduce operating costs or improve service. Clearly the capital charges associated with this investment should be uniformly distributed over all the traffic rather than being attributed merely to $x_1^t - x_1^{t-1}$ (that is, they should be treated like c_o). Secondly, a very significant proportion of Railway investment is composed of the price inflation element of replacement expenditures. Since this expenditure is a function of time rather than expansion in capacity, a careful cost analysis would presumably attribute this expenditure to the c_o term. It should, however, be excluded altogether from $C_k^t - C_k^{t-1}$ because rates set equal to c_i in effect already reflect the replacement cost of the capital assets. If the coefficients of the equation $C = c_o' + c_1'x_1 + c_2'x_2$ are stable over time, however, c_o should be zero except for the two items just mentioned.

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[1]At the official rate of exchange, one naya Paise equals .01 of a rupee, or .21 of a cent.

Appendix B

ESTIMATES OF INDIAN RAILWAY COAL COSTS

The differences between the two sets of estimates of Indian Railway coal costs made to date[1] can be conveniently divided between those that are comparatively easily reconciled and those that are directly attributable to the basic simplifying assumptions made. Under the first heading are found differences in the size of the capital stock and the rate of return used.

The differences in the capital base assumed result largely from the fact that the ICTS uses historical rather than reproduction costs and assumes that the capital stock is substantially more depreciated on the average. Because of the very substantial rise in prices during and after World War II, and the significant proportion of Railway capital dating from prior to the War, the ICTS's use of historical costs[2] has the effect of greatly underestimating the capital stock. Although there are a number of uncertainties involved, particularly concerning the correct price index to use,[3] Tables 1 and 2, which

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[1]As developed in the author's "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, June 1964, Chapter 3 and Appendix B, and Surveys and Research Corporation and Coverdale and Colpits, "India Coal Transport Study," June 1, 1964, Volume III.

[2]Specifically, the ICTS uses the value of Railways assets at the time of their most recent replacement (see Volume III, pp. 123-124, and Appendix B, Exhibit 55). The "price increase element" mentioned refers to the addition that must be made to Railway captial stock figures to include the full price increase that occurred between the time the assets were originally created and their most recent replacement.

[3]As partly explained in Carlin, op. cit., pp. 280-287, the price index is heavily dependent not only on less than perfect information concerning prices, but also on the prices for steel and foreign exchange established by the Government of India, which probably do not reflect equilibrium conditions. Both prices were held constant between 1957 and 1961, resulting in their progressive underevaluation. As a consequence, both the domestic and imported price of steel, a major component of the index, should be increased over that suggested by the raw data. Some allowance has been made for this in the index, but probably more could be justified. Revised steel price estimates can

represent slightly more refined estimates of those made earlier, suggest that reproduction cost may be almost twice historical cost. Reproduction costs are to be preferred over historical costs in computing capital stock because they more nearly reflect incremental capital costs.[2]

At the same time, because a large percentage of Railway capital has been created in the last decade and a significant percentage does not depreciate, Railways capital is considerably less than 48 per cent depreciated, as the ICTS in effect assumed.[3] Table 2 suggests that it is only about 31 per cent depreciated.

In addition to these two major sources of underestimation of capital costs, there is a third and relatively minor one in the fact that the ICTS does not appear to have included all of the capital used in broad gauge operations (even when valued at historical cost). Exhibit 55, Appendix B of the ICTS includes only the assets of the six railways with substantial broad gauge trackage and assumes (without explanation) that a round 80 per cent of their assets are used in

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be found in William A. Johnson, "India's Iron and Steel Industry: A Study of Planned Industrial Growth" (unpublished doctoral dissertation Harvard University, 1964, Chapter 2.

[1]See Carlin, op. cit., Appendix B.

[2]Footnote 1 on page 57 provides some further discussion of the reasons for the selection of the particular capital stock concepts used in this Appendix.

[3]The ICTS, Volume III, p. 129, "assumed an approximate average rate of 6.25 per cent on original cost as the equivalent of a rate of 12 per cent on net assets after depreciation." The 6.25 per cent "was determined as the average during the life of the assets. This was calculated on the basis of an average life of 35 years, a salvage valu of 2.50 per cent of original cost and a rate of return of 12 per cent on the depreciated value." The details of how this particular figure was arrived at are far from obvious and are certainly open to question but the basic error is that of assuming that the percentage depreciation of a rapidly growing enterprise can be computed by taking the average depreciation of a supposedly typical type of asset over its lifetime. This would only be the case if all Railway assets were created sufficiently long ago so they are on the average half depreciated.

Table 1

CAPITAL STOCK OF THE INDIAN RAILWAYS AT HISTORICAL COST

(Rs. millions)

March 31	1939	1951	1955	1956	1957	1958	1959	1960	1961	1962
1. Capital-at-charge	6,937	8,317	9,041	9,690	10,717	12,224	13,566	14,322	15,709	16,830
2. Less miscellaneous projects	-	- 220	- 262	- 290	- 280	- 320	- 331	- 330	- 349	- 402
3. Less over-capitalization and commercial concerns	- 382	- 382	- 422	- 432	- 444	- 449	- 457	- 468	- 483	- 501
4. Net capital-at-charge	6,555	7,715	8,357	8,968	9,993	11,455	12,778	13,524	14,377	15,927
Investment charged to:										
5. Open Line Works-Revenue		134	304	363	441	543	650	766	879	973
6. Depreciation Reserve Fund		1,161	2,179	2,502	2,714	3,057	3,700	4,220	4,715	5,162
7. Development Fund		88	461	582	778	1,031	1,232	1,468	1,715	1,752
8. Miscellaneous										34
9. Gross stock	6,555	9,098	11,301	12,415	13,926	16,086	18,360	19,978	21,686	23,848
10. Less working capital			- 624	- 704	- 861	-1,228	-1,432	-1,259	-1,005	n.a.
11. Gross fixed stock			10,677	11,711	13,065	14,858	16,928	18,719	20,681	

Notes on following pages.

Table 1 (continued)

Notes on line:

1. Capital-at-charge is an accounting category which is roughly equal to the sum borrowed from the Government. The figures refer to now Government-owned lines plus miscellaneous independent projects. The 1939, 1951, and 1955 figures thus include an allowance for the assets of non-Government railways since purchased. This allowance has been estimated by subtracting Rs. 24 million (the approximate capital-at-charge of worked lines from 1956 to 1960) from the total of capital-at-charge of worked lines, the non-Government railroads since purchased, Government-owned lines, and independent projects. For 1939 and 1951 the figures used for this total are for Railway assets now in India as shown on page 90 of A Review of the Performance of the Indian Railways, New Delhi, March 1962, by the Directorate of Statistics and Economic Advice Branch of the Railway Board. The corresponding 1955 figure is from GOI, Ministry of Railways, Indian Railways, 1960-61, p. xxxviii, from which the 1951 figure can also be derived. For subsequent years the figures are as shown in Block Accounts (Including Capital Statements Comprising Loan Accounts), Balance Sheets and Profit and Loss Accounts of Indian Government Railways, various years. The 1955 figure can also be derived from these accounts by adding Rs. 25 million (the capital-at-charge of non-Government lines since purchased). The 1962 figure is from the Report by the Railway Board on Indian Railways for 1961-62, New Delhi, 1963, p. 10.

2. Sum of capital-at-charge of the Integral Coach Factory, the Chittaranjan Locomotive Works, and the strategic lines of the Northeast Frontier Railway. The first two are excluded because they are operated as virtually separate manufacturing units that are paid by the individual railways for their production. A suitable return on capital is presumably included in these payments, or should be, and should not form an additional charge on Railway transportation services. The 1951 figure is an estimate based on the date of completion of the Locomotive Works and its approximate capital cost. Later figures are those given by the Block Accounts, op. cit.

As of 1961, Rs. 89.6 million of the capital-at-charge represented capital of "strategic lines," which in practice have been defined as lines originally built chiefly for defense purposes which have been "unremunerative." Since commercial traffic is carried on these lines, particularly on the broad gauge Mukerian-Pathankot section of the Northern Railway, it is very difficult to assign the capital involved to one purpose or another, although a case certainly exists for some compensatory payment by the Ministry of Defense. However, since the new Rangapur to Lakhimpur line of the Northeast Frontier Railway is expected to carry very little commercial traffic, the capital costs of the line have been excluded.

Table 1 (continued)

The 1961 figure was taken from Block Accounts for 1960-1961, op. cit., while the 1962 figure is derived from GOI, Ministry of Railways, White Paper on the Railway Budget, New Delhi, 1962, p. 60.

3. The sum of charges to Railway capital-at-charge that would not be necessary in any replacement of such assets, plus Railway capital invested in commercial concerns other than by the Chittaranjan Locomotive Works. The latter is largely invested in State road transport undertakings and are thus not directly connected with supplying railroad transportation services. The figures are taken from the Block Accounts, op. cit., except for 1962, which is derived from the Report by the Railway Board for 1962-1963, p. 24.

A detailed audit of the extent of Railway "overcapitalization" made in accordance with the recommendations of the 1954 Railway Convention Committee, determined it to be Rs. 1,216.236 million. Of this amount, Rs. 626.4 million represented "unremunerative assets charged to capital." These are "assets like amenities for passengers, staff welfare works including quarters for Class IV staff and unremunerative operating improvement works, which used to be charged to Capital, if above the Minor Works Limit, prior to the introduction of the 'Betterment Fund' from 1 April 1946 (which merged into the Development Fund from 1 April 1950) and of the head 'open Line Works-Revenue'" from April, 1955. Some critical comments concerning similar current capital expenditures can be found in Louis Lefeber with M. Datta Chaudhuri, "Transportation Policy in India," Pricing and Fiscal Policies: A Study in Method, P. N. Rosenstein-Rodan (ed.), London, Allen & Unwin, 1964, p. 101. As the responsibility for the unremunerative nature of these assets rests largely with the Railways, there is no reason for excluding this amount from the table. Rs. 180.5 million represents "capitalization of replacement cost," that is, "the excess cost of replacement of assets over the original cost charged to capital during the period from 1924-25 to 1935-36." Since historical cost is taken in this table to be the cost at the time of last replacement, this element should also be included, as it is for the years subsequent to 1936-37 in lines 5, 6, and 7. This leaves Rs. 409.3 million "representing no tangible assets." This figure is made up of the following items included in the footnotes to the Block Accounts:

(a) Premium paid on the purchase of old guaranteed railroads and the old B.&H.W. and R.&K. Railways to the respective companies;

(b) Difference arising from the difference in the exchange rates at which sterling payments were converted into rupees in terms of the contracts of the various railway companies, and the rate prevailing at the same time the expenditures were incurred;

Table 1 (continued)

(c) Additional liabilities incurred in the form of redemption charges in financing the purchase of old guaranteed railroad companies;

(d) Premium paid on purchase of various branch lines;

(e) Interest paid by the companies during construction; and

(f) "Loss in working" during construction.

The total expenditure under (a), (b), and (c) is reduced by the amount charged off to revenue to the end of 1924-1925. Although considerable research would be required to fully assess the merits of these exclusions, preliminary analysis suggests that (e) and (f), amounting to Rs. 26.2 and 1.0 million, respectively, should be included in this table since they would probably be incurred in any replacement of the Railway assets involved. This leaves Rs. 382.1 million, which has been subtracted for all years, "representing no tangible assets" for the purposes of this Appendix.

5. From Table B.6 of the author's "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964. As in lines 6 and 7, this consists of new investment and the price inflation and improvement elements on replacements in kind.

6. Ibid., Table B.1.

7. Ibid., Table B.5.

8. Cost of U.S. surplus machines received free of charge, as given in Report by the Railway Board, op. cit., p. 10.

9. Working capital is taken as inventories of Railway stores, balances in workshops and manufacturing suspense accounts, and miscellaneous accounts. These items are excluded for the Chittaranjan Locomotive Works and Integral Coach Factory. Since the breakdown for these two independent projects is not available for 1962, no figure is given. Based on Block Accounts, various years.

Table 2

INDIAN RAILWAY CAPITAL STOCK

Period (years ending March 31)	At Purchase Price: According to Date of Original Acquisition (Rs. millions)	At Purchase Price: Original Cost of Assets Replaced Since 1939 (Rs. millions)	At Purchase Price: According to Date of Last Replacement (Rs. millions)	Price Correction Factor	At Reproduction Cost: According to Date of Last Replacement (Rs. millions)	At Reproduction Cost: Assets Replaced Since 1939 (Rs. millions)	At Reproduction Cost: According to Date of Original Acquisition (Rs. millions)	Percentage of Total Stock in 1961	Ratio of Depreciated Value to Replacement Cost (per cent)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1. Prior to 1939	6,555		4,228	350	14,798		23,305		
a. Depreciating assets							19,165	53.48	50
b. Non-depreciating assets							3,329	9.29	100
2. 1940-51	2,543	807	3,350	175	5,863	3,339	2,524	7.04	74
3. 1952-55	2,203	602	2,805	152	4,264	2,104	2,160	6.03	84
4. 1956	1,034	137	1,171	130	1,522	481	1,041	2.90	89
5. 1957	1,354	140	1,494	130	1,942	369	1,573	4.39	91
6. 1958	1,793	158	1,951	100	1,951	412	1,539	4.29	93
7. 1959	2,070	167	2,237	100	2,237	684	1,553	4.33	95
8. 1960	1,791	168	1,959	100	1,959	588	1,371	3.83	97
9. 1961	1,962	148	2,110	100	2,110	530	1,580	4.41	99
10. Total		2,327				8,507	35,835		69.1
11. Working capital (1961)							1,005		
12. Gross stock (1961)							36,840		

Notes on Columns:

(1): Increase in gross fixed stock during the period as shown in Table 1, except in the first three periods, where the figures shown indicate change in gross stock as a whole.

(2): Sum of appropriate lines of column (3) of Tables B.1, B.5, and B.6 of the author's "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964.

(3): Line 1: line 1, column (1) minus the total of column (2). Other periods: sum of columns (1) and (2).

(4): Prices are assumed to have increased by 250 per cent over pre-World War II prices rather than the 260 per cent shown in Table B.4 of Carlin, op. cit. Other prices are as derived there.

(5): Column (3) multiplied by column (4).

(6): Column (4) multiplied by the sum of the appropriate lines of columns (3) and (4) of Tables B.1, B.5, and B.6 of Carlin, op. cit.

(7): Line 1: line 1, column (5) plus the sum of column (6). Line 1a: 85.2 per cent of line 1 minus Rs. 811 million. Line 1b: 14.8 per cent of line 1 minus Rs. 811 million. 14.8 per cent of fixed Railway assets created before 1939 are assumed to be nondepreciating on the basis of an examination of the breakdown [illegible] Western Railway assets charged to capital-at-charge, as shown in the 1959-60 "Finance Accounts." Specifically, this figure is the sum of capital expenditure headings I, II, 3100, 3400, and VI as a percentage of the sum of headings I to VIII. Rs. 811 million, representing March 1955 working capital at 1960 prices, has been subtracted from line 1 to compensate for the fact that the first three periods represent the increase in gross stock rather than gross fixed stock. Lines 2 to 9: column (5) minus column (6).

(8): Column (7) as a percentage of the column subtotal.

(9): Assumes that the depreciating portion of the capital created prior to 1939 has been in existence long enough so that by 1961 it was, on the average, one-half lifetime old or 50 per cent depreciated. This is a [illegible]er crude assumption, especially given the presence of considerable "over-age" capital stock, but there is little basis for making any other assumption. M[illegible]atly created assets are assumed to be too new to have been replaced and to have depreciated by 2 per cent per year. Use of this rate is justified in C[illegible] cit., pp. 78-82. The percentage for the total is the sum of the products of columns (8) and (9).

their broad gauge operations,[1] or roughly 67 per cent of total assets. Consideration of only the six railways excludes the substantial amounts invested in railway electrification (almost entirely on the broad gauge) and another but relatively minor broad gauge "independent" project. More important, there is some evidence to suggest that even the 80 per cent may be too low.

One way of estimating the distribution of total Railway capital between the gauges is shown in Table 3, which attempts to derive the distribution of capital-at-charge (the major component of Railway capital at historical cost). It suggests that perhaps 76 per cent of capital-at-charge can be attributed to the broad gauge. A very similar estimate (about 75 per cent) is provided by the percentage of total interest charges paid in 1960-61 attributed to broad gauge operations by Railway statistics.[2] Use of either of these figures to compute any measure of broad gauge stock naturally assumes that the distribution between gauges is similar to that for capital-at-charge. Lacking adequate justification for the round figure used by the ICTS, this appears to be a safer assumption.

If these three differences are taken into account, the ICTS broad gauge, coal cost estimates should be increased by about 39 per cent if

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[1] Mr. Norman E. Carlson of Coverdale and Colpitts has explained in correspondence to the author that the 80 per cent "was developed by a study made with the Railway's [sic] Accounting Department, and was based on an analysis of DRF Appropriations and Expenditures." Exactly why the Depreciation Reserve Fund accounts would be an appropriate source of information is not clear. An analysis of the DRF Appropriation Account for 1960-61 (which does not include depreciation for the independent projects) shows that 72.5 per cent of the appropriation was attributed to the broad gauge by the Railways.

[2] More exactly, 75.06 per cent. This was derived by dividing the 1960-1961 interest attributed to the broad gauge in Statement 15 (columns 3 and 4) of Government of India, Railway Board, Report by the Railway Board on Indian Railways for 1960-61, Volume II, New Delhi, 1962, p. 196, by total interest payments (Rs. 558.6 million). It is not clear how the Railway statistics distribute interest payments on the capital of the various independent projects. Interest payments are based on capital-at-charge with a few minor variations. Because of these various uncertainties, the 76.15 per cent figure will be used in subsequent calculations.

Table 3

DERIVATION OF THE PERCENTAGE OF INDIAN RAILWAY CAPITAL-AT-CHARGE ATTRIBUTABLE TO THE BROAD GAUGE IN 1961
(Rs. millions)

Railway or Project	Capital-at-charge Attributable to Broad Gauge (1)	Capital-at-charge Attributable to Individual Gauges (2)
1. Six major railways	10,812	
2. North Eastern and Northeast Frontier Railways	2	
3. Total Government Railways	10,814	14,359
4. Railway Electrification Project	463	463
5. Dandakaranya-Balangir-Kiriburu Projects	44	44
6. Total	11,321	14,866
7. Column (1) as a percentage of column (2)	76.15	

Notes on line:

1. Sum of products of capital-at-charge per route mile and mean route miles worked for broad gauge lines of the Central, Eastern, Northern, Southern, South Eastern, and Western Railways in 1960-61, as given in Statements 9 and 14 of Government of India, Railway Board, Report by the Railway Board on Indian Railways for 1960-61, Vol. II, New Delhi, 1962. There appears to be a number of relatively small discrepancies in the numbers and the underlying definitions of capital-at-charge and route miles used in Statements 2(a), 9, and 14, but it is believed that they are small compared with the uncertainties involved in drawing conclusions from this table about the distribution of various concepts of total assets.

2. Rs. 0.64 million per mile (approximate average for broad gauge lines) multiplied by 3.17 miles of broad gauge route miles on the two Railways.

3. Column (2): Mean route miles worked on all gauges multiplied by the overall average capital-at-charge per route mile. The figure shown is slightly lower than the corresponding capital-at-charge shown in Statement 2(a), but the difference is relatively small.

4. Report by the Railway Board, op. cit., Statement 2(a). As nearly all electrification has taken place on the broad gauge, all capital charged to this project is shown as broad gauge stock.

5. Since all the lines under construction as part of this project are broad gauge lines, this is also attributed to the broad gauge.

the ICTS assumption of a 12 per cent rate of return is used, and by 27 per cent on the basis of my earlier 10 per cent assumption, as shown in columns (2) and (3), line 14b of Table 4.[1] A minor correction has been made in the broad gauge working expenses used by the ICTS for distributing capital charges (see lines 7, 8, and 9). Although the uncertainties in these calculations are particularly great, they alter the results (line 14) by only a few percentage points.

Besides these relatively easily documented underestimates in the ICTS estimates, there is reason to believe that there may be others of at least equal importance. The ICTS determined line haul costs, among other things, "on the basis of movement in through goods trains with a minimum of intermediate yard classifications."[2] While it is true that "good railroading would result in hauling a wagon in a through goods train to the nearest major terminal and in a shunting goods train from such terminal to the consignee's station or siding,"[3] there is no discussion of and considerable doubt whether this is typically the case in India today.[4] In North America, at least, coal is not generally

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[1]Both of these estimates are based on the estimates of reproduction cost of Railway capital developed in Table 2. These are somewhat higher than those used in Carlin, op. cit., where gross stock at historical cost is used as a (deliberate) underestimate of net stock at replacement cost (see especially page 82). Since the ICTS attempts to compute the full average cost of coal transport directly, later making various assumptions about the percentage of total costs which are variable (see Volume II, p. 96 and Appendix C, p. 76), it is the estimates of reproduction cost developed in Table 2, above, that are most appropriate to use in correcting the ICTS full average cost figures. Use of the lower capital base concept employed in Carlin, op. cit., would imply two downward adjustments for the difference between marginal and average costs. By far the easiest way to correct all of the ICTS figures is to retain the ICTS full average cost concept.

[2]ICTS, Volume III, p. 93. Calculations are also made of the additional cost of moving the coal in shunting trains for the last 65 kilometers of the journey (see pp. 125-126 of Volume III), but this is only a minor correction compared with that discussed here, which assumes movement in trains making frequent intermediate stops involving numerous reclassifications for most of the journey.

[3]Ibid., p. 125.

[4]Conditions during the coal transport crisis of 1961-1962, when there is some evidence that coal was given greater priority than usual, should not be taken as typical of normal conditions on the Indian Railways.

Table 4

DERIVATION OF REVISED COAL TRANSPORT COSTS
(Rs.millions)

	India Coal Transport Study	Revised ICTS Estimates		
	(1)	(2)	(3)	(4)
1. Capital base used				
a. Basis	Historical	Higher reproduction	Higher reproduction	Lower reproduction
b. Net or gross of depreciation	Gross	Gross	Gross	Net
2. Rate of return assumed (per cent)	(12)	12	10	10
3. Total capital stock, 1961	18,447	36,840		21,686
4. Half of net investment, 1961-62	789	1,081		1,081
5. Capital stock, 1961-62	19,236	37,921		22,767
6. Broad gauge stock	15,389	28,877		17,337
7. Gross fixed capital stock	-	36,916		31,512
8. Depreciation allowance	471	562		480
9. Broad gauge working expenses	2,695	2,786		2,704
10. Return on investment as percentage of line 9	35.7	85.9	71.6	64.1
11. Deduction for taxes (per cent)	-5.0	-5.0	-5.0	-5.0
12. Balance (per cent)	30.7	80.9	66.6	59.1
13. Total costs as a percentage of 1961-62 operating costs				
a. 1961-62	130.7	180.9	166.6	159.1
b. 1962-63	132.6	184.5	169.9	162.3
14. Revised costs as a percentage of ICTS costs				
a. 1961-62		138.4	127.4	121.7
b. 1962-63		139.1	128.1	122.4

Notes on following pages.

Table 4 (continued)

Notes on line:

1a. Higher refers to the estimate of reproduction cost developed in Table 2. Lower reproduction refers to that used to compute costs in the author's "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964. Lower reproduction represents gross stock at historical cost, which is taken as an estimate of net reproduction cost.

2. Column (1): Parentheses are used because this was the figure that the ICTS claimed to have used rather than what was actually used, as explained in the text of this Appendix.

3. Column (1): ICTS, Appendix B, Exhibit 55. Includes only the assets of the six railways with broad gauge trackage. Columns (2) and (3): Table 2, herein. Column (4): Table 1, herein.

4. Column (1): ICTS. Columns (2), (3), and (4): Half of net fixed investment during 1961-62 as shown in Table 1, herein.

6. Column (1): Eighty per cent of line 5, as in the ICTS. Columns (2), (3), and (4): 76.15 per cent of line 5, as derived in Table 3.

7. Columns (2) and (3): Line 5 minus working capital in 1961 as shown in Table 1. Column (4): Line 5 minus 1961 working capital, divided by the estimated ratio of depreciated value to replacement cost (.691) as derived in Table 2.

8. Column (1): Appropriation to Depreciation Reserve Fund for broad gauge lines in 1960-61 (Rs. 326 million), as shown in Statement 30 (p. 429) of Government of India, Ministry of Railways, Report by the Railway Board on India Railways for 1960-61, Volume II -- Statistics, New Delhi, 1962, multiplied by 1.444. The latter represents the ratio of the 1961-62 depreciation provision (Rs. 650 million) to the 1960-1961 provision (Rs. 450 million). Columns (2), (3), and (4): Two per cent of line 7 multiplied by the percentage of broad guage to total assets as given in Table 3.

9. Column (1): ICTS. Columns (2), (3), and (4): Corresponding column of line 8, minus line 8, column (1) plus line 9, column (1).

10. Column (1): Line 6 multiplied by 6.25 per cent interest and divided by line 9. Column (2): Line 6 multiplied by 12 per cent interest and .691 divided by line 9. The .691 represents the ratio of depreciated value to reproduction cost as derived in Table 2. Column (3): Line 6 multiplied by 10 per cent and .691 divided by line 9. Column (4): Line 6 multiplied by 10 per cent and divided by line 9.

11. Includes allowance for a foreign exchange premium as given in ICTS, Volume III, p. 129.

13a. Line 12 plus 100.

Table 4 (continued)

13b. Column (1): Computed from ICTS, Volume III, pp. 120 and 130. Since the percentages are slightly different for terminal and line haul costs, the average is taken. Columns (2), (3), and (4): 102 per cent of line 13a, following the ICTS, p. 125.

14. Corresponding figures as a percentage of line 13, column (1).

moved on through trains and is subject to considerably more than the average number of intermediate yard reclassifications. To the extent that this is the case, basic carload coal rates should reflect these additional costs.[1]

One of the other basic simplifying assumptions used in the Study, namely, that capital costs are proportional to operating costs, is also likely to result in a substantial understatement of coal costs. While operating costs per freight-car mile are typically slightly lower for bulk minerals than for other freight, capital costs are likely to be higher due to the relatively slow movement of such cars. This again is based on North American experience, but should not be ignored in the absence of Indian data.

Some idea of the magnitude of incremental Indian Railway capital costs can be obtained by a crude attempt to estimate the $C_k^t - C_k^{t-1}$ of equation (1) in Appendix A associated with $x_1^t - x_1^{t-1}$ (see Table 5) and computing $C_k^t - C_k^{t-1}/x_1^t - x_1^{t-1}$. Some of the difficulties of actually computing $C_k^t - C_k^{t-1}$ have already been discussed in Appendix A. In this case, it is comparatively easy to exclude the price inflation element from Railway investment figures, but very difficult to determine the investment associated with reductions in operating costs. But using the same percentage of total capital charges attributed to freight service in the Railway accounts, it is possible to arrive at a rough estimate of c_1 $(x_1^t - x_1^{t-1})$ including, however, the latter element (see line 5 of Table 5). Dividing by $x_1^t - x_1^{t-1}$, c_1 is found to be 4.43 nP. per ton-mile[2] for the period 1957-58 to 1960-61. If the growth in traffic is assumed to be lagged by one year (that is, if $x_1^t - x_1^{t-1}$ is taken as the increase in revenue traffic between 1958-59

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[1] Some discount might justifiably be offered for full train load lots, especially in unitized, closed circuit operations. It is not claimed that the ICTS was necessarily attempting to compute basic carload costs, although the graphs facing pp. 124 and 125 certainly suggest that the reader should compare rates with the computed costs, with the modifications listed on page 124.

[2] Rs. 250 million divided by 5,647 million revenue ton-miles.

Table 5

RAILWAY CAPITAL CHARGES ON FREIGHT SERVICES,
1957-58 to 1960-61
(Rs. millions)

	1960-61		1957-58		Difference	
	Total	Freight	Total	Freight	Total	Freight
1. Average gross stock	20,832		15,006		5,826	
2. Less inflation element of replacement expenditures					-1,275	
3. Difference					4,551	
4. Capital charges according to Railway accounts	556.8	329.1	461.5	276.7	95.3	52.4
5. Revised capital charges					455	250

Notes on line:

1. Based on historical cost. Average of the end of year figures given in line 9 of Table 1.

2. Half of the 1957-58 and 1960-61 plus all of the 1958-59 and 1959-60 figures given in column (4) of Tables B.1, B.5, and B.6 of the author's "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964.

4. Dividends paid to general Government revenues. Freight portion as given by figures furnished by the Railway Board.

5. Total charges are 10 per cent of line 3. Freight portion is taken as the same proportion as in the Railway accounts (line 4).

and 1961-1962), c_1 becomes 3.55 nP. per ton-mile.[1] It has previously been suggested that assuming a uniform cost per freight-car mile, coal costs are only slightly lower than the average per ton-mile even after various adjustments like heavier average load per car and a higher percentage of empty return miles are accounted for.[2] Since variable capital costs are indeed likely to vary with freight-car miles (rather than operating costs, as the ICTS in effect assumed), these figures are probably only slightly higher than those that would be derived from a detailed analysis of Railway capital costs. It is therefore probably safe to say that c_1 is between 3 and 4 nP. per ton-mile.

Broad gauge operating costs for coal are somewhere between 2.7 and 3.1 nP. per ton-mile according to the ICTS,[3] so that total costs according to this method of computation are roughly 6 to 7 nP. per ton-mile. This is substantially higher than the revised ICTS estimates shown in line 2b or even 2a of Table 6, somewhat similar to my earlier estimate (line 3), and markedly higher than current average coal rates (line 4).

Finally, the ICTS may understate coal costs by its rather arbitrary and to some extent contradictory assumptions concerning the relation between marginal and average costs.[4] Probably because of the substantial investment being made in second tracks, marginal cost (on the basis of the crude estimates made in the last two paragraphs) may indeed be very close to average cost at present.

Despite this support for my earlier estimates,[5] there may be some overstatement of coal transportation costs inherent in the simplifying

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[1] Rs. 250 million divided by 7.039 million ton-miles.

[2] Carlin, op. cit., p. 307.

[3] The 2.7 nP. figure is that shown in line 1c of Table 6. The 3.1 figure is line 1b, column (3) of the same table divided by 1.376.

[4] It is interesting but not very important that the ICTS uses at least two different assumptions concerning the relationship between marginal and average cost. In Volume II (page 96), marginal costs are taken as 80 per cent of average, while in Appendix C (page 76), 75 per cent is used.

[5] Made in Carlin, op. cit., Appendix B.

Table 6

ESTIMATES OF COAL TRANSPORT COSTS ON THE BROAD GAUGE INDIAN RAILWAYS

	Terminal (Rs. per long ton)	Line Haul (nP. per ton-mile)	Average (nP. per ton-mile)
	(1)	(2)	(3)
1. India Coal Transport Study			
a. Total costs, through trains	2.11	3.09	3.68
b. Total costs including shunting train movement	4.05	3.09	4.22
c. Operating costs on through trains			2.68
2. Revised ICTS (total costs on through trains)			
a. Higher capital base; 12 per cent return (1962-1963)	2.94	4.30	5.12
b. Higher capital base; 10 per cent return (1961-1962)	2.64	3.86	4.55
c. Lower capital base; 10 per cent return (1961-1962)	2.52	3.69	4.35
3. Author's estimates (1960-1961)	2.69	5.91	6.59
4. Rate charged			
a. 1961-1962			3.82
b. 1962-1963			4.35

Notes on line:

1a. These figures are supposed to represent 1962-63 costs and are derived from the ICTS, Vol. III, p. 130. The average is computed on the basis of a 360-mile average lead for coal for the public in 1962-63 on the broad gauge lines, based on figures presented in the ICTS, Appendix B, Exhibit 78.

1b. The ICTS, Vol. III, p. 126, assumes that some (unstated) proportion of coal, that destined for low volume stations, is carried on shunting goods trains for an estimated average of 65 kilometers from the nearest major terminal at an additional cost of Rs. 1.76 per (metric) ton. This apparently represents what the ICTS characterizes as the cost to the Railways. The corresponding cost to the nation, according to the ICTS method of computing it, would presumably be Rs. 1.91 per metric ton (132.6 per cent of Rs. 1.44, the cost "excluding return on investment") or Rs. 1.94 per long ton. This has been added to the terminal charge shown in 1a. It is important to point out that

Table 6 (continued)

rates are based on coal carried by all types of trains on all guages, so that neither 1a nor 1b are directly comparable with rates. About 95 per cent of coal revenue ton-miles are on broad guage, however, so that the discrepancy arising from the higher costs on the narrower guages is not too large.

1c. Line 2b divided by 137.6 (line 13b, column (1) of Table 4 plus 5 per cent, the deduction for taxes).

2a. Line 1a multiplied by line 14b, column (2) of Table 4. If all coal haulage included the shunting train movement postulated in 1b, the terminal cost would be Rs. 5.64 per long ton and the average 5.87 nP. per ton-mile.

2b. Line 1a divided by 1.02 and multiplied by line 14a, column (3) of Table 4. The 1.02 is derived from the fact that the ICTS assumed that Railway unit costs increased by 2 per cent between 1961-62 and 1962-63 (see Vol. III, p. 125). Based on a 384-mile lead in 1961-62, as derived from figures presented in the ICTS, Appendix B, Exhibit 78. Including shunting movement, the terminal cost would be Rs. 5.06 and the average 5.18 nP.

2c. Line 1 divided by 1.02 and multiplied by line 14a, column (4) of Table 4. Including shunting, the terminal cost would be Rs. 4.83 and the average 4.94 nP.

3. Alan Carlin, "An Evaluation of U.S. Government Aid to India" (unpublished doctoral dissertation), Massachusetts Institute of Technology, 1964, p. 307. These estimates assume a terminal cost of Rs. 60 per four-wheel freight-car loading since this is closer to the revised ICTS figures.

4a. On broad guage only. Derived from Government of India, Ministry of Railways, Report by the Railway Board on Indian Railways for 1961-62, New Delhi, 1963, p. 80.

4b. Derived from Report by the Railway Board on Indian Railways for 1962-63, New Delhi, 1964, p. 82. Rates for the longer hauls were further increased in 1964.

assumptions made in those calculations. It is generally accepted that the long-run marginal cost for bulk commodities is somewhat less than the average for all commodities in the United States. John Meyer suggests that rail costs for bulk commodities are roughly 78 per cent of those for manufactured commodities in carload lots.[1] My figures, on the other hand, suggest that there is relatively little difference. The reason that my method may have led to some overstatement lies in the fact that the adjustments made account for only the more easily quantified adjustments from the average cost per ton-mile, namely, differences in load per freight car, percentage of empty returns, distribution by gauge, and average length of haul. Some of the other adjustments commonly made by the ICC are listed elsewhere.[2] The question is whether these other adjustments are likely to account for the fact that after adjusting for differences in the amount of capital charges, the adjusted ICTS figures are still only 66 per cent of my figures.[3] The little evidence available suggests that they are not likely to account for it.

One of the few established reasons for lower than average bulk mineral costs in the United States is the longer trains used in such operations. Specifically, one study presents evidence that indicates that U.S. railroads with larger than average percentages of mineral carloads (and relatively high percentages of empty car miles) operate trains with greater than average numbers of cars.[4] Because the length

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[1]See "A Comparison of the Advantages and Disadvantages of the Various Modes of Transport" in Robert S. Nelson and Edward M. Johnson, (ed.), Technological Change and the Future of the Railways, Evanston, Transportation Center, Northwestern University, 1961, p. 7. Interstate Commerce Commission figures show that their "out of pocket" costs per ton-mile for "products of mines" were 82 per cent of the over-all average in 1958, even though the average length of haul was over 120 miles shorter. See ICC, Bureau of Accounts, "Distribution of the Rail Revenue Contribution by Commodity Groups -- 1958," Statement No. 4-60, Washington, September 1960, Table 7.

[2]See Carlin, op. cit., p. 104.

[3]Line 2c, column (3) of Table A.6 divided by line 3, column (3).

[4]George H. Borts, "Cost and Production Relations in the Railway Industry" (unpublished doctoral dissertation), University of Chicago, June 1953, p. 90.

of sidings puts a much stricter limit on the length of Indian than U.S. trains, this factor is unlikely to be of great significance in India. One would therefore expect that barring other significant differences in U.S. and Indian railroad operations that there would be a smaller rather than a larger percentage difference between the cost of hauling bulk mineral and other products in India and in the United States.

The conclusion from all this is that despite the more detailed analysis of operating costs carried out by the ICTS, there is some doubt that even the revised ICTS costs are very clost to what would represent a reasonable rate for coal.

Appendix C

THE ECONOMICS OF INVESTMENTS IN ELECTRIFICATION AND DIESELIZATION

The problems with the ICTS's analysis of the merits of dieselizing and electrifying a number of sections of the Indian Railways can best be expressed in terms of symbols. Let

K_e = original cost of capital needed for electrification (or dieselization),

K_s = replacement cost to the Railways of steam capital equipment of equal work capacity,

O_e = annual operating costs of alternative electric (or diesel) operations,

O_s = operating costs of steam operation,

R = annual revenue,

r = alternative external rate of return available.

The ICTS appears to use the following decision rule for investing in electrification (or dieselization) on any section:

$$\frac{O_s - O_e}{K_e} \geq 6.25 \text{ per cent},$$

where O_s and O_e are taken to include depreciation allowances.[1]

The fundamental problem with this criterion is that it yields different conclusions from those arrived at by directly computing the present discounted value of each alternative and comparing them, as economic theory would suggest. This would not only yield much more accurate conclusions than those reached by the use of any set of simplifying assumptions such as the ICTS apparently used, but would involve little extra work.

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[1] See the ICTS, Vol. III, p. 230; Appendix B, Exhibit 76; and Appendix D, pp. 16-26.

Bearing this fundamental objection in mind, it is nevertheless of some intellectual interest to derive a more theoretically correct decision rule, using the simplifying assumptions implied by the ICTS calculations. If it is assumed that the problem is to choose between steam and one of the other two forms of traction at a time when the existing steam equipment would have to be replaced anyway, and if the assets are assumed to have infinite lifetimes and uniform maintenance costs over time, the present value of the electrification or dieselization investments would be

$$PV_e = -K_e + \frac{R - O_e}{r}$$

while

$$PV_s = -K_s + \frac{R - O_s}{r} ,$$

where O_e and O_s do not include depreciation allowances and R is assumed to be identical in both cases. The discount rate $\bar{r}$ which equates the present values is

$$\bar{r} = \frac{O_s - O_e}{K_e - K_s} ,$$

so that electrification or dieselization can be justified in this case if

$$\frac{O_s - O_e}{K_e - K_s} > r.$$ [1]

If all the existing steam equipment suitable for use on the line in question has some remaining value to the Railways in alternative uses, the equation becomes more complex, to the detriment of the case for investing in the two new modes of traction.

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[1] Taken as 12 per cent by the ICTS.

It can be seen that the ICTS formula makes three somewhat compensating errors, even given the important simplifying assumptions implied by the Study, namely, the omission of K_s, the use of too low an i, and the inclusion of depreciation allowances in O_e and O_s. An estimate of the extent and direction of the resulting bias depends on the specific relationship of K_s to K_e and the rates of depreciation used by the ICTS in each case. Direct computation of the present discounted values[1] for each alternative, as advocated above, would, of course, allow the use of more realistic assumptions concerning asset lifetimes, the variation of maintenance expenditures over time, and the important line capacity-increasing effects of dieselization and electrification.

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[1]Those not familiar with such calculations, particularly in quantifying capacity increasing effects, may find the discussion of the centralized traffic control versus doubling alternatives in Carlin, op. cit., pp. 65-66, of some value.

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