

Socio-economic Evaluation

A socio-economic evaluation is required that estimates the benefits and costs of the project in national terms and including both quantified and non-quantified impacts. The basis is shown in Module 3 -> Sector Planning and Strategy -> Planning Policy and Making -> Socio Economic Evaluation.

Project Rationale

The identification, quantification and valuation of costs and benefits are central to preparing a SCBA. The main objective is to determine whether a project is economically viable i.e. an effective and timely use of public money and resources.

An important part of evaluating a project includes the need to address problems and constraints (such as congestion in ports or on roads) and considering possible alternative solutions.

Project planning ensures that a project is not over-designed e.g. not building a 6 lane highway when a 4 lane highway would be adequate for a given first phase of say 10 years.

Bases of Costs and Benefits

Before analyzing the costs and benefits of a project, it is important to state the recommended standard approach. This comprises defining the:

Without and With Project

The definition of the “without” and “with” project are crucial in the SCBA and are sometimes called ‘do nothing or do minimum’ and ‘do something’ respectively. These describe the benefits and costs if the road is built, compared to not building it.

Shadow Pricing and Resource Costs

SCBA uses costs and benefits. Benefits may either be included as exogenous monetized values or may result from the difference between the costs associated with the “without” versus the “with” project scenarios. Costs and benefits are both ‘shadow priced’ to eliminate price distortions especially taxes and subsidies. By shadow pricing, SCBA analysis uses ‘resource’ costs and thereby measures the cost savings to the country, as resources are considered scarce commodities.

Excluding tax from project costs is a straightforward process. However, shadow price standard conversion factors (SCF) which convert financial prices to economic prices, require a breakdown of costs and benefits and the appropriate application of these factors. Standard Conversion Factors (SCF) such as 70% for unskilled labor are often available from the multilateral agencies for use in economic evaluation. This means for

example, that the economic or real resource cost of unskilled labor is only 70% of a regulated minimum wage where there is surplus labor.

As a guideline, in some countries, the removal of taxes and use of conversion factors often results in the total economic cost of an infrastructure project averaging 85% of its (domestic) financial cost and varying mostly between 70% and 90% depending on the costs structure/type of project. The general formula is as follows:

$$\text{Economic Investment Cost} = K \times \text{Financial Investment Cost}$$

Where *K* is the factor used by convention.

(Note however that if the economic cost is calculated in more detail then the formula becomes; $\text{Economic Investment Cost} = \text{SCF} \times (\text{Financial Investment Cost} - \text{tax} + \text{subsidy})$).

The financial cost being the market value of the various components and *K* is the conversion coefficient from financial to economic costs (aforementioned to vary between 70% and 90%). In some instances the *K* value could be given by Government officials to be used for road projects in a country or region, as a matter of policy. In such case, the *K* value is considered as an overall conversion factor to be applied to the total financial investment cost.

An example for calculating shadow prices of road capital investments is included next.

Example of calculation method of economic investment costs

The economic cost is the market (financial) cost adjusted by a coefficient that takes into consideration transfer charges and other distortion of the price, such as, foreign exchange, local labor cost, taxes and subsidies.

Description of parameters

EIC: Economic Investment Cost

FIC: Financial Investment Cost

K: conversion coefficient from financial to economic costs, where

$$\text{EIC} = K \times \text{FIC}$$

SFEX: Shadow Foreign Exchange Rate, to reflect the scarcity of foreign currency

FEX: part of foreign exchange (% of capital investment costs)

SWR: Shadow Wage Rate, taken as a percentage of the real cost of local labor

LLC: Local Labor component (% of capital investment)

OLC: Other non-labor Local component, excluding taxes/ subsidies (% of capital investment)

TC: Tax component (% of capital investment)

Therefore,

$$\text{FIC} (\%) = \text{FEX} (\%) + \text{LLC} (\%) + \text{OLC} (\%) + \text{TC} (\%) = 100\%$$

$$K = \text{FEX} \times \text{SFEX} + \text{LLC} \times \text{SWR} + \text{OLC}$$

and

$$\text{EIC} = K \times \text{FIC} = [\text{FEX} \times \text{SFEX} + \text{LLC} \times \text{SWR} + \text{OLC}] \times \text{FIC}$$

EIRR, NPV and Discount Rates

The EIRR is calculated through an iterative mathematical procedure (e.g. provided either within economic analysis software or simply using an Excel spread sheet) that automatically discounts the net benefits of a project over the life of the project. For infrastructure, this is normally 20 to 30 years. Discounting means the projected net benefit in any year is subject to a (compounded) discount factor, and thus the further into the future, the discount factor becomes smaller and so does the net benefit.

Consequently, net benefits after 20 or 25 years can become irrelevant, especially with high discount rates [although it is possible that with modest discount rates and very high and sustained high forecast traffic growth rates over a project concession period, that later years are more ‘relevant’ in a discounted analysis, a simple example shows that extreme cases may add only a small increment to the EIRR and, in any case, it would not be good practice to forecast high growth rates over a long period into the future]. The discounting process brings all monetized values to a common year, usually the base year. In other words, all future values are discounted to “present worth” values:

$$PW = FW \times (1 + i)^{-n}$$

Where,

PW: present worth cost

FW: future worth cost

i: discount rate

n: number of years

It is important to mention that a discount rate is used irrespective of inflation (which is excluded from an economic analysis), since the time has an inherent value associated with it. To put it differently, a person would prefer to have one dollar today than one dollar in the future. To accept a value in the future, a person would wish to be compensated by an increase,

i.e. instead of receiving one dollar today a person is likely to accept $1 \text{ USD} \times (1 + i)^n$ in a future year n , where i equals the discount rate (in this case equivalent to an interest rate).

The relations between EIRR, NPV and discount rate are explained in Module 3.

The EIRR and NPV are important for several reasons. Values of these indicators provide firstly the socio-economic justification (or not) of a proposed project and its priority ranking. Secondly the NPV defines the upper limit of any requested financial support i.e. the government should not support a project beyond its worth to the country.

The EIRR is independent of the discount rate used (unlike the NPV). By definition the EIRR is the discount rate at which the NPV is nil, i.e. discounted costs equal discounted benefits.

The NPV provides a measure of the net worth of a proposed project and uses the appropriate discount rate. The discount rate can be derived or that used by IFIs or all projects in the same country must use the same discount rate so that the estimated NPVs of all projects are directly comparable.

As described in Module 3, NPV and IRR can be also be used to suggest optimal timing of projects through the use of First Year Rate of Return which discounts the first year net benefits relative to the project cost.

The Bases for Prices

Economic analysis uses constant base year prices which are called 'real' values i.e. a dollar today will generally buy the same amount of goods next year (because inflation is ignored). Physical contingency (normally 10 percent) must be included in costs as this takes into account unforeseen events such as difficult ground conditions. However, as the costs and benefits are in real values no inflation/price contingency is included.

The base year is usually assumed to be the year in which the analysis is undertaken and in particular the year when the project cost estimates are made. These should always be the latest costs (original estimates or updated) available.

Other Parameters

Other parameters may be used in an economic analysis. Some can be standard (and possibly only updated to the base year) while others may need to be specifically calculated for the proposed project. Parameters include the values of time saved (working time, non working time), vehicle operating cost savings, value of (reduced) accidents, passenger and cargo savings, and other costs and benefits specific to the proposed project e.g. health and education benefits.

Costs and Benefits

Costs will include initial project development costs and annual operating and maintenance costs and will include environmental dis-benefits, severance and other negative impacts and all mitigation costs as appropriate.

By convention, capital costs are all (or almost all) incremental i.e. in the without project scenario there will be no capital expenditure. The without project scenario should also include substantial future maintenance and/or rehabilitation costs as these will certainly be needed but whether they will actually be expended under the usual budget limitations is debatable. Annual operating costs may or may not be incremental depending on type of project and are calculated (as incremental costs) based on whether it is worth analyzing small differences in (with and without) costs for little or no impact on the EIRR.

Over the life of a project, some investment components will need replacing (will be fully depreciated) and roads will need heavier maintenance, periodically. Annual costs therefore should be supplemented in the appropriate years, both for the without and with project scenarios, by such periodic costs.

Some Examples of Cost Savings/Benefits

An increasingly congested road will increase costs and time for road users including possible diversion to longer alternative routes. A proposed road project to overcome these problems will generate vehicle operating resource cost savings, time savings, savings in the cost of the transport of freight and other benefits including accident cost savings and possibly environmental benefits (and/or costs).

TYPES OF BENEFITS FOR TOLL ROADS IN A CONVENTIONAL COST BENEFIT ANALYSIS
Time savings
Vehicle Operating cost savings
Fuel cost savings
Reduced accidents
Consumer surplus
Safety

There may be many other types of benefits (and costs) that might arise from a project which may be identified from more detailed studies.

The purpose of citing examples of cost savings and benefits is to emphasize four aspects of evaluation:

- The importance of determining the rationale of the proposed project design and operation to deal with the problems that are planned to be overcome. That is, what will be (i) the result of not undertaking the project and (ii) the result of implementing it.
- The need to quantify the incremental benefits/cost savings resulting from the project.
- The need to quantify as far as possible costs and benefits that are ‘external’ to the project e.g. pollution nuisance from a new project and other environmental and social aspects. These have traditionally not been included in economic analysis, due to difficulty of measurement, but are increasingly being so, e.g. the cost of loss of flora and fauna, as well as health and education benefits. If these externalities are costed and included in the CBA, then they have been “internalized”.
- The need to at least identify and describe other costs and benefits that cannot be quantified or that are not included in the quantified analysis but to which attention should be drawn.

In an economic analysis, benefits from savings in resource costs (such as savings in vehicle operating costs and time savings) are not directly related to the proposed tariff that does not directly measure such savings. However, the tariff charged will reflect in part such resource savings. That is if a toll road improvement saves each user USD 10 per trip in fuel, vehicle costs, time and other benefits, the financial tariff will be set to capture a percentage of that USD 10.

While a project usually adds capacity and so incremental demand is considered, existing users will also benefit from lower costs/prices. This is because of economies of scale and

increased productivity. The difference between the market price and what the existing and other consumers would be willing to pay for project output is called consumer surplus (i.e. the market price is lower compared to the price some consumers would be willing to pay).

An increase in consumer surplus represents an increase in economic welfare.

It should also be noted that conventional cost benefit analysis employs a range of assumptions about the micro and macro economic framework that are convenient simplifications of reality which may or may not apply in any specific country or project.

EIRR and NPV

The primary indices of economic viability or project worth are the EIRR and NPV respectively. These indicators are determined through the following sequence:

Estimating the incremental costs (capital, annual, periodic, replacement) for each year of construction and operation for the entire analysis period.

Estimating the difference between incremental costs and benefits for each project year thus generating a net benefit for each project year. The net benefits are negative during the construction years when there are only development costs but should become positive in subsequent operating years.

Calculating the EIRR and NPV by the application of Excel functions to the stream of net benefits over the project life. As mentioned above, in most cases after the initial construction period (negative cash-flow) benefits could be expected for the remaining analysis period and those benefits increase over time as traffic increases up to the capacity of the highway. However, if during the analysis period the cash-flow alternates between positive and negative values, the calculation of a unique EIRR cannot be ensured (more than one EIRR value is possible) but this is an unusual scenario but can be overcome through specialist analysis.

Other Benefits: Each project will also likely have particular benefits in addition or instead of the above.

Risk and Sensitivity

In economic analysis, after the EIRR and NPV are calculated, two other stages are normally undertaken.

Sensitivity Analysis

Sensitivity analysis is generally a simple approach to assessing uncertainty in the evaluation of infrastructure projects. It assesses the impact on the EIRR of changing key project variables. These variables can be changed singly or in combination. That is if traffic demand is 10% lower or project costs are 10% higher, or both of these changes in variables together, sensitivity analysis indicates whether the project is still viable or

not. Simply, if the EIRR is 20%, an increase in capital cost of 10% might reduce the EIRR to 18% or if the EIRR is 12% an increase in capital costs of 10% might make the project unviable.

An extension of sensitivity analysis is now more commonly used and involves estimating 'Switching Values'. Instead of applying a fixed change in sensitivity (e.g. 10%), various percentages are tested. The changes in the value of key parameters or combination of values (such as changes in project costs and revenues) are thus calculated in order to bring the EIRR to its minimum acceptable level, or the NPV to zero. The switching value could indicate, for example, that capital costs would have to decrease by 25% to bring the EIRR to the minimum rate of 12%. Basically, it provides a better view of the robustness of the project related to potential changes in key project parameters.

Risk Analysis

This is a related but different approach to risk management. Risk analysis takes sensitivity analysis a stage further. For large projects, it assesses the probability (attached to the key factors identified in the sensitivity analysis) that the EIRR will fall to the cut-off rate, or the NPV becomes zero. This is a somewhat time consuming and technically complex process but is required for large projects. Proprietary software is, however, available for risk analysis. In general, quantitative risk analysis are recommended to be undertaken for major, complex projects, due to the time and cost involved.

Risk and sensitivity analysis are used flexibly in conjunction with scenario modeling. For example, demand is usually dependant on economic growth; therefore, demand is often projected, based on high, mid and low national/regional economic growth scenarios. On the other hand, project costs are normally only subject to sensitivity and risk analysis.

While it is possible to analyze every single combination of scenario and sensitivity test, it is usually sufficient to analyze only a selective number of options.

While economic and financial evaluation both use IRR and NPV mechanisms to measure viability, financial analysis measures the financial internal rate of return (FIRR)/ the return on equity (ROE), payback and debt service cover ratios (DSCR). Financial analysis also uses the weighted average opportunity cost of equity as the financial discount rate which for the private sector may range for example between 15% and 20% in Indonesia.

These three indicators are important and together provide sufficient information on profitability, sustainability and financial risk to the (equity) investors and GOI at this stage.

Economic and financial analysis are regarded as different sides of the same coin or analysis of the same situation from different viewpoints.