A Comparative Analysis of Evaluation Methodologies for Railway Investments of China and Korea

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Abstract

Economic evaluation methodologies for railway investments of China and Korea are comparatively analyzed. Chinese procedures specified in the new economic evaluation manual of 1997 were compared with those of Korea based on the economic evaluation manual of 1982. As expected those procedures reflect general economic requirements of the respective countries. Several differences in the specification are also noted. Details of the specification of Chinese procedure far exceed Korean specification, while Korean manual is rich of explanation on the fundamental theory. Differences in the procedure of calculating benefits of investments are most conspicuous, and specific requirements of carrying out a optimum opening year analysis in Korean procedure is notable. Despite of these differences in the procedure, two methodologies share same objective of ensuring selection of economically and financially sound railway projects. Both procedures of China and Korea, however, limit their evaluation scope on railways alone. Therefore, they are needed to expand scope of evaluation to encompass the idea of multi-modal or inter-modal evaluation, which will eventually contribute to build truly efficient national comprehensive transportation system.

1. Introduction

Every country in the world has its own evaluation framework for deciding transport infrastructure investments. Usually they carry out an a-priori evaluation for the positive impacts from the investments, and compare them with cost involved. This process of evaluation is to ensure that scarce national resources are properly utilized to build up an efficient national transportation system. The evaluation processes are not only interesting topics for research but also they can provide insights on the national transportation policy of the countries. By carrying out a comparative analysis of the investment evaluation processes, one can expand understandings of the transportation policies of the countries involved and learn from each other's practice. Eventually, the analysis will contribute to the enhancement of the one's own evaluation process.

Some countries have separate manuals for modal evaluations, while others have one integrated procedure. For example, Germany has one integrated procedure for highways, railways and in-land waterways (MOT, 1993), while China has a separate manual for railway (MOR, 1997). Korea also has one manual for highways and railways (EPB, 1982). Despite of this apparent difference, all the evaluation procedures are critically based on the economic system of the country, and also reflect national transportation policy. Therefore, evaluation procedures should be updated to reflect current economic environment and contemporary transportation policy of the country. Germany utilized separate evaluation manuals to develop Federal Transport Investment Plans of 1985 and 1992. China also recently updated her railway economic investment evaluation manual in 1997 from that of published in 1992. In this regard, Korea's procedure of 1982 needs to be updated to reflect changed environments since its publication. Recently highway investment evaluation procedures are being updated, but there is no specific movement for railway. By studying Chinese procedure, one can get valuable insight for updating Korean procedure.

Evaluation methodologies for railway investments of China and Korea are comparatively evaluated. Because China's national economic system is much different from that of Korea, one will find details of Chinese evaluation process are much different from those of Korea. But, one will also find that overall objective of evaluation process of ensuring efficiency in transport infrastructure investments is all the same in the both countries. This comparative analysis will contribute to a mutual understanding of the practice, and eventually will shed light on the improvement direction of the current Korean evaluation process.

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2. Impact of Railway Investments

Transportation investments induce many impacts. Those impacts can be defined in many different ways, but basically they can be grouped into two categories, project impacts and infrastructure impacts (JCES, 1992). For larger scale projects, such as railway projects, project impacts, which are realized during the construction period, are substantial, but still, one has more interest on the infrastructure impacts, which will be materialized during the operation of the facilities after the completion. Infrastructure impacts comprise user impacts, producer impacts and indirect impacts. User impacts have direct impacts on the users of the infrastructure, and they include travel time reduction, cost reduction, and enhancement of safety. Reduction of operation cost is one of the important producers' impacts. Indirect impacts include other impacts which have influences on the society in general, such as increase in productivity and income, increase in employment, and impacts on environment.

This demonstrates that impacts of transportation infrastructure investments have many different forms and the time periods of their materialization are also diverse. Therefore it is imperative to choose right measures of effectiveness and balanced level of detail for their evaluation or quantification. This argument also applies to the evaluation of railway investments. For example, Cascella and Nuzzolo (1994) proposed evaluation method for Italy.

3. Korean Evaluation Methodology

Officially, economic evaluation processes are governed by the procedures defined in the economic evaluation manual for transport investment (EPB 1982). This manual provided theoretical and methodological background for deciding transport infrastructure investments. It has four parts altogether. It has parts for introduction, highway, railway and appendix. In the introduction part, it contains detailed description on demand forecast, economic analysis, financial analysis, and sensitivity and risk analysis. It also contains description on the differences between economic cost and financial cost. It states that index for shadow foreign exchange rate is 1.06 for the early part of 1980s, and 1.00 for labor. For calculating benefits, it employs the concept of consumers' surplus, and recommend preliminary engineering study to calculate reliable cost figures. It also contains instruction to calculate an optimal opening year, and sensitivity and risk analysis.

For railway investments, it specifies eight subsections on demand forecast, alternative generation and capacity analysis, cost estimation, benefit calculation, economic evaluation, financial evaluation, overall evaluation and directions to prepare a master plan. The manual recommends preparing demand forecast utilizing 4-step demand forecast method or corridor analysis. Transport demand for the facility is categorized into normal, transfer, and induced traffic. The manual employs a mixed scanning theory in the process of alternative generation. It recommends generation of all possible alternatives while utilizing a screening process to reduce the number of alternatives to a manageable number. Interestingly, the manual assumes all funds will be funded by public sectors.

The cost figures are presented in five different stages. And error margins for the five stages from preliminary planning to the actual investment cost are suggested. Impacts items and ways to quantify them are also specified. Ways to represent the impacts in monetary term are also described as follows.

	Item	Quantification	Monetary Term
Direct Benefits	Reduction of Cost	Cost	Operation Cost
	Reduction of Time	Time	Time Value
	Safety Enhancement	Accident	Insurance Payment
	Increase In Comfort	NA	NA
Indirect Benefits	Impacts on Industry	NA	NA
	Development Effects	Land Value, Regional Product	Land Value, Income
	Noise	DB	Land Value
	Air Pollution	Emission	Land Value

For railway, benefit is based on producers' surplus concept. It recommends use of the marginal wage method to calculate time value. Time saved for freight can be either included or not, based on the discretion of the evaluator.

In economic evaluation, benefit/cost ratio, internal rate of return, and net present value are to be calculated. Discount rate is recommended to be 13 % at that time. Also there is description for the calculation of the optimal opening year and risk analysis. The manual also includes detailed description to carry out a financial analysis. But it basically assumes all the railway projects will be carried out by the public sector, and does not include margins for different kind of projects such as private-public joint projects or private investment.

The overall evaluation for railway investments should be based on the results of economic evaluation, evaluation of impacts and their distribution effects, risk analysis for the uncertainties for future, results of financial analysis, ability of securing enough funds, and results of environmental impact statement (EIS). Finally the manual describes ways to prepare a master plan for the projects.

Even though, the manual specified many impact items to be evaluated, savings on operation cost and travel time were all the impact items evaluated for the most of the project in practice. This was the result of the fact that the manual does not contain detailed description of how to evaluate those impact items. Therefore, most evaluators choose to evaluate those two items, mainly because procedures to evaluate them are somewhat more clearly defined. By neglecting safety, environmental issues and other factors, impacts of railway investment are usually under estimated, and when railway and highway were considered for the same corridor, highway was usually preferred based on the evaluation. This modal bias was considered to have big implication on the current transportation policy of Korea. The manual does not have descriptions how to calculate speed differences between do and do-not cases. This fact also causes much confusion and frustration to the evaluators. Also the manual does not include specific procedures to calculate operation costs for different demand size, thus making it hard to utilize scale economies which is available to railway. Basically the manual has much materials on the fundamentals of economic evaluation, while lacking detailed step-by-step directions how to carry out the evaluation. This fact, again, made it hard to maintain consistency between evaluations carried out independently.

Most of all, the manual does not contain materials how to balance evaluation for highway and railway. In other terms, it lacks logic for evaluation for inter-modal or multi-modal planning.

Another issue is that most of the numbers in the manual are outdated. It has been more than 16 years since the publication of the manual, and economic situation has changed drastically. Therefore it is necessary to redefine economic evaluation procedures to reflect current economic situation and transportation policy of the country.

4. Chinese Evaluation Methodology

The second edition of the Economic Evaluation Method for Railway Projects (MOR 1997), which was published in 1997, was the outgrowth of the previous edition, which was in circulation since 1992. It reflects new accounting system and updated information regarding economic evaluation of construction projects. The draft was prepared by the West-South Transportation University and was reviewed by the authorities. The manual has three parts, and the first part contains nine chapters of regulations for economic evaluation, and their explanations. The second part is appendix, and contains materials on operation cost, shadow prices, and other information. The third part is examples for new national railway, electrification project, and local railway project.

The manual is to also provide specific procedures to evaluate projects with different financing scheme, such as projects funded by central government, lending from banks, central-local government joint investment, local government, and foreign investments.

It specifies that economic evaluation for railway investment should include financial analysis, national economic evaluation, risk analysis and overall evaluation. Evaluation period is recommended to be between 25-30 years, but it should not be shorter than the expected pay-off period when debt is involved.

The manual specifies to use current price, which reflects inflation, for financial analysis and constant price which reflects shadow price for economic analysis. Interest payment should be included in the financial analysis.

Contingency for the increased demand will not be included in the analysis, but that for cost increase will be included. Financial evaluation is to analyze financial feasibility of the projects based on the cost and benefits of the project from the perspective of rail operator. Cost items include investment cost, operation cost, taxes, interest payment for debt, and non-operation expenditure. Fare-box revenue is the single most important benefit item.

National economic evaluation is for the economic feasibility of the project based on the cost and benefits calculated from the perspective of the national economy. Direct and indirect costs and benefits are to be calculated. Some of them are tangible, and others are intangible. Benefits and costs in the national economic evaluation are, in theory, based on shadow price, shadow wage, and shadow foreign exchange rate. Social discount rate is to be utilized to discount future costs and benefits streams into present value. Transfer payments such as, government subsidy, taxes, or interest payment on local debt, are not to be included in the national economic evaluation. However, interest payments on foreign debt should be included in the calculation of cost.

There are certain benefits that are classified as social benefits, which usually defy easy quantification. These social benefits should be also evaluated even in a qualitative manner. Impacts on national unity, foreign trade, economic development along the corridor, environmental protection, and land use and population relocation are some examples of the social benefits.

Shadow prices are calculated by multiplying parameters to financial costs. Government periodically updates these parameters. The parameter to convert wage to shadow wage is 1.0 for the railway projects. A parameter of 1.08 should be multiplied to the official exchange rate to give shadow foreign exchange rate. Social discount rate of 12% is being utilized since 1990.

The manual lists explicit parameter values to be used to convert direct costs and benefits to shadow price. It lists separate values for civil infrastructure, rolling stocks, and operation cost. For fare-box revenue, the manual present shadow tariff rate.

Indirect benefits and costs are called as externalities in the manual. The manual identifies the need of evaluation of some of indirect benefits and costs. It warns about the possibility of double counting. The manual recommends the benefit/cost analysis and it be based on the comparison of do-project and do-nothing situation to calculate indirect impacts.

Indirect benefits are total cost reduction for normal, transfer, and induced travel demands. Enhancement of safety, transportation quality, employment, and increase of land value are other benefits to be evaluated. Cost items include environmental coat, cost for power supply line to the project corridor. Land value is accounted for by the opportunity cost of agriculture. Revenue lost of competing mode or railway lines by transfer demand to the new projects can be regarded as indirect cost.

Economic internal rate of return and net present value are to be calculated to give economic feasibility of the projects. Even though benefit/cost ratio can be readily calculated, it is not specified in the manual.

The manual recommends to carry out a probabilistic risk analysis to account for the uncertainties in demand forecast, investment cost, operation cost, tariff, and other important input factors. Impacts of uncertainties on the financial and economic analysis are to be analyzed. Cumulative probability of 0.5 for net present value to be zero is threshold value for the project to be economically viable.

The manual specifies items to be considered in the overall evaluation phase. It includes role of proposed railway, recommendation for the technology to be utilized, results of economic evaluation, evaluation of adjacent environment, and overall conclusion.

5. Comparative Evaluation

Based on the preceding descriptions, some of the differences between Chinese and Korean procedures are noted. Understanding differences and similarities for the both procedures will critically contribute toward better appreciation of different social and transport system. These observations are far from exhaustive. It is expected

that these comments provide starting points for comparative analysis and in-depth study on the subject.

Presentation format for the both procedures is somewhat different. Korean manual has much material on the fundamental theory of economic analysis, while Chinese manual has more specific procedures. Chinese manual includes many parameter values to account for different railway administrations, and project types. It contains parameters even for operation costs of different rolling stocks. Korean manual contains evaluation procedures for highway and railway in the same book, even though the modal procedures do not specifically consider other mode. Also Korean manual has somewhat long pages of description on demand forecasting. This seems a little bit of out the context.

Korean manual is out-dated considering Chinese manual which was published in 1997. Also the practice of updating manuals periodically should be established to keep the evaluation procedures up-to-date.

Chinese manual allows different kind of projects, such as local railway and local-foreign joint investment projects. Currently Korean manual assumes that all railway projects are constructed and operated by government. Korean manual should be expanded to account for the possibility of non-government railway projects.

The method of calculating benefits and costs is somewhat different. Even though, the concept of using shadow price is same to both countries, Korea does not calculate shadow price differently from the market price. China has extensive list of parameters for different direct cost and benefit items to calculate shadow price. This is a direct result of Chinese economic system. Some of the indirect benefit items according to Chinese procedure are considered direct benefits in Korean practice. Reduction in operation cost and travel time are two examples. Korean counterpart for the direct benefits in Chinese manual is not so obvious.

Another interesting observation is that some of economic indicators that can be found in Korean manual are not explicitly present in Chinese manual. Benefit/cost ratio and optimum opening year are two of them. Even though benefit/cost ratio can be readily calculable from the numbers utilized, it seems that the manual does not specifically use it. Also procedures to identify optimum opening year are not explicitly stated in the manual.

Basic principle of economic evaluation, however, applies to the both manuals. Idea of comparing do-project and do-nothing cases (ex-post analysis) is common to the both manuals. The specific method to calculate these cases will be of help to evaluators. The main objective of providing objective and comprehensive evaluation regarding economic and financial feasibility of the projects is same to the both procedures. Both manuals, however, lack in the specification of how to calculate speed changes wikth and without the project. Judging from previous evaluation results, this is the single most important factor in proving benefits. It should be standardized.

Both manuals do not contain materials how to balance evaluation for highway and railway. In other terms, they lack logic for evaluation for inter-modal or multi-modal planning. Chinese manual allows revenue loss caused by transfer demand to be considered as cost to the project. To expand both manual in this regard, German practice (MOT 1993) should shed light on direction.

6. Summary

Economic evaluation manuals for railways of China and Korea were comparatively analyzed. Korean practices are described based on the investment evaluation manual, which was published in 1982. Overall structure of the manual, and specifics regarding railway evaluation are described. Chinese evaluation practice was described based on the railway project evaluation manual published in 1997. Also general contents and specifics are described.

Differences and similarities are noted. Chinese manual usually has more detailed step-by-step instructions while Korean manual tends to have more general explanation on the procedure. Korean manual contains evaluation procedures for highway and railway in the same book, while Chinese has separate manual for railway. Chinese manual allows different kind of projects to be evaluated, while Korean manual assumes that all railway projects are constructed and operated by government. The method of calculating benefits and costs is somewhat different. Korea does not calculate shadow price separately from the market price, while China has extensive list of parameters for different direct cost and benefit items to calculate shadow price. Some of the indirect benefit

items according to Chinese procedure are considered direct benefit in Korean practice. Korean counterpart for the direct benefits in Chinese manual is not so obvious. Even though benefit/cost ratio can be readily calculable from the numbers utilized, it seems that the Chinese manual does not specifically use it. Also procedures to identify optimum opening year is not explicitly stated in the Chinese manual.

Idea of the ex-post analysis is common to the both manuals. Both manuals do not contain materials how to balance evaluation for highway and railway, which makes evaluation for inter-modal or multi-modal planning difficult. Therefore, they are needed to expand scope of evaluation to encompass the idea of multi-modal or inter-modal evaluation, which will eventually contribute to build truly efficient national comprehensive transportation system.

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