ABSTRACT

The goal of a proper project evaluation is to stop bad projects and to prevent good projects from being rejected. This book on Cost-Benefit Analysis for Investment Decisions is aimed at helping public officials and private analysts develop and evaluate investment projects to promote economic and social well-being of the country in question. The book proceeds from the formulation and definition of a project to the data requirements for an evaluation, then to the criteria used for accepting a good or rejecting a bad project from both the financial and the economic viewpoints, and finally to the analysis and management of many types of uncertainty faced by various stakeholders. These components are integrated into the analysis in a consistent manner. This chapter contains an overview of the book and of the components of such an integrated appraisal. The forward, table of contents and preface of the book are included with chapter 1.


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COST-BENEFIT ANALYSIS FOR INVESTMENT DECISIONS

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FOREWORD

Few published works have histories as long or as convoluted as this book. It all began with the awakening of my interest in cost-benefit analysis and applied welfare economics during my own graduate studies (1946-49) at the University of Chicago. This interest was nurtured by work in Latin America (starting in 1955) sponsored by USAID and its predecessor ICA, and in India starting in 1961-62 under the sponsorship of MIT’s Center for International Studies in collaboration with India’s cabinet-level Planning Commission. Out of these experiences came a series of professional papers which formed the background of a graduate course in Project Evaluation at the University of Chicago starting in 1965. Many of these papers were collected in my book, Project Evaluation, first published in 1972 and currently available as a Midway Reprint from the University of Chicago Press.

Glenn P. Jenkins took that course as a graduate student, and almost immediately began to put it to practical use. Even while still a graduate student he consulted on these matters with branches of the government in his native Canada. He continued these Canadian exercises during his appointment as Assistant Professor of Economics at Harvard University, culminating in a year of leave from Harvard, working with the Canadian Government’s Ministry of Industry, Trade, and Commerce and its Department of Regional Economic Expansion. Chun-Yan Kuo was a member of the team which evaluated a number of important Canadian government projects at that time. I, too, was involved with these Canadian entities at that time and subsequently, but in the meantime was also accumulating cost-benefit experience in Colombia, Panama, the Philippines, Spain and Uruguay, as well as at the World Bank where I served steadily with its
teaching arm, the Economic Development Institute, from 1962 through the 1960s and most of the
1970s.

Professor Jenkins’s Harvard appointment evolved into a senior position with the Harvard
Institute for International Development. His first foreign assignment in this role was to
Malaysia, where his first task was to give a full-length course in economic project appraisal,
under the sponsorship of the National Institute for Public Administration and the Economic
Planning Unit of the prime minister’s office. This course was very well received, so much so
that Jenkins was asked to develop a manual on the subject, following the main lines of that
course. It was in the resulting monograph that my name first appeared, placed there by Jenkins
in an act of pure kindness, recognizing the role of my Chicago graduate course in the
development of his own subsequent thinking. In the mid-1980s the resulting manuscript began
to be used as the main text of an intensive summer course (for participants from developing
countries) that HIID offered, under Professor Jenkins’s direction.

Our separate collaborations with the Canadian government continued, nearly always
dealing with project evaluation and often overlapping (i.e., with the two of us working jointly on
a given problem). This phase of our work reached something of a climax when Jenkins was
appointed Assistant Deputy Minister (ADM) of Finance in Canada’s government, a post he held
from 1981 to 1984. During this period I consulted regularly with the Department of Finance as
well as with other branches of the Canadian government. In some of these activities, Kuo, then a
senior Department of Finance official, also collaborated. It was in this period that I first learned
that I had been (since 1977) the co-author of this manual. And it was here that I first began to
actually participate in successive revisions of and additions to the book’s text. On completing
his service as ADM, Professor Jenkins returned to Harvard, and soon started the HIID course
referred to above. I ended up making brief appearances in this course every single year. More important, perhaps, was a tradition that developed of my staying on for a week or so after each of these visits, in order to work jointly with Professor Jenkins, continuously editing and updating one part or another of the book. Out of these sessions, and of other work that each of us was doing in other contexts and/or under other auspices, many new ideas were incorporated as time went by. Among them were the analyses connected with distributional weights, the concept of basic needs externalities, the formalization of stakeholder analysis and the introduction of the notion of a shadow price of government funds.

Perhaps the story of one such new idea is worth telling in detail. Around 1998 Professor Jenkins, Kuo and I were contracted by the World Bank and the bi-national commission in charge of the project to undertake a certain component of the research needed for the evaluation of a major bridge project, a planned linkage of Argentina and Uruguay, across the Rio de la Plata, going between the cities of Buenos Aires and Colonia. Our job was to advise concerning the so-called “national parameters” of the two countries. What were the relevant opportunity costs of capital in Argentina and Uruguay? What about the corresponding opportunity costs of foreign exchange? And, finally, of labor? It was in pursuing the economic opportunity cost of foreign exchange that we ran into a snag. The almost-standard way of handling this question seemed straightforward enough. The project authority was assumed to go into the foreign exchange market and buy the necessary divisas (say, dollars) using local currency (say, pesos). As we pursued this standard model in one of our post-course sessions in Cambridge, we found that it was not consistent with a full general equilibrium of the economy. The new demand for foreign exchange was assumed to arise because of an increased demand for tradable goods. As a result the real price of the dollar would rise, and with it the price level of tradables. Hence the supply
of tradables would increase. But the rise in the price level of tradables would stimulate the demand for nontradables, the output of which would then also increase. Increases in the output of both tradables and nontradables did not jibe with economic theory (except under conditions of recession or depression) so something was wrong.

As we tried to resolve this paradox, we found that the “standard” analysis suffered from a missing link. It did not incorporate the way in which the pesos were raised, which were then to be spent on tradables. The raising of these pesos (presumably in the capital market) would displace both consumption and investment, and hence reduce the demand for both tradables and nontradables. Starting from this reduced demand for both, one could then contemplate the demand for both of these aggregates increasing, thus resolving our paradox. No paradox was present in both tradables and nontradables increasing if we measured these moves from a position where both had been reduced from their starting position. This end result laid bare the fact that the whole idea of an economic opportunity cost of foreign exchange was not a stand-alone concept. This concept had a natural and unavoidable twin, which we called the shadow price of nontradables outlays, and which we from that point on built into our book’s analysis.1

This concept captured the economic costs involved when money was raised in the capital market and spent on nontradable goods or services. It performed exactly the same function as the economic opportunity cost of foreign exchange, differing only in that it traced a scenario where the spending was on nontradables rather than tradables.

The evolution of the book continued, but it was occurring too slowly, even for our own satisfaction. This led to our inviting Chun-Yan (George) Kuo to join us as a third co-author. Professor Kuo had been associated with the Harvard program from its inception, and had continued his affiliation with it when it was moved to Queen’s University after HIID’s untimely demise. With his addition to the team, the preparation of the manuscript for publication advanced more rapidly, bringing us to the present moment.

I close this preface on a personal note. Beyond Jenkins’s generosity in making me a co-author some five years before I knew about it, I ended up being the beneficiary of coming first, as our names appeared in alphabetical order. I always felt this left readers with an inadequate appreciation of the extent of Professor Jenkins’s role. He was the sole writer of the initial version of the book, and the sole director of the course whenever it was given, whether at Harvard, or at Queen’s, or in any of the numerous other venues in which versions of varying lengths were presented over the years. These other versions include numerous presentations at the World Bank, the African, Asian, and Inter-American Development Banks, plus multiple presentations in Argentina, Azerbaijan, Bolivia, Chile, Indonesia, Malaysia, Nicaragua, Philippines, South Africa, Sri Lanka, Thailand and Uruguay.

For the final published version of the book, I therefore insisted that Professor Jenkins’s name come first. I promised to write this foreword in order that readers would have a reasonably clear understanding of our respective roles.

Arnold C. Harberger
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PREFACE

This book on Cost Benefit Analysis for Investment Decisions represents a culmination of work in this field by its authors over a period of more than 40 years. Many of our colleagues and students have played important roles as the intellectual contents of this text were developed. Those who have made specific contributions during the long gestation of this manuscript include Ernesto Fontaine, Alejandra Cox-Edwards, Donald Tate, Savvakis Savvides, Graham Glenday, M. Baher El-Hifnawi, G.P. Shukla, Vijdan Korman, Andrey Klevchuk, Pradip Ghimire and Aygul Ozbaflı.

The preparation of this book has been guided by two main objectives. First, the approach must be firmly rooted in the disciplines of finance and economics, and structured to reflect the principles of these disciplines. Second, that it must address the practical needs of analysts faced with evaluating a broad gamut of real-world public and private sector projects.

This book has evolved over time through its use as the core reading material in the Program on Investment Appraisal and Management that was initiated at Harvard University in 1984, and that since 2000 has been offered at Queen’s University in Canada. Through that program and many shorter courses taught to groups around the world, thousands of professionals have been trained in this discipline using various earlier drafts of this book as their primary teaching materials. Alumni of this program have used these same earlier drafts to train thousands more in universities and government institutions around the globe. As a result of these experiences, we have gained many insights and have introduced many improvements dealing with real-world applications of the principles outlined in the text. Hence, this book is designed
so that it can be used both in the classroom as a reference manual and to help professionals apply the principles of investment appraisal in a wide array of settings and sectors.

Earlier versions of this text have been used in several dozen programs taught to enhance the professional development of the staff of multilateral financial institutions, including the World Bank, the African Development Bank, the Asian Development Bank, the Inter-American Development Bank and the Caribbean Development Bank. Recently, the World Bank has provided generous funding to modify the basic training materials so as to make them more applicable for the analysis of infrastructure projects with private sector participation. This interaction has contributed to our thinking and in particular to reinforcing the importance of making this text directly relevant for the development professionals who need to apply the principles of cost-benefit analysis to real world decisionmaking.

It is not easy to summarize the many ways in which this book differs from other texts and/or manuals on cost-benefit analysis. In part it still bears some marks of its origin in an economic graduate course. Even though this aspect has been toned down over the years, it delves more deeply into issues of concept and methodology than do most cost-benefit texts. Moreover, it quite consciously builds on the long tradition of applied welfare economics, as it was developed by a series of great economists going from Adam Smith to David Ricardo to Jules Dupuit, John Stuart Mill, Alfred Marshall, Vilfredo Pareto, Harold Hotelling, and James Meade, down to the present time. It is from this great tradition that economists learned how to quantify the gains from trade and the costs of monopoly, to evaluate policies such as price controls, export subsidies, agricultural support programs and the like. These results, plus many others developed in the 200-odd year evolution of applied welfare economics, emerged from a rigorous,
disciplined application of economic principles. There is nothing casual or ad hoc about this great tradition.

We have consciously and constantly strived, in developing the materials in this book, to remain faithful to this tradition. In seeking answers to new questions we have tried always to base our work on economic fundamentals. Any measure of benefits and costs over time must be expressed in real terms, but cannot plausibly be carried out “at constant prices of a given base year”. It is a basic economic truth that there is great economic benefit in the act of taking copper bars from the ongoing economy when their price is one real dollar per pound, and returning them to the economy when it values them at three real dollars per pound (so long as the real opportunity cost of capital is covered). But then we must find a way of defining the real dollar that is capable of capturing such movements in relative prices. That role is played in economic theory by choosing one price or price index as what we call the numeraire, our basic unit of measurement. We face this choice and conclude that the only two reasonable candidates for a numeraire are a country’s consumer price index and its GDP deflator. With the first of these we measure all benefits and costs in “consumer baskets”; with the second our measurement is done in “producer baskets”.

The mere fact that we have to have a numeraire has important implications for the discount rate to be used in project analysis. The project starts with our extracting purchasing power from the rest of the economy; the payback comes later as the project yields its benefits over time. The question is, of course, are these benefits worth the costs that were entailed as purchasing power was extracted in order to do the initial investment? Economic logic and rigor require that both the extraction of resources and the subsequent benefit flows be evaluated in the same units -- in our case either in consumer baskets or in producer baskets. So what about the
discount rate? In the process of extracting resources we displace either investment or consumption that would otherwise have taken place, and possibly also draw some new capital funds from abroad. On the displaced investment the economy loses the future flow of earnings that it would have yielded; on the displaced consumption (which means increased saving), the economy suffers a loss unless the savers earn a rate of return covering the “supply price” of these savings. Thus fundamental principles of applied welfare economics tell us that the economy has suffered a loss unless a project yields benefits sufficient to cover the lost productivity (from displaced investment) plus the genuine economic supply price of any newly-stimulated savings, plus the marginal cost (to the economy) of the funds drawn in from abroad. The project, in order to be worth while, has to generate benefits (translated into numeraire units) sufficient to cover the costs (also expressed in numeraire units) that were entailed in raising the investment resources in the first place.

Then comes the question, what is the mechanism by which these resources are raised? Investment and consumption can be displaced by new taxes, but which taxes? Each new tax law is different from the last, which makes the choice of a standard or typical tax package arbitrary. Moreover, we would hardly ever be able to link the funds from a particular project to a particular tax package.

Once again, economic fundamentals come to the rescue. The capital market (which in some poor countries is simply the banking system), is in fact the “sponge” which absorbs any net new funds the government might have in any day, week or month. The capital market can also be relied on to generate the purchasing power to cover any current cash deficit or shortfall. The capital market is thus truly the government’s marginal source and use of funds. Typically, when expenditures end up bigger than expected, the government borrows more. When receipts turn
out to be unexpectedly high, it borrows less (and sometimes pays down its outstanding debt).
There is a big added dividend to the use of the capital market as the standard source of funds,
since it is typically the source of private sector funds as well. Hence the economic opportunity
cost of capital is derived from an essentially similar scenario, regardless of whether the
investment is being done by the private or the public sector.

The methodology of cost-benefit analysis applies quite easily and naturally to
commercial-type ventures (whether private-sector, public-sector or joint between the two) whose
costs and benefits consist overwhelmingly of cash outlays and cash receipts. But what do we do
with benefits and costs that are not in this form? The answer here is a bit complicated. Some
non-cash benefits and costs can be quantified by direct application of economic analysis. Thus
we have economic studies that estimate the value that commuters place on the time they spend
going to and from work, and the costs involved in ships waiting in line to enter a port or canal,
and the value that recreational users place on their visits to parks, museums, etc. Then we have
other benefits which can be set by the analysts themselves (in the absence of other instructions)
or by public sector authorities attempting to put values on particular non-market goals. In this
vein we have values denoting “society’s” willingness to pay for added fulfillment of the basic
needs of the poor, or for added economic activities in a given region or industry. Finally, we
have a range of areas in which neither of the previous answers can plausibly apply. National
defense benefits and those linked to a nation’s culture, history and traditions come to mind here.
For these the standard answer of professional economists is that we have little or no claim of
professional expertise in setting values on such elements. Instead, we try to quantify those items
which we are professionally equipped to estimate, and derive measures of costs and benefits for
just those items. We then confront our audiences with statements like “In this project, the direct
economic costs exceed its direct economic benefits by $200 million. We leave it to the authorities to decide whether its national defense or other non-quantifiable benefits are worth this cost.”

In addition to its heavy reliance on economic fundamentals, this volume emphasizes what we call an integrated analysis of projects. In this aspect we incorporate financial and stakeholder analyses in addition to a strictly economic one. The clearest motivation for our doing so is the fact that many projects which have the potential to be highly beneficial in strictly economic terms run into trouble because they face difficulties on the financial or the stakeholder side. The financial analysis is central in the sense that it tries to capture all the relevant financial flows connected with a project. Far too often, evaluators will neglect such items as routine maintenance and repair, or recurrent expenditures for insurance, record-keeping or supplies. Financial analysis can also call attention to situations in which particular outlays are dependent on fragile and unreliable sources of funds -- sometimes on state budgetary items that are subject to capricious fluctuations from year to year or from administration to administration. Finally, the financial analysis, by setting down all of a project’s outlays and receipts (usually in a spreadsheet format), establishes a solid basis for the subsequent economic analysis, helping to ensure that it provides comprehensive coverage.

The stakeholder analysis is also related to the financial one, but in a different way. Many projects require collaboration, or at least tacit acceptance, from a number of stakeholder groups, if the projects are to succeed, or perhaps even if they are to get started. Agricultural projects depend on the contributions of farmers, truckers, middlemen and perhaps exporter interests. Regional development projects require willing help from experts from outside the region. Projects to enhance medical service in rural areas often founder because of the reluctance of
experienced physicians to relocate there. The function of the stakeholder analysis is to see to it
that provision is made, within the framework of the project, to ensure that each critical group of
stakeholders has an adequate incentive to carry out its required role.

In addition to presenting the methodologies that apply to the general financial,
stakeholder and economic analyses, this volume deals with a number of particular types of
projects that are commonly encountered in developing countries -- e.g., those dealing with
transportation, electricity, potable water and irrigation. The relevant chapters are mainly devoted
to exploring the specific aspects which set these classes of project apart from others. Of
particular importance here is the quantification of benefits in cases where they are not captured
by a market price, or in which the relevant prices are not good measures of the corresponding
benefits. These chapters can serve as roadmaps guiding analysts through the landscape that is
special for each class of project. These general roadmaps are supplemented in most cases by
examples drawn from actual real-world project evaluations in the area in question. These are
presented in summary form with the intention of focusing on the particular activities that give
each type (e.g., roads, dams, electricity systems) its special characteristics.

Finally, in an appendix to this book, we make available a number of problem sets that
have been used over the years in university courses based on the book’s material.
CHAPTER 1

THE INTEGRATED ANALYSIS

1.1 Introduction

The goal of a proper project evaluation is to stop bad projects and to prevent good projects from being rejected. This Book on Cost-Benefit Analysis for Investment Decisions is aimed at helping public officials and private analysts develop and evaluate investment projects to promote economic and social well-being of the country in question. The book proceeds from the formulation and definition of a project to the data requirements for the evaluation, then to the criteria used for accepting a good or rejecting a bad project from both the financial and the economic viewpoints, and finally to the analysis and management of many types of uncertainty faced by various stakeholders. These components are integrated into the analysis in a consistent manner.

Ideally, government investment expenditures should be in the public interest. Such expenditures can be in the form of government investment, public-private partnership arrangements or other forms of government intervention. This implies that resources should not be reallocated from the private to the public sector unless such a move is likely to make residents better off. In situations where private investments are being undertaken with financial support from either governments or development finance institutions it is important to know the financial viability of such activities. Financial failure often leads to a contingent liability coming due at the expense of a public body. For an activity with contingent liabilities to be undertaken in the first place, it should be clear that its economic benefit exceeds its economic cost. Regulations impose both investment and operating costs largely on the private sector with the hope of either creating or preserving benefits for the people. Many developed country governments now require that cost-benefit analyses be undertaken to evaluate regulatory interventions. In each of these situations, account must also be taken of how the benefits and costs of these actions are distributed among the relevant stakeholder groups. These themes will be addressed under the headings of the financial, economic, and stakeholder analyses of what we refer to here as simply a “project”.

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By their very nature investment projects offer uncertain benefits and costs over life of the project. Even a project’s investment costs are often subject to overruns due to technical difficulties and delays in implementation. These uncertainties must be taken into account in the course of a project’s evaluation. Risk analysis and how to reduce risk through the use of contracts are thus basic elements of the integrated project evaluation framework developed in this book.

Some public sector projects or programs such as healthcare and education may not be properly assessed using the standard framework of cost-benefit analysis because of difficulty in quantifying their benefits in monetary terms. This book will show how the evaluation of such projects or programs can be handled, using the techniques of cost-effectiveness analysis.

1.2 The Targeted Users of the Book

This book is intended for a variety of users. First, it serves as a guide to those in finance and planning ministries, national government treasuries budget bureaus and even line ministries such as public unless, energy and necessary who are responsible for making public sector investment decisions. In short it addresses the needs of any group involved with the formulation, evaluation and implementation of projects. Second, the book is provided to educate the private investment community on the economic and social aspects of investment appraisal. Third, it provides a methodology that can help to taxpayers as well as to international development and lending institutions to be confident that the money allocated for public investments will be spent in a responsible and productive way. Fourth, the book contains theoretical developments and practical applications to real world cases that will be of interest to the academic community.

With such a wide audience, the book has to be comprehensive yet not get bogged down in abstract theory or complicated calculations and technical refinements. Thus, we have tried to present the theory underlying our analysis in a clear and accessible fashion, yet without bypassing important details. Similarly, we have tried to choose our real-world cases in such a way that they both illustrate how basic principles should be applied, and at the same time guide practitioners through the steps that must take in carrying out real-world applications.

1.3 Project Definition
Public investments are key policy instruments used by governments in pursuing their overall development goals and strategies. The chosen projects should fit into the overall development strategy given the limited resources that are available. In principle, governments should maintain a running list of potential projects, out of which priorities for further evaluation and eventual construction should be continuously selected.

1.3.1 Definition of a Project and Building Blocks for Evaluation

In capital budgeting, a project is the smallest, separable investment unit that can be planned, financed, and implemented independently. This helps to distinguish a project from an overall objective that may consist of several inter-related investments. Often projects form a clear and distinct portion of a larger and less precisely identified objective or program. While it is possible to treat an entire program as a project for the purposes of analysis, it is far better to work with individual projects. Broad programs very likely will contain both good and bad components. It is precisely the task of project evaluation to identify and select those with the greatest positive impact.

The principles and methodology set forth in this book can be applied to the full range of projects - from single-purpose activities such as small infrastructure projects to more complex multi-component systems such as integrated rural development and area development schemes. Our basic definition considers a project to be “any activity that involves the use of scarce resources during a specific time period for the purpose of generating a socio-economic return in the form of goods and services”.

After a project’s objectives and scope are defined, a number of key modules should be identified. This will include the project’s market and competitors, the technology and inputs required for the project, and how the project is likely to be financed.

a) Demand Module: This identifies the likely users of the project’s output as well as the likely valuation of its products. Are the products destined for domestic use or for sales abroad? Are there alternative sources capable of meeting the likely demand? The analysis should initially be based on secondary research, but may also involve consultations with potential users and beneficiaries. The expected volumes and unit values over the life of the project
should be examined and forecasted. The information identified provides the basic data for a profile of the project’s costs and benefits, while the breakdown between tradable and nontaxable purchases and sales is needed in order to separately apply the relevant exchange rate to the foreign part. Analysts must make serious efforts to incorporate in their work the likely future trends of relative prices -- real exchange rates, relative product prices, real wage rates, etc.

b) Technical Module: This module examines the technical feasibility of the project’s investment and operating plans, alternative project scales, location, as well as timing of the project’s implementation. Technical parameters should be separately determined and clearly laid out for each of the investment and operating phases. In the process, engineering data in terms of inputs by type (machinery, equipment, and material), quantity, cost, and time of use should all be specified. In the case of manpower requirements, the type of skill, number, and expected real wage rate should also be determined. Project analysts should also identify potential bottlenecks for key project inputs, especially workers with particular skills. This information will provide the basic construction and operation cost year by year over the life of the project, i.e., the project’s profile.

For certain projects, it is important to identify any technological uncertainties. In such cases, some guarantees from the suppliers should be sought and incorporated in the evaluation. In addition, one should identify a number of project sizes and associated inputs or costs estimated by technical or engineering experts. This information will help project analysts to identify a project with the optimal scale and timing.

c) Project Financing: The possible sources of debt and equity financing for the project should be examined since the terms of financing can have a significant impact on the financial viability of a project. Where borrowed funds are involved, the amount of debt, interest rates, and repayment schedules should all be spelt out and closely examined. Alternative schemes of financing such as Build-Operate Transfer (BOT) may be contemplated in certain cases.

1.3.2 Project as an Incremental Activity
An important element in the investment appraisal is to examine the incremental impact of the project; that is how net receipts, net cash flows or net economic benefits with the project in the presence of the project under study can be expected to differ from those that would prevail in its absence. One should make the with/without distinction clearly and carefully so as not to include in the “with-project” scenario any benefits or costs that would exist “without” the project being undertaken. The “without project” situation does not mean that nothing is done to the current situation if the project is not undertaken. In principle it is a sort of moving picture of how the relevant items and markets would naturally evolve if the project were left aside, but with “good” decisions being taken on all other (non-project) matters at each step.

In this context, one should conceptualize two states of nature: one with the project and the other without the project. The former identifies the revenues and expenditures associated with the case in which the project is undertaken, while the latter refers to all relevant benefits and costs that would likely prevail if the project were not undertaken. Comparing the two, a project usually involves incremental net expenditures in the construction phase followed by incremental net benefits in the operating phase. The incremental net cash flow (or net economic benefits) refers to the net of benefits minus outlays that occur with a project less the corresponding figure that would have occurred in the absence of the project. In this way, we would properly identify the additional net benefit flow that is expected to arise as a result of a project. And from it, the corresponding change in economic well-being that is attributed to it can be measured.

1.4 An Integrated Approach

Traditional approaches to investment appraisal have tended to carry out a financial analysis of a project completely separated from its economic evaluation. The integrated project analysis developed in this book measures benefits and costs in terms of domestic prices for both the financial and the economic appraisal. Identification is then made of the stakeholder impacts among parties. Since project costs and revenues are spread over time, uncertainty becomes an issue and is first dealt with in the financial analysis. Its consequential effects are then assessed in the economic analysis. In what follows, we present an overview of how an investment project is evaluated through an integrated financial, economic, risk and stakeholder analysis.
1.4.1 Financial Appraisal

The financial analysis of a project inquires whether the project is financially viable. It is a cornerstone of many capital investment projects. The requirements for data and the assessment of the commercial viability are briefly outlined below.

A. Data Requirements

The module starts with the projection of the volumes of output, inputs, and deliveries that constitute the principal financial flows of a project. It then proceeds to generate the financial cash flow statement of the project by taking into consideration, where relevant, such items as accounts receivable, accounts payable, and changes in cash balances. The final result will yield the expected flows of financial receipts, financial outlays, and hence the net cash flow of the project period by period over its life.

In forecasting benefits and costs over the life of the project a key decision concerns whether to work exclusively with real (i.e., inflation-corrected) magnitudes, or whether to carry out some of the analysis in nominal terms, before converting them to real terms. In this book, we follow the principle of always carrying out the economic analysis in real terms, and it usually (though not necessarily) doing the financial analysis in nominal terms. The guide as to whether this book exercise should be performed is whether key elements exist (like nominal debt, nominal tax components, or nominal rental contracts) that are fixed in advance in nominal terms, and whose conversion to real terms thus varies under different assumed future inflation rates.

The data on benefits should identify whether they accrue domestically or abroad. Correspondingly, expenditures on each item (including machinery, equipment, and material inputs) should also be separated according to whether or not it is internationally traded. The breakdown is important for analysing foreign exchange implications in the economic appraisal. In the case of manpower requirements, it is essential to classify labor by occupation and skill type in order for a proper estimate of the economic opportunity cost of labor to be obtained.

Project financing may also be a key variable for the commercial viability of a project. Its debt/equity structure and the terms of interest rates can have an impact on tax liability and cash
available to cover its costs. Thus, some reasonable assumptions about these parameters are necessary. In the case of projects with private equity participation, the required market rate of return on such capital will influence the viability of the project from the investor’s point of view.

B. Development of Financial Cash Flow Statement

A project’s viability is very much determined by the timing of the cash receipts and disbursement. Thus, the projection of these items has to be done carefully so as to alert the analyst in advance to possible periods of illiquidity (or even liquidity crisis) in the future. Items such as accounts receivable, accounts payable, changes in cash balances, prepaid expenses and inventories should all be accounted for in constructing the financial cash flow statement. Yearly tax liabilities (where relevant) should be estimated following the accounting and tax rules of the country where the project is located. Expected future changes in tax and tariff rates should be built into the project profile.

Very often the project will still have assets at its projected closing date. In such a case the likely future (real) market value of such assets should be incorporated as part of the final year’s net benefit. Normally, such residual values will be estimated by applying standard real economic depreciation rates for the different asset types.

Once the financial cash flow statement of the project is completed, its potential viability can be assessed. Since the project has different stakeholders who are mainly concerned with their own interests, financial cash flow statements can be generated for each such group. For government-sponsored and government-related projects, a minimum of three financial cash flow statements are usually developed from different viewpoints -- banker’s point of view, owner’s point of view, and government budget point of view:

- The banker’s (or total investment) point of view examines the expected possible receipts and expenditures of a project, considering the investment base to be the sum of equity and debt capital, and the annual cash flow to be the amount available for distribution to both equity holders and creditors.
- The owner’s point of view considers capital outlays to consist only of the owners’ (equity) funds. Loans are treated as inflows when they arrive, and amortization payments are treated as outflows.

- From the government budget viewpoint, the government will ensure if the relevant government departments have enough resources to finance its obligations to the project.

- Where a government project is expected to stand on its own, the financial flows accruing to the relevant entity, including receipts from sales, fees charged, plus cash inflows from earmarked taxes or budgetary allocations all count as benefits, but tax revenues changes unconnected with the entity do not appear in the financial analysis (but of course, they are part of the economic analysis of the project).

The financial cash flow statements vary among different points of view. For example, the financial profile from the banker’s viewpoint may start with cash flows expressed in current prices. These may then be deflated by the relevant price index to arrive at real values for this profile. Because the banker would like to know if the net cash flow is sufficient to repay the loans from different financing arrangements, his starting point for a credit analysis is the net cash flow from the total investment. Since the bankers’ viewpoint looks at the project “as a whole”, such as project profile serves as a natural base for the development of the project’s economic profile, which also looks at the project as a whole, but includes a wider range of benefits and costs.

The nominal financial cash flow statement from the total investment point of view can be augmented by the proceeds of debt financing but reduced by the interest payments and principal repayments of the loans to obtain the net nominal cash flow from the owner’s point of view. These values are then deflated by the inflation price index to determine the cash flow in real prices (as a given year) from the owner’s point of view. As the owner or investor of the project, he will be expecting to receive a rate of return on the project no less than his real private opportunity cost (net of inflation) of equity financing. Using this opportunity cost as the discount rate, a private equity owner would expect the discounted net financial cash flow over the life of the project to be greater than zero. This private discount rate would normally cover the risk associated with the operating and financial leverage of the project as well as the risk due to uncertainty.
C. Evaluation Criteria

There are alternative criteria for determining the financial attractiveness of a project. However, the net present value (NPV) of the project is widely accepted as the most satisfactory criterion for the evaluation of project profiles. As such, when a project is being appraised from the viewpoint of equity holders or owners, the relevant cost of funds or discount rate is the return to equity that is being earned in its alternative use. The project will be commercially viable if the present value of the discounted cash flows is greater than zero. If the NPV is less than zero, the investors cannot expect to earn a rate of return equal to its alternative use of funds and thus the project should be rejected.

Other criteria that are also used in the business community include internal rate of return, benefit-cost ratio, its pay-back-period, and its debt service ratio. Each of these measures has its own shortcomings. However, the debt service capacity ratio is often regarded as a key factor in determining the ability of a project to pay its operating expenses and to meet its debt servicing obligations. This measure is particularly relevant when considering a project from the banker’s point of view.

The government usually provides key social sector projects or a wide range of services such as healthcare or education. The issues involved in this undertaking tend to generate low or no revenues from the project at all. However, the financial analysis can still be relevant as a framework for presenting the yearly requirement of funds for continuing with the project.

1.4.2 Risk Analysis and Management

The financial analysis and results have so far been based on the deterministic values of project variables. It is, however, highly unlikely that the values of all of a project’s key variables such as the rate of inflation, the market exchange rate, and the prices and quantities of inputs and outputs will be projected with certainty throughout the life of the project. Hence a project’s net present value and other summary measures are subject to uncertainty and risk. Adapting the analysis to cover uncertainty is thus an important part of an integrated project evaluation.
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The first step in conducting a risk analysis of a project is to identify the key risk variables using sensitivity and scenario analysis. The variables chosen should not only represent a large share of relevant benefits and costs but also experience a significant amount of variation in terms of the final outcome. It is usually necessary to focus only on the uncertain variables that contribute to the riskiness of the project in a significant way.

Once the risky variables are identified, the second step is to select an appropriate probability distribution and the likely range of values for each risk variable, based on the past movements of values of the variable and on expert opinion concerning it. The relationships between variables are also important and need to be specified. Monte Carlo simulation is by now a well established device for generating a probability distribution of project outcomes. Such an exercise would end with an expected probability distribution of a project’s NPV, based on the underlying uncertainty surrounding each of the key risk variables specified. From this cumulative probability distribution we can read off the probability that the project’s estimated NPV will exceed $1 million, $10 million or any other given value. We can also derive the expected mean, median, mode, deciles and quartiles of the NPV distribution. With so much uncertainty in a project, a proper project evaluation should provide some assessment of the expected variability of a project’s net return, the probability of getting a negative NPV, and how this uncertainty affects the net benefit flows to the key stakeholders.

There are different kinds of uncertainty and risk associated with a project. Uncertainty can be related to suppliers, customers, or project financing. People may view uncertainty and risk differently in terms of their tolerance of risk. Contractual arrangements to manage risk are both a common and an essential component of certain projects. Thus, consideration must be given to redesigning or reorganizing a project to reallocate risk more efficiently. For example, there may be alternative financing arrangements that would help to redistribute some of the risk to a stakeholder who is willing to accept the risk at a low cost to the project and hence make a project more attractive. There may be contracts that project managers can enter into with its customers/end-users or its suppliers. These different arrangements could create incentives or disincentives that would encourage a project’s participants to alter their behavior so as to improve the project’s overall performance. The effects of such contractual arrangements are an integral part of the appraisal of a project. Monte Carlo simulations can be used to help understand the
nature and magnitude of the variability of the project. They can also be used to measure the impact of different contracts on the variability of the project’s outcome.

1.4.3 Economic Appraisal

The economic appraisal of a project deals with the effect of the project on the entire society and inquires whether the project is likely to increase the total net economic benefit of the society, taken as a whole.

A. Rationale and Underlying Assumptions

Economic cost-benefit analysis is an important component of applied welfare economics, a branch of economic science which has steadily evolved over more than 200 years. A great deal of what applied welfare economics has to contribute is based on three simple postulates:

a) The competitive demand price for an incremental unit of a good measures its economic value to the demander and hence its economic benefit;
b) The competitive supply price for an incremental unit of a good measures its economic resource cost; and
c) Costs and benefits are added up with no regard to who are the gainers and losers.

When no distortions are present, the demand price and supply price of a good will coincide, making its economic value clear. But distortions (of which taxes are paramount) are complicating our analysis.

In reality, many distortions prevail in the economy of any country, including among others, personal income tax, corporate income taxes, value-added tax, excise duties, import duties, and production subsidies. These distortions would have a considerable impact on the economic valuation of capital, foreign exchange, and goods or services produced or used in the project in question. They should be properly assessed and incorporated in the economic appraisal.

For example, the benefits of a project’s output should be measured by the demand price inclusive of a value-added tax or a general sales tax, rather than the market price received by the project in
the financial analysis. On the other hand, if there is a production subsidy in the project, the resource cost of inputs used in the production should include the subsidy as part of the cost in the economic analysis. Non-tax distortions like air and water pollution also generate external costs, which should be assessed and accounted for in an economic analysis.

Many public projects (e.g., roads and schools) have the outputs that are not sold in an open market. Nonetheless an economic analysis must somehow try to capture and evaluate the total economic benefits of the output of the goods and services generated by these projects.

B. Development of the Economic Resource Statement

Like the financial cash flow profile in the financial appraisal, the economic appraisal needs to reflect all benefits and costs (whether financial in nature or not) and whether they accrue to direct project participants or to other members or entities in the society (including the government).

Goods and services in the economy can generally be classified as internationally tradable and non-traded and they are evaluated differently in the economic appraisal. A good or service is considered internationally tradable if a project’s requirement for an input is ultimately met through an expansion of imports or reduction of exports. Conversely, the output produced by a project is a tradable good if its production brings about a reduction in imports or an expansion of exports. Land, buildings, local transport, public utilities and many services are almost intrinsically non-traded. In addition, there are potential tradable goods whose prices are “unhooked” from the world price structure. These include goods that normally would be considered to be internationally traded but are rendered nontraded with particularly high or prohibitive tariffs and also goods that are potentially tradable but whose internal price lies above the FOB export price or below the CIF import price.

For non-traded goods and services, the economic price of a project input or output is based on the impact an additional demand for the input or supply of an output has on the demand as well as the supply of the good in the market. For example, suppose a project increases the production of a good. The additional supply by the project results in a decrease in the market price, which will cause consumers to increase their consumption but make some of the existing producers to cut back their production. The economic benefits produced by the project’s output should be
measured by the weighted average of the value of additional consumption enjoyed by consumers, which is the amount consumers are willing to pay (the demand price which is the price inclusive of taxes, if any) and the value of resources released by the existing producers (the supply price or the value inclusive of subsidy but net of taxes). The demand and supply weights are determined by the response of additional demand and the cut back in supply with respect to the reduction in the market price.

By the same token, when a project demands an input, its additional demand will result in an increase in price, which in turn will stimulate the existing consumers to cut back their consumption and induce producers to increase their production. The economic cost of the inputs demanded by the project should be measured by the weighted average of the forgone consumption (valued by the price inclusive of taxes) and the value of resources costing the society (measured by the price excluding taxes but including subsidy, if any). Again, the weights are determined by the response of consumers and suppliers to the change in market price.

Labor is generally considered a non-traded good. However, the economic cost of labor varies by occupation, skill level, working condition, and location, depending upon the project in question.

Once the economic benefits or economic costs are calculated, they replace the values used in the financial analysis for value of receipts or expenditures in the financial cash flow statement. The simple calculations or a conversion factor can be created as the ratio of the economic benefits or costs to its corresponding financial prices of outputs or inputs and then simply multiplying the financial receipts or costs by the corresponding conversion factors to arrive at the economic benefits or costs for construction of the economic resource statement.

In the case of tradable goods, distortions may include customs duties on imported inputs of a project or those imported items that the project output will replace. An export tax or export subsidy on the output of the project is also a distortion and should be accounted in the economic evaluation. In general, the economic prices of these tradable goods are all equal to their border price converted at an exchange rate reflecting the economic opportunity cost of foreign exchange.
There are certain projects in which consumers are willing to pay more than the value of the prevailing market price. In such case, their gain in consumer surplus should be incorporated as an additional economic benefit and reflected in the economic profile of the project. This takes place most often in public sector projects such as enhancement of water supply projects or road improvement projects. On the other hand, there are also projects generating pollution or other negative environmental externalities. In this case, items such as pollution or congestion costs should be evaluated and accounted for in the economic analysis of the project.

C. Evaluation Criteria

Once the economic profile is constructed, the economic discount rate is used to estimate the project’s net present value. The relevant discount rate is the economic opportunity cost of capital in the country in question. This hurdle rate applies not only to investments financed solely with public funds but also to the economic evaluation of investments undertaken by the private sector. An economic net present value greater than zero implies that the project is potentially worthwhile. That is, it would generate larger net economic benefits than the normal use of equivalent resources elsewhere in the economy. On the other hand, if the net present value is less than zero, the project should be rejected on the ground that the resources invested could be put to better use if they were simply left in the capital market.

Like the financial appraisal, the Monte Carlo simulations can be used to generate a probability distribution of the net present value of the project.

1.4.4 Stakeholder Impacts

It is important for the sustainability of the project over time to identify the winners and losers and how much they would gain and lose as a result of the project’s implementation. The financial and economic analysis of the integrated project analysis will provide the basic data for estimating the specific stakeholder impacts. In the financial analysis, there are several groups or parties affected by a project. Each such group’s benefits and costs can be analyzed to determine who gains and who loses as a result of a project. The purpose of this distributional analysis is to see if the benefits of the project will actually go to the targeted groups, as well as to ensure that no specific group is subjected to an undue burden as a result of a project. The magnitude of any burden can
be measured by the present value of the incremental net benefit flows that are expected to be realized by that group. Among the main stakeholders affected by a project are generally the project’s suppliers, consumers, project competitors, labor, and the government. The impact on government is mainly derived from the externalities generated by taxes and subsidies.

1.5 Cost-Effectiveness Analysis

The capital investment project has so far been evaluated in the context of a cost benefit analysis. However, there are certain projects in which benefits of the project are difficult to quantify in monetary terms. These projects include health, nutrition, education, water supply, electricity generation, etc. In this case, an alternative approach called cost-effectiveness analysis is commonly employed.

Cost-effectiveness analysis functions by comparing the costs of achieving a given outcome by alternative routes. By simply choosing the lowest cost of achieving a given benefit, it avoids the necessity of placing a monetary value on the benefit. Where the output in question has several dimensions, one can develop an index that places plausible weights on these different aspects (e.g., speed, convenience, accessibility, etc.), and choose that option that yields the lowest cost per index unit. This variant is sometimes called cost-utility analysis.

Once a project is approved, managing and monitoring the progress of the project is important for organizations in terms of time, cost and performance. It requires an establishment of an implementation schedule for the project and progress is assessed against this schedule. The post evaluation focuses on the outcome of the project to see if the economic and social goals of the project are achieved and what are the impacts on stakeholders of the project after its implementation.

1.6 The Organization of the Book

This book consists of 20 chapters. Chapter 2 describes the evolution of project cycle and the links between the various components of a project’s development. It starts with the project definition, followed by building blocks and data requirements for appraising projects, and finally integrates the various components into the evaluation framework.
Chapter 3 examines the first major component of the overall evaluation framework: how to perform the financial analysis of a project. The purpose of a financial analysis is to estimate whether the project is financially sustainable, i.e., how will it cover its financial cost expenditures? For projects that have direct participation of the private sector, the question is whether the investors will find the project in their interest. The accuracy of the financial analysis depends heavily on the accuracy of the technical, marketing, and commercial analyses used to construct a project’s investment, financing, and operating plans. Accurate estimation of the net present value of the project’s net cash flows requires consideration of potential vulnerability to inflation as well as an estimate of the appropriate cost of capital that can serve as the private discount rate.

Project criteria are presented in Chapter 4 including debt service capacity ratios as a measure of a project’s sustainability. The dominant criterion used in project evaluation, namely the net present value, is described in detail. This is done against a backdrop of one of the key attributes of any investment project, its time dimension. Net economic benefits must also be discounted or accumulated to a given point in time before they can be added up or otherwise compared. Chapter 5 discusses how a project’s NPV helps answer important questions such as the appropriate initiation date, scale, duration, and termination date of a project.

The financial analysis is based on the deterministic value of each of the input and output variables of the project over the life of a project. The actual outcomes, however, are unlikely to be exactly as projected because of the uncertainty in the future over the life of the project. This uncertainty needs to be factored into a project’s financial analysis. Chapter 6 introduces uncertainty and risk analysis in the financial appraisal by examining the merits of sensitivity, scenario, and Monte Carlo analysis, with emphasis on the last of these. Measures necessary for dealing with uncertainty, such as different types of contracts and instruments of project financing are presented. The risk analysis also extends to the associated economic and distributional impacts of the project.

Chapter 7 presents the three basic postulates for applied welfare economics. These include the concepts of consumers’ and producers’ surplus and a definition of the different kinds of economic distortions and externalities. The chapter outlines how the three postulates can be used to estimate
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the economic prices of goods and services in the absence, and then in the presence, of distortions. The extension of the financial analysis to incorporate the additional costs and benefits linked to externalities shifts us to an economic framework, focusing on costs and benefits as they affect “society as a whole”.

Since the economic analysis, like the financial analysis, relies on the NPV criterion as the basis for decision making, an economic discount rate is needed to calculate the present values of the net economic benefit streams. Chapter 8 provides the methodology for calculating the economic discount rate. Similarly, an estimation of a shadow price for foreign exchange is needed to reflect the distortions that exist in the tradable goods sector. These distortions are the source of a foreign exchange externality that causes the economic opportunity cost of foreign exchange to differ from the market exchange rate. In addition, a corresponding premium should also be estimated and accounted for expenditures of non-traded goods and services which are influenced by the same externalities that apply to the traded-goods sector in Chapter 9.

The determinations of the domestic price of tradable and non-tradable goods are fundamentally different. Chapter 10 deals with the measurement of the economic price of tradable goods at project sites under various situations. Chapter 11 develops an analytical framework to measure the economic price of non-tradable goods or services when all repercussions of a project output or purchase of project inputs are taken into account.

Chapter 12 examines the economic opportunity cost of the labor involved in a project. The project wage is the financial cost of labor. However, its economic cost, or shadow wage rate, can differ from the financial cost because of various distortions prevailing in labor markets.

The distributional analysis, also known as stakeholder analysis, can be important for the sustainability of a project. One can identify major groups or parties affected by a project when one moves from the financial analysis to the economic analysis. They can be assessed to determine who will benefit and who will lose from the project and by how much. This helps identify and quantify the impacts of a project on various interest groups. This analysis is presented in Chapter 13 and its purpose is to ensure that no specific group is subjected to an undue burden or is presented with an unwarranted benefit as a result of a project.
Chapter 14 deals with two additional issues frequently raised in cost-benefit analysis. One is the shadow price of government funds and how it should be treated in our framework. The other is how distributed weights should be dealt with in the analysis of a project. In its ultimate analysis, poverty is the inability of households or residents to meet the basic needs including health, nutrition, water and sanitation, education and housing. A project that addresses these issues is more valuable to society and should get preference over another project that has the same financial and economic values but does not cater to these special areas. The concept of a basic needs externality and how a project can be given credit for helping the neediest groups in society is addressed in this chapter.

In certain projects, it is rather difficult to quantify benefits in monetary terms. A cost effectiveness analysis becomes a useful and effective criterion to make choices between projects or programs. The description of this concept and application is outlined in Chapter 15.

Applications of the integrated appraisal developed above to specific sectors are illustrated in the following chapters of the book. Chapter 16 deals with various conceptual issues of transportation projects. The focus is on highway projects, including road improvements and newly constructed roads. Externalities connected with road projects as well as those involving rail transport are also discussed in this chapter.

Chapter 17 illustrates how a proposed investment in upgrading a gravel road to a tarred surface in South Africa should be evaluated. This is a project with no toll levied on road users and thus no financial evaluation is carried out. However, from the economic prospective, the evaluation covers not only the assessment of savings in road maintenance costs by the Road Agency but also reduction in vehicle operating costs for road users due to the improvement of road surface, time savings for road users due to the increased speed of vehicles and other fiscal externalities.

Chapter 18 describes the unique features and the problems of electricity investment projects. The principles of the marginal cost pricing of electricity applied to peak and off-peak hours as well as resource cost savings by adopting least alternative generation technologies are particularly relevant to the investment in this sector. The conceptual discussion covers investments in both hydro and thermal electricity generation.
Chapter 19 demonstrates how the least alternative cost principle is applied to the appraisal of a project aimed to expand the capacity of the electricity generation system in Adukki. A single cycle thermal plant was originally proposed to be built and operated by an Independent Power Producer (IPP) while the state utility is the only off-taker of the electricity generated by this plant. The price paid to the IPP is negotiated through a long term Power Purchase Agreement. This chapter illustrates how a comparison of the financial and economic outcomes of the plant can be made with those of a combined cycle plant.

The last chapter, Chapter 20, applies the integrated investment approach to an assessment whether an investment program to upgrade the water and sewer utility in Panama is financially and economically feasible and sustainable. Estimates of the gross economic benefits or costs of the additional or reduced consumption of water are all based on the well-established welfare economics principles outlined in previous chapters. Nevertheless, the stakeholder analysis of this chapter causes concerns regarding the potential excess profits that could be received by a foreign concessionaire under the terms of the proposed concession.

The economic and social development of any country depends on the selection of sound investment projects. This book provides a theoretical and practical framework for project development and evaluation. It facilitates the preparation and assessment of projects to ensure that good projects get implemented while bad projects are stopped. Both decisions promote the economic and social well-being of the residents of the country in question.
REFERENCES


