Introduction

The first half of this book consists of six essays that describe a variety of methods and procedures that can be useful when evaluating potential infrastructure projects. The second half includes eleven hypothetical case studies that illustrate how these methods and procedures might be used. Each essay and each case study can be read as a stand-alone document, as there are no cross-references within them, nor is it necessary to read any essay before reading any case study. Someone familiar with the methodology may prefer to read about applications in their areas of interest. Someone with experience in particular kinds of applications may prefer to gain broader exposure to the methods described in the essays.

System Performance, the first essay introduces various measures that can be used to assess the performance of infrastructure projects and to evaluate alternatives for improving performance. Inevitably, there will be many aspects of performance to consider and many possible impacts on society or the environment that must be minimized or mitigated. Financial analysis, which is concerned with the cash flows directly related to a project, will be critical, but so will economic analysis, which also includes the impacts of a project on the overall economy. Both financial and economic impacts can be measured in monetary terms; which types of impacts are considered will depend upon who is doing the analysis. Owners, developers and users will largely be interested in financial matters; public agencies that must approve projects are concerned with broader economic matters, such as job creation and regional prosperity.

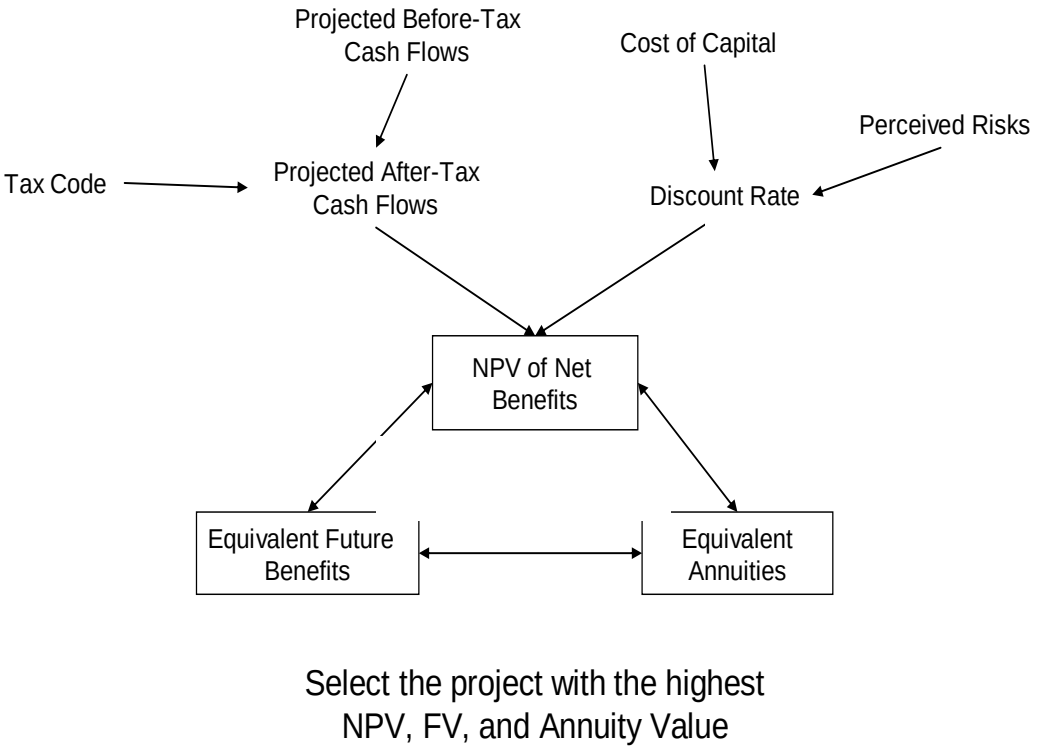
The next four essays are concerned with engineering economics, which provides many of the methodologies that are needed for financial and economic analysis, including the effects of taxes and depreciation, as illustrated in Figure 1. A central tenet of engineering economics is that it is possible to use a discount rate to estimate the equivalent present value of any future value. Given a discount rate, it is possible to calculate the net present value (NPV) of any stream of financial or economic costs and benefits that might be associated with a project.

Equivalence of Cash Flows develops the basic relationships that can be used to transform an arbitrary stream of financial or economic benefits into an equivalent present value, an equivalent value at some future time, or an equivalent annuity. These relationships are what makes it possible to compare the financial and economic impacts of multiple alternatives. The alternative with the highest net present value will also have the highest future value and produce the largest equivalent annuity. Thus, from a financial or economic perspective, it makes sense to choose the alternative that maximizes net present value.

The equivalence relationships all depend upon the choice of a discount rate, which is far from a simple, objective task. *Choosing a Discount Rate* goes into considerable detail discussing the factors that will affect the choice of a discount rate, emphasizing that different actors involved in implementing, using, or investing in a project may have different perceptions of the project and therefore may use different discount rates when evaluating a proposal.

Once the NPV of financial or economic benefits have been calculated, it is straightforward to select the alternative with the highest positive NPV. However, complications may arise if a different measure is used. Companies commonly use the internal rate of return when evaluating projects. The IRR is the discount rate that makes the NPV equal zero. If the IRR is greater than a company's discount rate, then that is a valid project. However, if there are mutually exclusive projects, then a small project with a high IRR might appear to be better than a larger project with a lower IRR that actually has a higher NPV. *Financial Assessment* presents methods that show how to deal with this issue. So long as the IRR analysis is applied properly, it will provide the correct ranking of mutually exclusive projects.

Figure 1: Structure of Four Essays Related to Discounting and Cash Flows



Public policy can affect the cash flows of a project in many ways. Zoning restrictions may limit what can and cannot be done on a site. Regulations may determine what kinds of materials or construction techniques can be used. The intricacies of the tax code can be manipulated by law-makers in order to promote or hinder certain types of development or certain types of investments. In particular, major investment expenses usually cannot be immediately deducted from taxable income; instead capital investments are depreciated over many years. Exactly how depreciation is treated in the tax code will determine when this expense is incurred. Since expenses affect profits, and profits result in income tax payments, it is necessary to consider depreciation in order to obtain a valid after-tax analysis of a project. *Rules of the Game* shows how depreciation, taxation, zoning, and environmental regulation can evaluation.

Dealing with Risks and Uncertainties introduces methods that are commonly used in project evaluation to deal with risks and uncertainties: modeling performance, probabilistic risk assessment, and performance-based technology assessment (PBTS). One case study uses probabilistic risk assessment to examine ways to reduce the risks associated with rail-highway grade crossings. Another case study uses PBTS to examine competition between airlines and railways for intercity passenger traffic.

Resource: Project Evaluation: Essays and Case Studies

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