Economic Analysis of Subregional Projects

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ECONOMIC ANALYSIS OF SUBREGIONAL PROJECTS

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Foreword

The Economics and Development Resource Center (EDRC) Methodology Series are papers prepared by EDRC staff to brief Asian Development Bank (ADB) staff, consultants, and government officials/experts associated with Bank operations on conceptual and analytical issues relating to project economic analysis. These papers aim at providing succinct accounts of concepts, methods, and illustrations of various aspects of project economic analysis. They are based on methodology development research studies funded by the ADB and undertaken by EDRC or good practice examples drawn from the ADB's own practices, those of similar other organizations or the literature. The papers are meant to disseminate knowledge and enhance analytical rigor and quality in project preparation and economic evaluation. They are also meant to assist in identifying and discussing policy implications, which may be drawn from project economic analysis. While prepared primarily for internal use of the ADB and its developing member country governments, the EDRC Methodology Series is available to other interested readers upon request to EDRC. These papers reflect strictly the views and opinions of the authors and do not necessarily reflect ADB policy or position.

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Chief Economist
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I. Introduction

Large multicountry infrastructure projects are increasingly promoted as subregional projects whereby governments, public and private investors and financiers of various countries, and regional and international development agencies take part. For decisions on such projects, in addition to a reasonable return on investment, the issue of the equitable distribution of project costs and benefits among all the participants and beneficiaries is important. Governments involved in promoting such projects try to maximize economic benefits in relation to the costs incurred. Private investors try to maximize their profits on their investment. External funding sources and international development agencies like to see each project participant’s interests protected.

The literature indicates that methodologies and practice of project economic analysis, namely cost-benefit analysis, tends to focus on analyzing allocative efficiency and to a certain extent income distribution effects of national projects. The methodologies are largely silent about cost-benefit analysis in a multicountry framework. They also insufficiently address the issue relating to project risks and sensitivity such as foreign exchange depreciation and changes in relative prices of goods and primary factor inputs.

This paper discusses related issues in project economic analysis in a multicountry framework. It presents a methodological framework for analyzing economic costs and benefits of multicountry or subregional projects at national as well as subregional levels. It also provides some illustrations of its application.

II. Background and Rationale

As with regional or subregional economic integration where common policies are implemented, ensuing costs and benefits of common projects under a regional or subregional economic grouping can be identified and analyzed. Conventional economic analysis of projects such as cost-benefit analysis is concerned mainly with the project costs and benefits within a country in which the project is designed to operate. Identifying project costs and benefits and analyzing their implications for the income of all the participants (such as government, equity holders, labor, and financiers) in a single country framework is straightforward and well documented.

Typically, subregional projects involve two or more countries, and economic analysis of subregional projects in a cost-benefit framework is complicated by multicountry participation. It is, however, possible to extend the conventional cost-benefit analysis from a single country (i.e., national economy) framework to multi-country (i.e., subregional economy) framework. The analysis can be undertaken in various stages looking into all kinds of financial and economic effects and their distribution among the participating countries within a subregion. For example, financial and economic net present value (NPV) and internal rate of return (IRR) at national as

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1 The paper draws on a joint special study on the preparation of a Handbook for the Economic Analysis of Subregional Projects, 1998 of the Greater Mekong Subregion Unit, Programs Department (West) and Project Economic Evaluation Division (EDEV), Economics and Development Resource Center (EDRC), Asian Development Bank. Many ADB staff contributed to the study by providing valuable comments. The core team was led by Ramesh Adhikari, Senior Economist, the staff consultant was John Weiss, Professor, University of Bradford; and Anneli Lagman, Economics Analyst, provided technical support. This paper has benefited from the comments and suggestions provided by David Edwards, Assistant Chief Economist, EDEV, EDRC, and excellent word processing assistance from Rina Sibal, Lala Chan, and Bubut Gelano.
well as subregional level are estimated. To ensure an equitable distribution of project net benefits, particularly where a significant discrepancy occurs in net benefits between national and subregion level, necessary compensatory arrangements can also be developed.

Because of the nature of the projects and difference in the level of economic development, overall development impact may not be commensurate with financial costs apportioned to each participating country. In some cases investments may be attracted towards relatively more developed locations within a subregion, as investors prefer locations with bigger markets and better social and economic infrastructure. This would influence the direction of benefit flows, resulting in a lopsided contribution to subregional economic development and welfare.

Subregional projects can be diverse, spreading over agriculture, energy, transport and telecommunications, environment and natural resources, human resource development, and tourism, with marketed as well as nonmarketed outputs. Some subregional initiatives may entail policy reforms/adjustments at a country level (e.g., cross border trade and investment, human resource development and regional tourism development). Many subregional projects will involve policy decisions at the country level, which will also require government decrees or legislative changes regarding, for example, duties and taxes, tariff/toll setting, foreign investment regulations, public and private partnership, and financing arrangements including external borrowing.

Because of the multicountry involvement and implementation complexities, analysis of financial, economic, and distribution effects should begin at the design stage of subregional projects. This would avoid possible differences in opinion among participating countries at a later stage when implementation should commence, differences that may arise regarding the equitable distribution of net economic benefits and compensatory arrangements in subregional projects. This raises two major issues: (i) what should be the appropriate methodological framework for an economic analysis of subregional projects; and (ii) what should be the main basis for ensuring a reasonably equitable distribution of benefits amongst participating countries.

III. Methodological Framework

Introduction

The practice of the Asian Development Bank (ADB) in the economic analysis of national projects follows the Guidelines for the Economic Analysis of Projects (1997), (henceforth Guidelines, 1997). This adopts the perspective that only costs and benefits to the national economy in which a project is located should be included in an appraisal. Thus the internal rate of return (IRR) shows the return on national resources committed to the project and the net present value (NPV) captures the change in national income for the economy. However in a subregional context this approach must be modified by estimating the net economic benefit (i.e., NPVs and IRRs) at the participating country level as well as for the subregion as a whole (i.e., at the project level). The subregional NPV gives the total change in real income for the group of participating countries and this must equal the sum of the national economic NPVs.

Further, the analysis of income distribution as a result of a project involves disaggregating the income change or identifying income flows created within a country by a

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3 The basic principles of project economic analysis are not discussed in this paper. For further reference, see the Guidelines (1997), UNIDO (1972), Little and Mirrless (1974), Squire and van der Tak (1975), and Powers (1981).
particular project into gains or losses to particular groups and project participants. This is important information since, for example, it can reveal the impact of a project on the government budget, on low income target groups or less developed regions as well as project financiers. The application of economic analysis at the subregional level can be seen as a simplified extension of this approach. Once economic NPVs at both country level and subregional (i.e., project) level have been derived the procedures of national income distribution analysis set out for a single country framework can be followed in the normal way to show how the income changes are allocated within the countries involved. The subregional level income distribution will look at the changes in income (in terms of NPVs) due to the project at the participating country level.

**Economic Rationale**

The key aspect of subregional cooperation is that it is intended to generate for the participating countries benefits that would not be available if the countries were to act independently by investing the same funds in national projects. Subregional projects should contribute to development by harnessing efficiently the natural, human, and financial resources of the subregion. Through collaboration between countries comparative advantage within the subregion can be exploited and growth accelerated. Gains in national income in participating countries should in turn contribute to wider social development.

A subregional or multicountry project is usually owned by more than one country and domestic and foreign private sector investors. A subregional project may be a commercial project where output is marketed. Subregional projects may also have nonmarketed output, for example, watershed protection or road projects where benefits include cost savings and induced economic activities across the border and roads are not subject to tolls. Such projects usually do not attract private sector participation, except under some special arrangements.

**Identification of Economic Benefits**

In a subregional project economic benefits or additional income changes may come from (i) financial flows (ii) externalities such as cost savings and induced economic activities across borders and (iii) adjustment for price distortions in factor and commodity markets. The mechanisms for creating such benefits will vary between projects, but will be based on a variant of one or more of the following effects: (i) generation of additional funds through the attraction of external funding that would not be forthcoming for nationally-based projects; (ii) capture of economies of scale and efficiency gains from subregional specialization as larger enterprises selling in a subregional rather than a national market can produce at lower unit costs; and (iii) creation of effects that cross the boundaries of individual countries. These effects are potentially very broad and can include, for example, the generation of new trade between participating countries with more efficient subregional specialization due to transport or telecommunications projects, the impact of decisions on environmental issues taken at subregional level, and the improvement in health conditions due to controls on communicable disease that stretch across national boundaries.

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4 For basic principles on project income distribution analysis, see UNIDO (1972), Squire and van der Tak (1975), and UNIDO (1978). Detailed examination of income distribution issues is given in Londero (1996a and 1996b). For illustrations of the application of project income distribution analysis, see Adhikari (1986) and UNIDO (1980).
Demand Analysis and Least-Cost Solution

Accurate demand studies are a precondition for project success. In subregional projects the only difference lies in the scope of the market, which crosses national boundaries, for example, with (i) power exports from countries well-endowed with energy to those with energy scarcity; or (ii) telecommunications networks that cover several countries. Any national differences in consumer tastes, market expansion, or government regulation must be allowed for and it will be important to establish separate projections for individual markets. For a project to be subregional, under the definition used here, benefits such as economies of scale cannot be obtained from exporting to the world market, but only through sales to the subregional market. Thus, subregional projects primarily will be utility projects (such as power, telecommunications and roads) that can be traded subregionally but physical characteristics prevent large-scale extraregional sales.

While projects must always be examined within the context of a macroeconomic and institutional framework, subregional projects must be assessed within the context not of a single national market, but of the markets of all participating countries. This requirement for an appropriate macroeconomic and institutional context in several countries is more demanding than that for success in a single country and will entail careful assessment of how the project will relate to expected conditions within the subregion. Policy reforms can have important effects on the performance of projects and where, for example, countries liberalize their markets at a different pace this must be allowed for in projecting project outcomes. The involvement of external funding sources in large subregional projects may increase the pace of change as dialogue on existing policies relating to proposed subregional initiatives may also serve to initiate further reform. The involvement of several countries, perhaps at different stages of development but with their economies closely linked, may also increase the risk of project failure, where a downturn in one market, for example, due to loss of confidence and outward capital flows, may spread to markets of other countries as a result of a more general loss of confidence in the subregion.

Once a project concept has been developed and its market quantified it is essential to establish that it is the least-cost means of achieving the particular objectives involved. The techniques for carrying out least-cost analysis, such as identifying the equalizing discount rate, are well documented (Guidelines, 1997). Several features of subregional projects should be noted. First, to use a technique like the equalizing discount rate, defined as the rate at which two cost streams from project alternatives become equal, one must have alternatives with equal benefits. For some subregional projects this may be no more difficult than for any other type of project; for example, alternative power stations with different technology or roads with different design can be compared. Situations involving broader definitions of project alternatives are more complex. For example, if subregional cooperation moved into the higher education sector, with a subregional university, alternative country locations could be compared but benefits in terms of students served from different participating countries would vary with the location of the university.

A second technical point regarding least-cost analysis and subregional projects is that the application of the equalizing discount rate technique (and a comparison of the present value of costs from project alternatives) requires the use of a test discount rate. ADB economic evaluations normally use an economic discount rate of 12 percent as a means of rationing funds between competing uses. This is a useful practical procedure although in principle one would expect the opportunity cost of funds (which is the normal basis for the discount rate) to vary between countries. If participating countries involved in a subregional project choose to apply
different discount rates, least-cost analysis and use of the NPV and IRR indicators would be undermined. For consistent calculations there is a need to agree on a single discount rate for comparisons of costs from alternatives and of costs and benefits. For most purposes, the use of a test discount rate of 12 percent will be adequate.

Project-Specific Finance

A new project financed within a subregional framework may bring in additional foreign funding; that is, the funds made available to the countries collectively for this subregional collaboration may be incremental to the level of foreign capital inflows that they would otherwise receive. The countries involved will benefit from the incremental funding given directly by the concessional element in such funds. This is the difference between the discounted value of inflows, when the foreign funds are received, and the discounted value of outflows when the funds are repaid. The level and the form of outflows will differ between the different possible types of additional foreign capital flows.

Once foreign investors are involved, however, the issue of taxes, whether on profits, trade, or local goods, becomes highly relevant since although taxes are a transfer from a national point of view, tax payments by foreigners are a means of retaining project income within an economy and are thus a form of national benefit. Hence it becomes necessary to consider the implications of alternative tax packages both for the level of foreign investment inflows and for the outflows from after-tax income. The indirect benefit from additional foreign funds arises when they are associated with technology and managerial skills that would not be available with the alternative funds open to a project, principally local private or public sources of capital. These indirect benefits are implicit in the net benefits that the operations of the project generate and therefore do not need to be accounted for separately.

Externalities

Many infrastructure projects, even those with a marketed output and thus by definition a commercial dimension, also create external effects. Road projects are an obvious example, since even where tolls are used they will probably not capture all benefits. In this scenario, a project's financial revenue, and thus returns to investors, will not reflect fully all benefits and if one wishes to allocate these between countries direct information must be collected on the location of project beneficiaries. Hence in the road example one would wish to know how vehicle owners, consumers, and producers in different countries in the subregion are affected by a collaborative project spanning more than one country (see also Example of Economic Analysis Methods – A Noncommercial Project: Highway, pp. 17-20). A similar argument applies on the cost side where externalities, such as harmful environmental effects, are spread across countries. By definition these will not show up in financial analysis so they cannot be apportioned on the basis of the financial costs of the project, which reinforces reliance on economic analysis.

Price Distortions

Marketed output may be sold in a distorted market so that the price paid by users (for example, power or telephone consumers) may not reflect the true value of the resource or service to the economy. As the Guidelines (1997) make clear, benefits from this type of project, may be either incremental, in which case the normal procedure is to value them at users' willingness-to-pay, or nonincremental, in which case benefits are valued at costs saved. A subregional issue arises where the ratio between economic value of project output and its
financial price or tariff differs between countries. Hence, if, for example, power is very scarce in one country and less scarce in another, even if the power tariff is the same in both countries we cannot use the financial revenue for the project collected from sales in the two countries as a means of allocating country benefits. We will have to study the degree of price distortion for power and use an estimate of the economic value of output in the two countries for the process of country allocation.

Further, a project could have external effects and operate in distorted markets. Distortions can affect a project on the input as well as the output side. For example, in many developing countries macroeconomic distortions affect markets such as those for foreign exchange and labor remain. These must be corrected by using national economic parameters, such as a shadow exchange rate factor (SERF) or standard conversion factor (SCF), a labor conversion factor, etc. Where, for example, the degree of foreign exchange distortion differs between countries, even if foreign exchange costs are shared equally between participating countries, the real national economic costs will be distributed unequally.

**Project Income Distribution Analysis**

Implementing the framework developed here requires that the income changes for different economies from a subregional project be estimated at two stages. First, it is necessary to establish who gains and loses from the operations of the project valued at financial prices. At this stage the financing structure of the project, that is, its loan and equity mix must be identified, and income flows to equity investors and lenders must be estimated. Any project-specific finance with a concessional element, in the sense that capital inflows exceed outflows, will benefit the countries concerned. At this stage the analysis addresses the question of who gains or loses from the financial operations of the project.

At the second stage it is necessary to consider how the externalities and price distortions associated with the project alter the allocation of income from that derived from the financial calculations. In the presence of externalities and distortions, by definition, financial prices do not give the full economic picture, and some groups must gain where economic costs are below financial ones and similarly where economic benefits exceed benefits at financial prices. Correspondingly, someone must lose where economic costs exceed financial ones and where economic benefits are below benefits at financial prices. Hence, at this stage the analysis picks up the gainer and losers from externalities and price distortions.⁶

**Pricing and Compensatory Arrangements**

Where subregional projects are essentially commercial, so that most benefits are marketed, and externalities are of minor importance (for example, power and telecommunications projects) the prices charged for intraregional sales will affect both economic efficiency and the distribution of benefits between participating countries. From the point of view of efficient use of the subregion's resources, such as hydropower, prices should be set at the long-run marginal cost of supply. Where distortions in production are important, marginal costs should be economic not financial costs. If unit costs fall with output due to economies of scale a form of two-part tariff may have to be introduced to allow the supplier to earn a normal profit on

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⁵ See Guidelines (1997) for further details on the estimation and use of national economic parameters (i.e. conversion factors for the adjustment of price distortions).
⁶ The analysis does not go to the extent of estimating and allocating distribution weights as in Squire and van der Tak (1975) because of the inherent problem in selecting meaningful and generally acceptable weights for different income groups and countries.
capital. This type of issue is now well understood and the principles of marginal cost pricing have been examined extensively in the context of public utility sectors. However, the tariff charged for such projects also determines the distribution of benefits between participating countries. In a monopolistic situation without public regulation, the supplier will tend to exploit its market power and charge a rate that generates above normal profits. Hence, to ensure an equitable subregional distribution where a monopoly is involved, there is a strong case for subregional antimonopoly measures. Where the problem is of monopsony with a dominant buyer rather than supplier, the charges for subregional sales may also need to be monitored to ensure that any adverse effects on suppliers are either avoided or compensated.

Where projects have strong externalities (for example, road or water resource schemes), by definition benefits will not be captured by the projects themselves and regional cost sharing will be an important issue. A road project will create benefits through cost savings on normal traffic and through induced production associated with generated traffic. While costs may be allocated between countries on the basis of the location of the road, these benefits may be highly unequally distributed between the participating countries and may bear little relation to the cost allocation of the road. Similarly for water management projects, a majority of benefits in the form of soil conservation or forest protection may be located downstream largely outside the country where the project is located. In such cases there is a need to quantify total benefits to participating countries and to ensure that individual countries in which projects with strong externalities are located are not disadvantaged. The difference between the total subregional NPV and IRR, and the NPVs and IRRs for each participating country, will give the distributional assessment of a project. If the initial arrangements suggest an important imbalance in net benefits between countries, ways of improving this situation will have to be considered. The NPV figures will show the income changes for participating countries and thus any net losses that may require compensation. The NPVs for gaining countries show the maximum they could contribute to a compensating fund to ensure that the project goes ahead.

Project Risks and Sensitivity Analysis

All projects have an element of uncertainty concerning their costs and benefits. Since they involve several project participants and may serve several markets, subregional projects may be subject to a greater degree of uncertainty. They may also be subject to greater delays than other projects because of the difficulty of coordination between the parties involved. The simplest techniques for dealing with uncertainty and the consequent risk of project failure is sensitivity analysis, which shows the impact on the project NPV and IRR when key project parameters are varied independently. More sophisticated techniques involving probability analysis and random numbers can now be applied easily with the development of computer software, but they are not yet part of standard appraisal practice and at this stage need not be considered for application to subregional projects.

Since several countries may be involved in a subregional project, benefits and costs arising in different countries must be converted into a common currency. Unless there are good reasons for using another currency this common currency, will normally be the US dollar. However, this creates an important aspect of project risk that affects subregional projects, particularly unfavorable exchange rate fluctuations or exchange rate risk. Revenues may be paid in one or more regional currencies rather than in a single international currency such as the US dollar. Hence even if payments in a regional currency rise in line with inflation in the country concerned, they may still decline in real terms if the real exchange rate of the country depreciates relative to international currencies. Hence those receiving payments in the currency involved will have a declining purchasing power over goods on the international market. Given
the instability in nominal and real exchange rates in many countries in recent years, it is important that this aspect of project risk be assessed in both financial and economic appraisals.

Project Decision Rule

An acceptable subregional project requires (i) a higher economic NPV from the project than that obtainable from its alternatives such as separate national investments in the same field as well as a positive economic NPV at an economic discount rate (e.g., 12 per cent) or an economic IRR above the economic discount rate (i.e., 12 per cent); (ii) where appropriate, financial returns that are acceptable to private investors and where public funds are involved adequate returns to ensure financial sustainability; and (iii) an acceptable distribution of the benefits of the project between the participating countries derived from individual country analysis of economic NPV and IRR, or, where necessary compensatory arrangements to ensure that no country is worse off with the project.

IV. Application of Economic Analysis Methods for Subregional Projects

A. Key Steps

To apply subregional economic analysis we require the economic (NPV) and (IRR) of the project for the individual participating countries as well as aggregated for the subregion as a whole. The recommended steps are as follows:

(i) identify the market for the project, both within and outside the subregion;

(ii) establish the financing plan of the project and identify if any of the funds are project-specific;

(iii) for commercial projects, estimate the financial NPV (e.g., at 12 percent discount rate) and IRR at constant US dollars and show how the income of different groups and countries is affected;

(iv) estimate the benefit of project-specific finance as the difference between the present value of the inflow of funds and the present value of the outflow under the terms specified;

(v) for noncommercial projects and for commercial projects with significant side effects, quantify and value the external effects (e.g., environmental impacts and consumer surplus);

(vi) allow for any important market distortions by applying national conversion factors to adjust financial values relating to expenditure in a country to economic prices (e.g., the shadow exchange rate factor and a conversion factor for important inputs);

(vii) where financial analysis has been carried out, adjust the financial NPV and IRR to obtain the corresponding economic NPV and IRR;

(viii) for noncommercial projects, compare economic benefits (externalities) directly with economic costs to obtain the economic NPV and IRR;
allocate the economic NPV between participating countries and show the gainers and any losers; and

consider whether any compensating arrangements are required to offset any loss to any of the participating countries.

The distribution of net project benefits among all project participants, including governments, private sector, and project financiers, features strongly in a subregional economic analysis. Figure 1 shows how financial flows can be identified and analyzed and Figure 2 depicts key components of a subregional project income flows analysis. The key steps in a subregional economic analysis are summarized below.  

**Step 1. Financial Return to Total Capital**

The financial NPV of a project should be calculated as a return to total capital before deduction of profit tax. This requires the project NPV and IRR to total capital with outputs and inputs valued at financial prices. For noncommercial projects with no financial revenue, all financial data will be costs.

**Step 2. Financial Flows from Financing Arrangements**

The financing arrangements expected for the project should be included in the analysis. This will allow a separation between income to equity investors, lenders, and government through profits taxation. NPV and IRR indicators can be calculated for the different parties involved with the financing of the project. At this stage, groups from the subregion and those from outside can be identified, and income gains to the latter must be excluded from the subregional economic NPV.

**Step 3. Project-Specific Concessional Finance**

Any project-specific concessional funds that would have not come to the subregion without the project should be identified and the net benefit it creates, measured as the difference between the present value of the inflow of funds to the subregion and the present value of the outflow from the subregion should be added as a project benefit to give a new NPV and IRR for the subregion. The beneficiaries from these funds within the subregion should be identified. Here private sector project-specific finance is already covered in Step 1, since normally foreign equity investment and commercial loans can be treated as available only for individual projects.

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For the basic project economic analysis steps, see the Guidelines (1997).
RETURN TO EQUITY = PV (DIVIDENDS) - PV (EQUITY)

RETURN TO LENDERS = PV (PAYMENTS) - PV (LOAN)

RETURN TO GOVERNMENT = PV (PROFIT TAX)

RETURN TO CAPITAL = FINANCIAL NPV

RETURN TO SUBREGIONAL GROUPS = PV (INCOME CHANGES)

RETURN TO EXTRAREGIONAL GROUPS = PV (INCOME CHANGES)

PV = Present value
Figure 2
Subregional Project Income Distribution Analysis

NPV (FINANCIAL)

+ NPV (ECONOMIC) - NPV (FINANCIAL)

INCOME FLOWS TO
INVESTORS
LENDERS
GOVERNMENTS

INCOME FLOWS TO
CONSUMERS
WORKERS
SUPPLIERS
GOVERNMENTS

INCOME CHANGES TO
PARTICIPATING COUNTRIES

NPV = net present value
Step 4. Economic Adjustments

Any externalities and market distortions must be allowed for either by including external benefits or costs not reflected in the financial evaluation or by applying conversion factors to financial price data. These adjustments reflect real income changes that are not measured by the financial NPV and IRR data and these must be allocated to different groups in the subregion. An economic NPV and IRR must be calculated and the economic NPV will show total change in real income within the subregion.

Step 5. Sensitivity analysis

Where appropriate, sensitivity tests can be carried out to establish how changes in key parameters, for example, real exchange rates affect the results.

These procedures can be illustrated by reference to two examples: (i) a commercial project exporting power; and (ii) a noncommercial project, a road linking the major cities of two neighboring countries. The summary results for these two subregional projects are given in the following section.

B. Examples of Economic Analysis of Subregional Projects

1. A Commercial Power Project

Step 1. Financial Return to Total Capital

The financial NPV and IRR are calculated by comparing financial revenue from power sale with investment and operating cost at financial prices measured in constant US dollars.

Financial NPV (at 12 percent) US$ 98.25 million FIRR 19 percent

Step 2. Financial Flows from Financing Arrangements

The investors involved are an extraregional foreign investor, the national electricity authority and a private sector company from the importing country. The lenders to the project are, for example, ADB, foreign suppliers of export credit, and a foreign commercial bank. The financial NPV to total capital is distributed as shown in Table 1.
Table 1
Distribution of Financial Flows Related Benefit - Net Present Values to Different Groups (US$ million)

<table>
<thead>
<tr>
<th>Investors</th>
<th>Total Capital</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Electricity Authority&lt;sup&gt;a&lt;/sup&gt;</td>
<td>41.07</td>
<td></td>
<td>41.07</td>
</tr>
<tr>
<td>Foreign Investor&lt;sup&gt;b&lt;/sup&gt;</td>
<td>12.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importing Country&lt;sup&gt;c&lt;/sup&gt;</td>
<td>12.31</td>
<td>12.31</td>
<td></td>
</tr>
<tr>
<td>Government&lt;sup&gt;d&lt;/sup&gt;</td>
<td>29.16</td>
<td></td>
<td>29.16</td>
</tr>
<tr>
<td>Creditors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Credit&lt;sup&gt;e&lt;/sup&gt;</td>
<td>0.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial credit</td>
<td>2.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>98.25</td>
<td>12.31</td>
<td>70.23</td>
</tr>
</tbody>
</table>

<sup>a</sup> Gains difference between the discounted after tax profits going to national electricity authority and the discounted value of its equity investment.

<sup>b</sup> Gains difference between the discounted after tax profits going to foreign investor and the discounted value of its equity investment.

<sup>c</sup> Gains difference between the discounted after tax profits going to importing country and the discounted value of its equity investment.

<sup>d</sup> Government of country B gains discounted value of profits tax and royalty payments, plus the difference between the present value of the Bank credit of $8.5 million loaned to the project by the government and the present value of repayments by the project.

<sup>e</sup> Creditors gain the difference between the discounted loan interest and principal payments and the discounted value of their loan inflow. As foreign creditors, this is not a subregional gain.

Step 3. Project-Specific Concessional Finance

Here it is assumed that 75 percent of the ADB funds to country B are project-specific and would not have come to the country in the absence of the project. The concessional or grant element in this funding is a gain to country B (Table 2).
Table 2
Distribution of Concessional Finance Related Benefit - Net Present Values to Different Groups (US$ million)

<table>
<thead>
<tr>
<th>Subregion</th>
<th>Total Capital</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Electricity Authority</td>
<td>41.07</td>
<td></td>
<td>41.07</td>
</tr>
<tr>
<td>Foreign Investor</td>
<td>12.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Importing Country</td>
<td>12.31</td>
<td>12.31</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>29.16</td>
<td></td>
<td>29.16</td>
</tr>
<tr>
<td>Creditors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Credit</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Credit</td>
<td>2.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank Loan(^a)</td>
<td>26.25</td>
<td></td>
<td>26.25</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>124.51</strong></td>
<td><strong>12.31</strong></td>
<td><strong>96.48</strong></td>
</tr>
</tbody>
</table>

\(^a\) For the project-specific funds the gain to country B is the difference between the discounted value of the loan inflow and the discounted value of the associated service charge of one percent and outflows in principal and interest payments.

Step 4. Economic Adjustments

The only economic adjustment is that the financial charge at which power is exported from country B to country A does not reflect economic value in A (given by a combination of cost savings and willingness to pay). The financial revenue from the power sale thus understates its economic worth. The difference between the financial revenue and the economic value of power sales is a gain to the power sector in A, which will be shared between power consumers and the power supplier (Table 3).
Table 3
Distribution of Economic Adjustment Related
Net Present Values to Different Groups (US$ million)

<table>
<thead>
<tr>
<th>Investors</th>
<th>Total Capital</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Electricity Authority</td>
<td>41.07</td>
<td></td>
<td>41.07</td>
</tr>
<tr>
<td>FOR</td>
<td>12.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>12.31</td>
<td>12.31</td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>29.16</td>
<td></td>
<td>29.16</td>
</tr>
<tr>
<td>Creditors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Credit</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial credit</td>
<td>2.81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bank Loan</td>
<td>26.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power Sector(^a)</td>
<td>92.63</td>
<td></td>
<td>92.63</td>
</tr>
<tr>
<td>Total</td>
<td>217.14</td>
<td>104.94</td>
<td>96.48</td>
</tr>
</tbody>
</table>

EIRR                        | 48%           | 39%               |

\(^a\) Assuming power tariffs in country A reflect the financial charge for power imports, consumers in A will gain the difference between the discounted value of their willingness to pay for incremental power sales and the discounted financial revenue to the project from incremental sales. The power supplier will gain the difference between the discounted value of their without-project cost for nonincremental sales and the discounted financial revenue to the project from nonincremental sales.

Step 5. Sensitivity Analysis

Here we test for the impact of exchange rate changes. We allow for a 10 percent real depreciation of the currency of country A. This has two main effects. Fifty percent of the revenue to B is assumed to be paid in country A’s currency and this declines in terms of constant dollars. In addition, the majority of the economic value of power in A is measured initially in national currency and thus will be worth less in dollars. Thus both investors and consumers lose to some extent by the real exchange rate change. Nonetheless returns remain high (Table 4).
### Table 4
Sensitivity Analysis -- Present Values to Different Groups (US$ million)

<table>
<thead>
<tr>
<th>Investors&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Total Capital</th>
<th>Subregion</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEA</td>
<td>33.55</td>
<td></td>
<td></td>
<td>33.55</td>
</tr>
<tr>
<td>FOR</td>
<td>12.31</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP</td>
<td>9.80</td>
<td></td>
<td>9.80</td>
<td>27.40</td>
</tr>
<tr>
<td>Government&lt;sup&gt;b&lt;/sup&gt;</td>
<td>27.40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creditors&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Export Credit</td>
<td>0.60</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial credit</td>
<td>2.81</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADB Loan</td>
<td>26.25</td>
<td></td>
<td></td>
<td>26.25</td>
</tr>
<tr>
<td>Power Sector&lt;sup&gt;d&lt;/sup&gt;</td>
<td>69.77</td>
<td></td>
<td>69.77</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>182.49</strong></td>
<td></td>
<td><strong>79.57</strong></td>
<td><strong>87.2</strong></td>
</tr>
<tr>
<td>EIRR</td>
<td>27%</td>
<td></td>
<td>41%</td>
<td>37%</td>
</tr>
</tbody>
</table>

<sup>a</sup> Investors' returns decline since the national currency portion of financial revenue is worth less in dollars.

<sup>b</sup> Government profits tax and royalty income declines with the fall in dollar value of revenue.

<sup>c</sup> Payments to creditors are unaffected.

<sup>d</sup> The power sector in country A gains less than previously because the economic value of incremental consumption is in national currency, which is now worth less in dollars. The net gain is the difference between the discounted economic and the discounted financial value of power sales. Both now decline in terms of dollars but the former declines more than the latter, because only 50 percent of revenue to the project is in A’s currency.

2. A Noncommercial Project: Highway

**Step 1. Financial Return to Total Capital**

As a noncommercial project, this has no financial revenue. Its costs are borne by the two countries. Since all financial flows to the project are costs and all benefits are external, there is no financial IRR.

Financial NPV (at 12 percent) -US$73.94 million
Step 2. Financing Arrangements

Both governments finance their portion of the project from their own resources.

Table 5
Financing Arrangements and Financial Flows

<table>
<thead>
<tr>
<th>US$ million</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>-17.36(^a)</td>
<td>-17.36</td>
<td></td>
</tr>
<tr>
<td>-56.58(^b)</td>
<td></td>
<td>-56.58</td>
</tr>
</tbody>
</table>

\(^a\) Discounted value of investment and operating costs in A.
\(^b\) Discounted value of investment and operating costs in B.

Step 3. Project-Specific Concessional Finance

It is assumed that even if both governments fund the project from concessional sources, these are not project-specific and thus would have been available to the country without this project. Hence there is no extra information to add at this stage.

Step 4. Economic Adjustments

Here the benefits from the project in the two countries are included. These are savings in vehicle operating costs for normal and diverted traffic, the net value of induced agricultural production and the net value of mining operations stimulated by the road. These benefits are shown first before any adjustment for a premium on foreign exchange and then second when shadow exchange conversion factors of more than 1.0 are used for both countries (Table 6).
Table 6
Distribution of Economic Adjustments Related Benefits to Participating Countries

<table>
<thead>
<tr>
<th></th>
<th>Project (US$ Million)</th>
<th>Gain to Country A</th>
<th>Gain to Country B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment/Operating Costs</td>
<td>-73.94</td>
<td>-17.36</td>
<td>-56.58</td>
</tr>
<tr>
<td>Benefits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Operating Benefits</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost Savings(^a)</td>
<td>149.66</td>
<td>27.97</td>
<td>121.69</td>
</tr>
<tr>
<td>Mine(^b)</td>
<td>2.52</td>
<td>2.52</td>
<td></td>
</tr>
<tr>
<td>Rice(^c)</td>
<td>4.75</td>
<td>4.75</td>
<td></td>
</tr>
<tr>
<td>Timber(^d)</td>
<td>3.33</td>
<td></td>
<td>3.33</td>
</tr>
<tr>
<td><strong>Total Net Benefits</strong></td>
<td>86.32</td>
<td>17.88</td>
<td>68.44</td>
</tr>
<tr>
<td>Foreign Exchange Adjustment(^b)</td>
<td>3.41</td>
<td>3.19</td>
<td>0.22</td>
</tr>
<tr>
<td><strong>Total Net Benefits</strong></td>
<td>89.73</td>
<td>21.07</td>
<td>68.66</td>
</tr>
<tr>
<td>EIRR</td>
<td>18</td>
<td>14</td>
<td>24</td>
</tr>
</tbody>
</table>

\(^a\) Discounted value of vehicle operating cost savings.
\(^b\) Discounted value of benefits from mine in Country A minus discounted investment and operating cost.
\(^c\) Discounted value of rice minus discounted cost of rice imports from Country B.
\(^d\) Discounted value of timber minus discounted cost of timber imports from A.
\(^e\) Traded content of economic benefits and costs is adjusted by shadow exchange rate factor of 1.1 in Country B and 1.25 in Country A.

Step 5. Sensitivity Analysis

Vehicle operating cost savings are the major form of benefit. The sensitivity analysis tests how far these have to fall before the project becomes marginal in one of the two countries. With a 50 percent reduction in vehicle operating cost savings, the project becomes marginal (Table 7).
V. CONCLUSION

The economic analysis of a subregional project should estimate the return on total investment at the individual participating countries as well as at the subregion as a whole. At the same time it must estimate the distribution of net benefits between participating countries. This requires an economic NPV and IRR for each country individually. The subregional economic NPV will be the sum of the economic NPVs for the countries involved. Also to ensure the financial sustainability of commercially oriented projects, financial indicators (particularly the financial NPV to total capital invested and the NPV and IRR to equity) should also be calculated. Such financial indicators will be useful to project cofinanciers, including the private sector.

The starting point for calculations is the return to the total capital in a project, which should be expressed as a financial NPV and IRR to total capital. Once the financing arrangements are allowed for, the return to total capital can be dis-aggregated into returns to investors, lenders, and the government. The residence of these groups allows us to identify country effects within the subregion. Project-specific finance must be identified and its financial inflows compared with its financial outflows.

For subregional projects operating in distorted markets it is important to establish the extent to which financial tariffs diverge from economic values in the different countries. The distribution of cost savings between producers, traders, and consumers is an important issue for regional distribution, and will normally require empirical research. Some environmental effects will be difficult to allocate between countries and these may require national contingent valuation surveys. For road, port, and rail projects that cross national boundaries, the value of incremental production created by the transport project should be quantified rather than just using half the vehicle operating cost savings as the net benefit for generated traffic.

To adjust for national price distortions, national conversion factors should be used in subregional economic analysis of projects. A domestic price system of economic analysis in constant US dollars is recommended. If this is applied the important national conversion factors will be the shadow exchange rate factor (SERF) and conversion factors for unskilled and skilled labor. A standard 12 percent discount rate can be applied for all subregional projects involving funding from the ADB.

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8 A world price system of economic analysis may also be used as long as consistency is maintained both conceptually and methodologically.
Further, (i) for commercial projects operating in largely nondistorted markets, the subregional distributional dimension will be determined primarily by financing issues determining profit-sharing between countries; (ii) where small countries receive more concessional finance than they would due to an individual subregional project, this benefit must be included; (iii) where externalities are the main or sole form of benefit, it is essential that the country distribution of benefits be identified, even if only approximately; (iv) subregional economic efficiency requires long-run marginal cost pricing for commercial projects; (v) monopoly and monopsony pricing should be avoided by subregional regulations; and (vi) serious imbalances in net benefits for participating countries should be avoided either by changes in pricing or by financial compensatory arrangements or by other arrangements acceptable to all participating countries.

The methodological framework presented in this paper is intended to be useful to project decision making by investors and financiers, and enhance the understanding of participating countries about the likely costs and benefits of subregional projects and thereby help them in their decision making. It is also believed that the use of methodological framework will strengthen the capacity in project decision making within multilateral development banks such as the ADB, and contribute directly to their operations, particularly in the ADB’s catalytic role in regional economic cooperation by facilitating subregional project development and implementation.
References


