GUIDELINES FOR ECONOMIC ANALYSIS OF PROJECTS

ECONOMICS OFFICE
August 1987
FOREWORD

During the past five years, the Economics Office has prepared and circulated various guidelines on specific aspects of the economic analysis of projects. These guidelines were prepared in pursuance of the recommendations contained in the Board Paper entitled "Economic and Financial Appraisal of Projects". Since most of the work in refining and improving the approach to these major aspects has been completed, it is desirable that these guidelines be now consolidated in one volume which can serve as a manual.

During the progress of the above work, it was also found necessary to substantially revise and update the general guidelines on economic analysis of projects which were initially prepared in 1970. This volume therefore begins with general guidelines; specific guidelines follow as annexes to the general guidelines.

The guidelines contained in this document represent the combined efforts of Bank staff from the Country Department, the Projects Departments, the Post-Evaluation Office and the Economics Office. The principal responsibility for producing these guidelines was borne by Dr. K. N. Kohli, Assistant Chief Economist, Economics Office.

To ensure uniformity of analysis, approach and coverage in all Bank projects, staff in the Projects Departments and the Post-Evaluation Office concerned with economic analysis of projects are advised to study these guidelines carefully and adhere to them in future work.

A. T. BAMBAWALE
Vice President, Operations
May 1983
PREFACE

The publication of the second edition of the Guidelines has been necessitated by the unusually heavy demand for the first edition whose supply has been exhausted. In its continuing effort to improve, update and simplify the Guidelines, the Economics Office has added, deleted, and sharpened the material as well as further edited it to improve the presentation.

The major revisions and additions made in the second edition are the following: (i) The sections dealing with the depletion premium and sensitivity analysis have been considerably reformulated to make them more rigorous. (ii) Reference to the foreign exchange earning capacity rate has been deleted as it does not provide any additional insight than what is already contained in the economic internal rate of return. (iii) Two new appendixes — Guidelines for the Treatment of Price Changes in the Economic Analysis of Projects and Guidelines for the Economic Analysis of Education Projects — have been added. The former suggests (a) use of World Bank Commodity Price Projections in valuing benefit and cost streams in the base case, unless there are compelling reasons to use other price estimates; and (b) use of base year prices in the sensitivity analysis. The Guidelines on Education provide an extension of the general guidelines to a sector specific context.

In the field of economic analysis of projects refinements and improvements are a recurring feature. While every effort is made to update the Guidelines through the issuance of Staff Instructions, users of the Guidelines are encouraged to bring to the attention of the Economics Office improvements they would like to see incorporated in subsequent editions.

K. N. KOHLI
Chief Economist
August 1987
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I. INTRODUCTION

1. The purpose of these guidelines is to provide a statement of the general approach to be followed in the economic analysis of Bank-financed projects. The guidelines draw on previous studies made by the Bank, specific guidelines issued on various aspects of economic appraisal from time to time, and practices followed by other multilateral lending institutions.

2. The focus of these guidelines is on the objective of maximizing net output or income, often referred to as the "economic" or "efficiency" objective. This approach to the economic analysis of projects has been followed by the Bank and it is proposed that it be continued. Under this approach, equal weight is given to all income accruing to different income groups and to different end-uses. In recent years, the methodological framework for economic analysis has been extended explicitly to incorporate income distribution criteria, reflecting the concern for the alleviation of poverty and the need for greater savings in developing countries. While this approach is conceptually more refined, its use has been limited because of the complexity of analysis and the problems involved in giving social weights to income and savings accruing to different income groups. It is therefore proposed that incorporation of these social considerations in the methodology for appraisal of Bank-assisted projects be deferred until a comprehensive assessment of application and practicability can be made. Meanwhile, it is proposed that the efficiency analysis be supplemented by a more detailed macroeconomic analysis and assessment of project impact on other socioeconomic objectives with particular reference to benefits to the poor or "target" groups.

II. OBJECTIVES AND APPROACH

A. Macroeconomic Analysis

3. Economic analysis of a project aims at determining whether that project is consistent with overall national and sectoral objectives and whether the investment proposed is the best means of achieving the intended objectives. Economic analysis involves a systematic evaluation of a range of options for
achieving a stated set of objectives. The framework adopted therefore depends on the set of policy objectives chosen.¹

4. While each developing member country (DMC) has its own socioeconomic priorities, all hold some major objectives in common. These include fulfilling the basic needs of all citizens, providing opportunities for gainful employment, and achieving both rapid and sustained economic growth and more equitable distribution of income. Governments adopt various policy instruments for pursuing these objectives, the most important of which relate to fiscal and monetary policy, and trade, investment, income and pricing policies. The purpose of macroeconomic analysis is to determine the importance and urgency of a project or program for which Bank support is sought in relation to national and sectoral objectives.

5. Allocating resources to a sector or specific purpose reduces the resources available for other sectors and purposes. Therefore, it is essential that the allocation of investment resources be efficient among sectors. Efficient allocation of scarce resources among the various sectors of the economy, taking into account linkages among them, is essential in achieving national objectives. For instance, continued investment in industry may not be appropriate without additional investment for increasing electric power supply, and additional sustained agricultural production may require additional investment in transport to move the increased agricultural output to markets.

6. The sectoral allocation and priorities of investment resources in different countries is governed by various factors such as the endowment of natural and human resources, the stage of development, and overall socioeconomic objectives and strategies. The main objective of macroeconomic project analysis as carried out by the Bank is to determine whether a proposed project is consistent with and to what extent it contributes to the achievement of the objectives and priorities stated in the country's national development program.

7. Macroeconomic appraisal of projects is carried out by the Bank when country programs are formulated. Sectoral justification is reconfirmed and elaborated during the project feasibility study and appraisal stages. Macroeconomic justification for a project should be provided in the background chapter and other relevant sections of each appraisal report. The background

¹ See Appendix 2, “Guidelines on Macroeconomic Priorities and Comparative Advantage of Bank-Assisted Projects".
chapter should describe the sector, subsector or industry to which the project relates and should assess the importance and urgency of the project to the national development program. It should assess the impact of the project on the achievement of sectoral objectives. If constraints exist in this regard, the measures proposed to remove them should also be described in the relevant sections of the report. A project may also have other effects such as those relating to foreign exchange earnings or savings and fiscal revenue; these should likewise be evaluated.

B. Analysis at the Project Level

8. Project analysis involves assessing technical, institutional (managerial and organizational), financial and economic viability. While these various aspects are interrelated and should be dealt with in the appraisal report, the present discussion focusses on various aspects of economic analysis.

9. Both financial and economic analysis of a project are closely related, and in Bank practice both involve, among others, the calculation of internal rates of return. Both types of analysis are conducted in monetary terms, the major difference lying in the definition of costs and benefits. Financial analysis evaluates the commercial viability of a project from the viewpoint of the project entity; that is, all expenditures incurred under the project and revenues resulting from it are taken into account. This form of analysis is necessary to assess the degree to which a project will generate revenues sufficient to meet its financial obligations, which is an important issue in financial planning.

10. Economic analysis attempts to assess the overall impact of a project in achieving the national economic objectives of the country concerned. This form of analysis thus assesses a project in the context of the national economy rather than the project entity. Economic analysis differs from financial analysis both in terms of identification and evaluation of inputs and outputs, and therefore in the composition of costs and benefits. The benefits from a project constitute the extent to which the end-product contributes to the achievement of national objectives. The costs reflect the degree to which the achievement of those objectives is sacrificed by diverting the resources required by the project from alternative uses. In the present context, the purpose of the analysis is to determine whether the project represents a means for increasing the net output of the country concerned. If the benefits of the project exceed the costs, the indication is that the project would make a positive net contribution to aggregate output.
If costs exceed benefits, such a project reduces welfare, and in the interest of the country concerned such a project should not be supported.

11. The projected financial cost and benefit streams may, where relevant, be taken as the starting point for economic analysis, though these streams must be adjusted to reflect true economic costs and benefits. For example, all payments for wages by the project entity are financial costs. The economic cost of wages could be substantially lower if there is considerable unemployment in the economy (see Section IV. D). Similarly, the tariff charged for power or rail transport may not reflect the economic cost of supply. A project may also involve an economic cost that does not involve a corresponding financial cost. For instance, a project may impose pollution abatement costs or urban development costs on society, but such costs will often not be reflected in the project accounts. "Shadow prices" are used to take into account all quantifiable effects of a project and thus its true economic costs and benefits. These prices are therefore likely to differ from the financial prices relating to the project.

12. A project affects the flow of income not merely in the project entity, but elsewhere in the system as well; e.g., in private households which provide labor, in enterprises which supply inputs, and in the government by way of changes in tax revenues. Many of the corrections to financial cost and benefit streams necessary to reflect true economic costs and benefits are adjustments that take into account the effects of a project on net income flows in the overall economy. These income flows are as real as the income flows to the project entity, and the "shadow prices" which take these into account are, in this sense, based on effects observed during project implementation.

C. Steps in Economic Analysis

13. The first step in the economic analysis of a project is identification of the need for the project. This involves analysis of demand including analysis of the quantity, quality and price of output of the project in relation to total demand and supply. It is particularly important to assess whether the project will lead to substantial changes in the prices of outputs and inputs.

14. The next step is to establish whether the proposed project is the least-cost or the most cost-effective way of attaining the project's objectives. This involves examination of alternatives to the project in terms of design, size, location, timing and technology. The interrelationship between the first two steps
is obvious: the demand analysis does not have much meaning without reference to cost and vice versa.

15. The final step is ascertaining whether the net benefits expected from the use of resources required by the project are in excess of, or at least equal to, the net benefits to the economy expected from the use of these resources in the next best available alternative project. This step applies only to projects for which most of the costs and benefits are quantifiable. In the "efficiency framework", this is usually done using cost-benefit analysis techniques.

16. Cost-benefit analysis involves a numerical comparison of costs and benefits, provided that both can be quantified. The economic costs of a project are relatively easy to quantify, except in cases where significant externalities such as environmental impact are involved. Even so, the costs of such effects should be quantified to the extent possible. If they cannot be quantified, their implications should be described and evaluated in qualitative terms.

17. The extent to which the economic benefits of a project can be quantified depends on the nature of the project. The benefits of projects in the agriculture and industrial sectors can usually be quantified, as there generally is a functioning market for their outputs. When most of the benefits cannot be quantified as in many social sector projects, those benefits that cannot be quantified should be explicitly identified as unquantifiable and evaluated in qualitative terms. For such projects, macroeconomic considerations and cost effectiveness in relation to assessed needs together with impact analysis should be the major focus of economic analysis.

18. As indicated earlier, since social equity aspects are not to be incorporated in cost-benefit calculations, the items listed below should be evaluated to the extent possible as a supplement to cost-benefit analysis.

(i) **Number of Major Beneficiaries.** The expected beneficiaries of the project should be identified by category, and an estimate made of their numbers, particularly for target groups. The target

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2 See Appendix 3, "Measurement of Economic Benefits."
3 The beneficiaries should be classified by income group and if appropriate by location, e.g., rural or urban, or whether the population lives within the Project area or in areas adjacent. In some cases, other criteria may be more appropriate and can be used.
groups should be clearly defined in the context of the country and not in the context of the project.

(ii) ***Proportion of Benefits to Target Groups.*** The proportion of the expected total benefits accruing to the target groups should be estimated if relevant.

(iii) ***Employment Creation.*** The number of full-time and part-time jobs measured in man-years expected to be created both during construction and during operation of the project should be estimated separately. If data are available, these estimates should be related to regional, sectoral and national levels of unemployment and underemployment. Where possible, the degree of labor intensiveness\(^4\) of the project should also be estimated.

If the project has additional significant economic or social effects, these should be described separately.

19. To ensure that a project results in maximum economic benefits, its various aspects such as scale, technology and institutional requirements and their appropriate mix should be evaluated when the feasibility of the project is being studied. However, the analysis of the options examined need not be as comprehensive as that of the project selected.

### III. IDENTIFICATION OF COSTS AND BENEFITS

A. General Approach

20. Cost-benefit analysis essentially involves three steps: (i) identification of the economic costs and benefits of a project, (ii) valuation of economic costs and benefits, and (iii) a comparison of costs and benefits.

21. In identifying the costs and benefits of a project, it is useful to start with a clear definition of the benefits expected from the project.\(^5\) In the case

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\(^4\) Defined as the number of workers employed per unit of investment or output relative to the sectoral and national averages.

\(^5\) See Appendix 3, "Measurement of Economic Benefits"
of industrial or agricultural projects, this is relatively straightforward since the major benefit is additional output of goods which are widely traded. In transportation projects, the benefit may be measured in terms of cost savings, and in public utility projects, in terms of the gain to consumers. In some social sector projects, benefits may be assessed only in qualitative terms. The benefits expected from a project will help define its costs. All costs incurred in realizing the benefits must be taken into account in the analysis, irrespective of whether they form a part of the financial cost of the project.

22. Economic analysis of projects must be based on incremental benefits and costs. This requires comparison of the situation that would prevail without the project and the situation with the project. This “with and without” comparison may not be the same as a “before and after” comparison. For example, it could be that the availability of the relevant inputs and outputs to the rest of the economy would change even without the project. Such expected changes should be taken into account in defining the “without project” situation.

23. The project accounts are based on streams of inputs and outputs and corresponding flows of costs and benefits. The accounts may not reflect fully all resources required for realizing the project benefits, or all the benefits to be realized due to the project. Thus, a distinction should be made between (i) the inclusion or exclusion in the cost-benefit analysis of certain types of inputs and outputs, and (ii) the valuation of these inputs and outputs. The modifications to the project accounts required with respect to (i) above are dealt with in this section. Those relating to (ii) are discussed in the next section.

B. System Costs

24. If a project is an integral part of a larger system, the expected benefits may not accrue if certain matching investments are not made in other parts of the system. For instance, the benefits from a power generation project may not materialize unless certain investments are made in transmission and distribution. A road project for a particular highway section may need complementary investments in other sections if the expected traffic flow or cost savings are to be realized. It is necessary to draw the boundaries of the project correctly so that all key investments are combined into a package. Then the total system cost necessary for realizing the expected benefits should be estimated. In such cases, the entire system should be evaluated on the assumption that the complementary investments will be made. If the system is economically viable, the
A project can also be considered as viable, provided that it is also the least-cost alternative for achieving the desired result.

C. Sunk Costs

25. A project may require the use of facilities in existence prior to appraisal of the project. The cost of such facilities are “sunk costs” and thus should not be included in the project cost, provided that these facilities have no alternative use, and their use in the project involves no opportunity cost.

26. In some cases, a project is part of a sequence of related investments. While a project that uses excess capacity created by an earlier project may well show high returns, such returns may also arise if a project is designed in a way that allows it to capture benefits originally expected from an earlier project. For instance, a rehabilitation and modernization project for an irrigation system may include as benefits yield increases expected from the original project. Hence, in all such cases it would be desirable to also indicate the net return on the entire project, including sunk costs, in order to show whether the original decision to provide the facilities was well founded.

D. Contingencies

27. While contingency allowances are determined by engineering and financial considerations, they also have implications for economic appraisal. In estimating project costs, both price and physical contingencies should be included. Since the economic rate of return of a project is measured in constant prices, provision for general price contingencies should be excluded from the economic cost of the project. However, price contingencies may include expected changes in the relative prices of project items. In that case, provisions should be made in the time profile of project costs or returns for the items whose relative prices are expected to change. Physical contingencies represent the monetary value of additional real resources that may be required beyond the base cost in order to complete the project. They should thus be treated as part of the economic cost of a project.

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6 See Appendix 10, “Guidelines for the Treatment of Price Changes in the Economic Analysis of Projects”.
E. Working Capital

28. Working capital is commonly defined in accounting and financial analysis as net current assets consisting of inventories, including goods in process, net receivables, marketable securities, bank balances and cash on hand. A certain amount of working capital is normally required to run project facilities created by investment in fixed assets. This requirement varies with the size and the nature of project and the institutional arrangements relating to the project. However, a certain minimum amount of working capital is necessary for efficient operation of a project, and that amount should be included in the financial cost of the project. For purposes of economic analysis, only inventories which constitute real claims on the nation's resources should be included in the economic cost of project. Other items which merely constitute financial transactions in the economy should not be included in the economic cost of the project.7

F. Transfer Payments

29. Some of the items included in the financial analysis of a project are not economic costs since they do not increase or decrease the availability of real resources to the rest of the economy. These items may, however, affect the distribution of financial costs and benefits between the project entity and other entities. Taxes, duties and subsidies are examples of transfer payments that should be excluded from the economic analysis of projects. To the extent that these are reflected in the unit financial prices of inputs and outputs, they should be excluded from the procedures for economic pricing discussed in the next section.

G. Depreciation

30. The financial accounts of a project include provision for depreciation on the basis of prevailing accounting practices. For purposes of economic analysis, the important factor is the stream of real investment required for realizing and maintaining project benefits at the assumed levels. Apart from the initial investment, this may require repairs, maintenance and replacement during the

7 See Appendix 9, "Guidelines on the Treatment of Working Capital in the Economic Analysis of Projects."
project's life. The time profile and magnitude of these expenditures does not generally coincide with the time profile of depreciation in the financial accounts of the project. Moreover, at the end of the project's life, the assets created may have some residual value, even though they may be fully depreciated in the financial accounts. Hence, economic analysis requires that depreciation provisions be excluded and that expenditures for repairs, maintenance and replacement and the salvage value of assets at the end of the project life be taken into account.

H. Depletion Premium

31. Many projects involve the exploitation of a non-renewable natural resource such as crude oil, natural gas or mineral deposits. The opportunity cost of using a natural resource must be taken into account in the economic analysis of such a project. Such resources cannot be replenished, and when depleted must be replaced by imports or domestic substitutes. The opportunity cost of using such a resource is therefore the cost of its substitutes when the resource is exhausted. The depletion premium or allowance is the economic price of using such a resource. It depends on the proportion of total reserves exploited during each year. The depletion premium should be added to the estimated cost of exploitation to arrive at the true economic cost of using the non-renewable resource.

I. Consumer Surplus

32. Consumer surplus arises when the output of a project leads to a reduction in the price of the output. A lower price results in a saving to consumers because of the difference between what they are willing to pay and what they actually pay. The benefit arises because of the project, but is not reflected in the project accounts. With an unchanged price, such a situation may also arise if the price is fixed below the demand price by the government or a government-controlled enterprise, as may well be the case for public utilities.

8 See Appendix 4, "Guidelines for Pricing Inputs and Outputs in the Economic Analysis of Projects."
33. The theoretical measure of consumer surplus is the difference between the price that consumers are willing to pay for any given quantity and what they actually pay. This can be measured if an estimate of the price elasticity of demand in the relevant range is available, but this is seldom the case. If such an estimate is available, it should be taken into account. If quantitative analysis is not possible, then qualitative assessment should be attempted.

J. Externalities

34. In several cases, project effects — positive or negative — go beyond the limits of the project, but are not reflected in the financial accounts of the project. If these effects, known as “externalities”, involve a significant economic cost or confer a significant economic benefit, these should be taken into account in estimating the overall economic impact of the project.

35. The external economic impact on the cost side may, for instance, include increased pollution resulting from a cement or a chemical plant, or the adverse effects of an irrigation scheme on health and fisheries. External economic benefits may include improved recreational or tourist facilities provided by a water storage dam. While it may not be possible to measure all such effects, an attempt should be made to identify them, and if they appear to be significant, to evaluate them. In some cases it may be helpful to “internalize” externalities by considering a package of closely related activities as one project. For instance, in the case of a cement or chemical project where technologies exist for reducing pollution, an effort should be made to include pollution-control facilities in the cost of the project.

IV. THE VALUATION OF ECONOMIC COSTS AND BENEFITS

A. General Considerations

36. After the costs and benefits of a project have been identified and the size of their flows over the life of the project established, they should be valued so that they can be aggregated and compared. The costs and benefits should be valued according to their economic prices, which in many cases will differ from their market prices.
37. Since the main objective of economic analysis is to assess the real contribution that a particular project is expected to make to the national economy, costs and benefits should be valued in constant prices, i.e., in terms of the prices prevailing in the year in which the project is appraised. Any expected change in the general price level during the life of the project should be disregarded, but anticipated changes in relative prices (e.g., a greater increase in the price of oil than in other products) must be taken into consideration since relative price variations reflect changes in the claims on real resources of the country.

38. Financial and economic profitability will coincide if market prices are equal to the marginal social cost of production (the supply price) and the marginal social value (the demand price) of all inputs and outputs. Decisions made on the basis of these prices ensure the most efficient allocation of resources. However, market prices do not always reflect social costs or social values because of a variety of market imperfections, taxes, subsidies and other interventions. For purposes of cost-benefit analysis, discrepancies between market prices and social costs or values should be taken as given, and policies that cause these discrepancies must be assumed as remaining effective. However, if there is evidence that these policies are likely to change, these changes should be taken into account.

39. Economic analysis of projects requires estimates of the marginal social cost or value of the inputs used and the outputs produced by a project. The following paragraphs suggest an approach for such valuation of costs and benefits. Special attention is given to the valuation of traded as well as non-traded commodities, the valuation of the services of labor, and the use of conversion factors for establishing correct relationships between the prices of traded and non-traded goods for purposes of estimating the rate of return of a project.

B. Economic Prices of Traded Goods and Services

40. It is necessary to make an initial distinction between goods and services traded internationally at the margin and those that are not. These are respectively referred to as "traded" and "non-traded" goods and services. The term "traded" means that the goods and services concerned are actually imported into or exported from the country, and are not subject to binding quantitative

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9 See Appendix 4, "Guidelines for Pricing Inputs and Outputs in the Economic Analysis of Projects."
restrictions such as import quotas or to prohibitive trade taxes (i.e., taxes that are so high as to prevent trade from occurring). All other goods and services are “non-traded”. The valuation of these two categories of goods and services is different.

41. In the case of traded goods it can usually be assumed that the country concerned can buy and sell such goods at prevailing prices. In this case, traded goods and services are valued at their “border prices,” i.e., net of any trade taxes or subsidies. These are the CIF prices in the case of imports and the FOB prices in the case of exports. The prices are calculated by using the official exchange rate and then are adjusted for local transport and distribution costs, though trade taxes or subsidies are not included in the prices used in economic analysis of projects.

42. Production or use of traded goods by a project generally does not affect border prices since the impact on global demand and supply may well be small. However, in cases where such an assumption is not justified and project inputs or outputs are likely to influence border prices, the marginal costs of the inputs or marginal revenues from the output should be used in valuing traded commodities. Changes in prices due to a project also affect the demand and supply of goods and services elsewhere in the economy. The effects of these changes in addition to their effect on foreign trade must also be taken into account in evaluating a project.

C. Economic Prices of Non-Traded Goods and Services

43. The valuation of non-traded goods and services tends to be more complex than the valuation of traded goods and services because production or use of non-traded goods in a project often affects domestic market prices of these and hence the use or production of these goods by other users or producers. The use of non-traded goods as project inputs may be met partly by reducing

10 Commodityes which are not at present traded but would be traded in the absence of government intervention are often classified as “tradeables”, especially when there is an active world market for them. It may therefore be a desirable additional exercise to evaluate them directly in terms of border prices in order to assess whether their production would withstand foreign competition in the absence of intervention.

11 See Appendix 4, "Guidelines for Pricing Inputs and Outputs in the Economic Analysis of Projects."
domestic consumption of these goods and partly by increasing domestic production. If the use of a non-traded input by the project affects only the amount of use by others, the input's economic price should be derived from its marginal value to users (its demand price). If the project affects only the level of production, then the economic cost should be derived from the input's marginal cost of production (its supply price). If the project affects both production of the input and use by others, then the economic price of the input should be derived from the weighted average of the demand and supply prices, using the shares of production and use by others as weights.

44. In most cases, the supply price or cost of production is used in the valuation of non-traded goods and services. However, it should be noted that there are several cases in which the price of non-traded goods and services departs significantly from its marginal cost. For example, peak load power or power supply to rural areas may be priced well below marginal cost, railway tariffs may not fully reflect the transportation costs of goods either by commodity type or by destination, and road transport rates may not reflect the costs of highway development and maintenance. It is necessary that such discrepancies between price and marginal cost be taken into account in the valuation of non-traded goods and services.

D. Shadow Wage Rate

45. Among non-traded goods and services, labor is the single most important component. Hence, an appropriate procedure for the valuation of labor is important for economic analysis of projects. Since the objective is the maximization of net output or income, the extent to which labor use affects project costs or results in loss of output elsewhere in the economy must be assessed.

46. Project accounts are determined on the basis of prevailing market wage rates for the various categories of labor. In general, the market wage for a particular category of labor determines the level of employment for that category of labor. If the prevailing market wage is higher than the supply price of a particular category of labor, then there will be some unemployment for that type of labor. In such a situation, the additional demand for labor for the project will be met, at least partly, by a reduction in unemployment and, to that extent, there will be no loss in output elsewhere in the economy. Hence

12 See Appendix 5, "Guidelines for Determining the Economic Price of Labor."
the appropriate valuation for such unemployed labor will be the supply price which, by assumption, will be lower than the market wage rate.

47. The additional demand for labor in one sector may be met by workers from another sector. Analysis of the impact of additional labor demand through interlinked labor markets is required to identify sectors in which the adjustments will take place. The existence or absence of surplus labor in these sectors determines the nature of adjustments to labor costs required for economic analysis.

48. Even in countries with high rates of unemployment or underemployment, it is unrealistic to assume that labor is available at a wage close to zero, since at a very low wage, many people prefer leisure to employment. The supply price of labor depends on several factors including household income, the value placed on leisure and other non-wage activities, and the nature of employment vis-a-vis income and other benefits accruing from employment. Thus, it would be simplistic analysis to ignore the supply price altogether in estimating the economic price of labor, and it is reasonable to assume that the shadow wage rate is considerably higher than that indicated by narrow application of the opportunity cost principle.

49. Although labor is of many types and grades, for purposes of analysis, labor required for a project may be divided into the three categories of skilled, semi-skilled and unskilled. Since the level of remuneration for the three types varies, each category of labor should be treated separately when establishing shadow prices.

50. The market for skilled labor is generally competitive and such skills are often in short supply. The market wage for such workers should therefore be assumed to be the value of output forgone at market prices for this type of labor. The market wage should include, in addition to the basic wage, allowances, social security contributions and other benefits.

51. Semi-skilled and unskilled labor is employed in both the formal, or "protected" sector, where wages are regulated by the government, and in the informal, or "unprotected" sector, where regulations do not apply. The supply price of labor in these two categories is assumed to be equal to the market wage rate in the informal or "unprotected" sector, the reason being that even if a new job created by a project is filled directly by a worker drawn from the formal sector — which means he is paid at the market wage rate — the vacancy created in the formal sector will be filled by a worker, employed or unemployed, from
the informal sector. The net loss of output for the society is thus the marginal product of a worker in the informal sector, i.e., the informal sector wage.

52. The supply of semi-skilled labor relative to demand is likely to vary from country to country. If there is a clear evidence of oversupply, then the "unprotected" wage should be adjusted downward, taking into account the extent of unemployment in the relevant skills, but not below the "unprotected" wage for the unskilled labor, since the semi-skilled workers have a competitive edge over unskilled workers in finding unskilled jobs.

53. With regard to unskilled labor, many developing countries have high levels of unemployment or underemployment in both urban and rural areas. In determining the value of unskilled labor in such cases, the "unprotected" wage should be the starting point. Adjustments should then be made to account for the extent of unemployment or underemployment in the country, particularly in the project area, at the same time taking into account the "reservation" wage below which people in the area may be unwilling to offer their labor as wage-earners.

54. The economic price of labor in urban areas is likely to be higher than in rural areas and also to vary from region to region. Such differences arise in part because labor must be compensated for migrating from one place to another. In determining the economic price of labor, both the level of skills required and the location of the project should be taken into account.

E. Conversion Factors

55. The previous sections of this chapter have dealt with the valuation of traded and non-traded commodities and labor. According to the procedure suggested, traded goods should be valued in terms of border prices, and non-traded goods and labor in terms of opportunity costs valued in domestic prices. There remains the task of bringing the two sets of prices into correct alignment. Two approaches are possible in this regard. The first is the shadow exchange rate approach, which converts the border prices of traded inputs and outputs into their domestic price equivalents. The second is the conversion factor approach, which is used to convert the domestic prices of non-traded goods

13 See Appendix 6, "Guidelines for the Use of Conversion Factors in the Economic Analysis of Projects."
and labor into their border price equivalents. The advantage of the conversion factor approach is that it takes into account distortions in the pricing of non-traded inputs and outputs that are specific to the project. Since in Bank projects most of the outputs and a large proportion of inputs are traded, the use of conversion factors yields more reliable results than the alternative approach. It may be noted that the shadow exchange rate and the conversion factors are not meant to reflect balance of payments disequilibria; they only reflect differences between border prices and domestic market prices which may be present even when the balance of payments is in equilibrium.

56. The non-traded inputs used or produced by a project have an impact on production and consumption. The conversion of the domestic prices of non-traded goods into equivalent border prices can be based on an analysis of this impact. Conversion factors are defined for specific commodities or groups of commodities and provide a means of estimating border prices which is founded on such an analysis.

57. Generally, the non-traded inputs required by a project will be met by increased production, in which case the appropriate valuation will be the supply price. The conversion factor for converting this supply price into the equivalent border price is the "supply price conversion factor" (SPCF). When a project produces a non-traded output, the impact will generally take the form of increased consumption of the non-traded output. In such a case, the appropriate valuation is the demand-price, i.e., the price that consumers are willing to pay. The conversion factor for converting this demand price into the equivalent border price is the "demand price conversion factor" (DPCF). When the project affects both production and consumption of the non-traded good, weighted average of the SPCF and DPCF should be used, the weights being the shares of production and consumption in the total output due to the project.

58. The supply price conversion factor incorporates all of the adjustments required to ensure that (i) domestically produced goods are valued at marginal social cost, and (ii) that this marginal social cost is estimated at appropriate shadow prices for inputs. The first step in estimating the SPCF is analysis of the costs of production of the commodity concerned. These costs involve both traded and non-traded inputs. The traded inputs can be directly valued at border prices, labor at the shadow wage rate, and the non-traded inputs decomposed and analyzed in terms of their costs of production. In most cases, no more than three rounds of decomposition of the non-traded inputs is required to arrive at an acceptable approximation.
59. Demand price conversion factors are to be used whenever a project leads to a change in domestic consumption; this is generally the case in the valuation of non-traded outputs. The demand price, or the price that consumers are willing to pay, is related to the prices and quantities of substitutes and complements consumed. Changes in the quantities of substitutes and complements consumed should thus be determined and their amounts valued at border prices. The demand price conversion factor is an approximation that incorporates this correction. For instance, in the case of a power project, electricity output may replace petroleum products or coal, which are close substitutes. In the case of a railway project, the output replaced may be road transport. A demand price conversion factor reflects the value of a non-traded output in terms of the border prices of the commodities it replaces.

60. When evaluating the benefits and costs of a project, it is sometimes convenient or necessary to use data that aggregates project inputs or outputs into groups such as the “costs of domestic machinery”, “civil construction”, “transport and distribution margins” or, for the shadow wage calculation, “the value of agricultural output forgone”. In such cases, group conversion factors (GCF) may be used.

61. Group conversion factors are defined as weighted averages of individual commodity conversion factors for a set of commodities. For instance, the group conversion factor for civil construction may be a weighted average of the conversion factors for steel, cement, bricks, skilled and unskilled labor. Group conversion factors are approximations and may be calculated for general use for any magnitude on the benefit or cost side when the analysis in terms of specific commodities is difficult or time-consuming. Calculation of group conversion factors requires (i) an estimate of the conversion factors for the component commodities, and (ii) a set of weights for aggregation. Foreign trade and border tax data and similar sources can provide information for the estimation of conversion factors for component commodities, and data for the weights can be obtained from general statistical sources such as consumer expenditure surveys, crop production statistics, and censuses of manufacturing.

62. There are some items for which a group conversion factor cannot be readily estimated. In such cases, use can be made of a standard conversion factor (SCF) which is a weighted average of the commodity conversion factors for all commodities produced or consumed in an economy.

63. In certain situations, commodity-specific or group conversion factors
may not be available for an item. In such cases, the following procedure should
be followed. First, correct any underpricing or overpricing of the critical non-
traded inputs relative to marginal cost. Second, segregate the principal traded
inputs used to produce the critical non-traded outputs and value them at border
prices. An SCF can then be used to convert the residual non-traded element
into an equivalent value in border prices. This procedure captures most of the
adjustment required for the inputs.

64. If an SCF is used to convert the entire cost of non-traded output valued
at market prices, the approach is equivalent to using a shadow exchange rate
(SER). The only difference is that use of an SCF converts all values of non-
traded inputs and outputs into their border price equivalents, and use of an
SER expresses the values of traded inputs and outputs in terms of domestic prices.
This does not affect project rankings in terms of desirability or calculations.
However, if commodity-specific conversion factors are used in making any of
the adjustments, the two approaches are not equivalent, except in the unlikely
event that all conversion factors are exactly equal to the SCF. The real advan-
tage of the conversion factor approach is its more thorough treatment of non-
traded inputs and outputs.

65. Conversion factors are basically meant to be used for converting the
domestic prices of non-traded outputs into their border price equivalents. While
traded goods can be valued directly in terms of border prices, since the conver-
sion factors for non-traded outputs are derived from the conversion factors of
substitute and complement goods, conversion factors for traded goods are also
necessary. Conversion factors are also useful in estimating group conversion fac-
tors for both inputs and outputs. Finally, even though traded goods can be
border-priced directly, it is convenient to have a complete set of conversion factors
for commonly encountered project inputs and outputs.

V. COMPARING COSTS AND BENEFITS:
INVESTMENT CRITERIA

A. Techniques for Comparison

66. Having identified and valued the costs and benefits of a project, the
next step is to compare the two streams in order to determine whether the proj-
ect would result in an efficient use of resources from an economic point of view. A project must satisfy at least two conditions in order to be acceptable for investment. First, it must yield benefits in excess of costs over its life. Second, the net benefit must be larger than, or at least as large as that resulting from the next best alternative project. Three devices are commonly used for comparing cost and benefit streams in arriving at investment decisions:

(i) the economic internal rate of return (EIRR), which is the rate of discount at which the cost and benefit streams over the life of the project are equalized;

(ii) the cost benefit ratio (CBR), which compares the present values of the cost and benefit streams by discounting them at a rate equal to the opportunity cost (or economic price) of capital; and

(iii) the net present value (NPV), which is the difference between the present values of the cost and benefit streams of a project which have been discounted at a rate equal to the opportunity cost of capital.

67. While both the NPV and the CBR have the disadvantage that they require assumptions regarding the opportunity cost of capital over a fairly distant time horizon, the CBR is less commonly used because of its high degree of sensitivity to the way costs and benefits are classified. That is, by grouping costs and benefits differently, the cost-benefit ratio for the same project can change substantially. Since there is no fixed rule for grouping the costs and benefits of a project, it is important to clearly state the grouping of the discounted values of costs and benefits of the project when this method is used. Despite its shortcomings, the CBR is a useful supplement to other methods, especially when evaluating a project that requires little or no fixed investment and which is short-lived and quick-maturing, such as a program loan.

68. The NPV and EIRR are the two techniques most frequently used in investment decision making. The NPV technique is particularly useful when an array of projects is to be financed from a fixed amount of money. If the opportunity cost of capital is known, the NPV method helps identify projects that will maximize output or national welfare. However, the NPV requires the use of a discount rate, and a change in this discount rate can change the ranking of projects. Moreover, since NPV is an absolute magnitude, the size of the project is an important determinant, whereas in EIRR calculations, the size
of the project is of much less significance. On the other hand, the EIRR is not always unique (e.g., where the net benefit stream changes sign more than once) and is not definable for certain cases (e.g., where benefits exceed costs for all years). But these pose no practical handicap in using the EIRR technique.

B. Economic Internal Rate of Return

69. It has been standard Bank practice to use the EIRR for the economic analysis of projects. The major advantages of EIRR over the other two techniques are that it does not require preselection of a discount rate and that it provides a single measure of the return of the project and allows a ready comparison among projects. However, the EIRR should be supplemented by other techniques when warranted.

70. A project is generally considered to be economically viable if its EIRR exceeds the economic or opportunity cost of capital (OCC) in the country concerned, though it is difficult to estimate with much precision the opportunity cost of capital or the investment rate of interest for most countries. Domestic interest rates are not of much relevance in this respect. Capital markets in most developing member countries are highly imperfect and fragmented, and are often distorted by government interest rate policies. Moreover, there are difficult conceptual and practical problems in translating a market interest rate into the OCC in terms of efficiency prices. In Bank practice, 10-12 per cent has been accepted as the EIRR cut-off point: a project whose EIRR is less than 10 per cent may be supported only if there is strong socioeconomic justification for it, and this should be fully described.

71. Cost minimization is an essential step in maximizing a project’s EIRR. This should therefore be done for each alternative project before ranking projects for an investment decision. Options usually exist for cost minimization in terms of design, technique, location or timing. A discount rate that equalizes the costs of alternative options, known as the equalizing discount rate (EDR), is often calculated as a means of comparing the cost effectiveness of the options. However, identifying the least-cost option is in no way tantamount to demonstrating economic viability for a project. This is because even for the least-cost option, costs may exceed benefits, implying a negative rate of return for the project. Therefore, project analysis must go beyond least-cost analysis, if possible, and consideration must be given to whether benefits exceed costs by an acceptable margin. Except for projects for which most of the benefits
cannot be identified and valued, e.g., loans to development banks and for social sector projects, all other projects must include EIRR calculations in the appraisal report, in addition to identifying the least-cost option.

72. Many projects consist of a number of interdependent components. For these, the links between components should be firmly established in the description of the project. The EIRR is normally estimated for the project as a whole, and where a particular component is excluded in estimating the EIRR, justification for doing so should be given. For projects that consist of independent components, the EIRR should also be estimated for each component.

C. Sensitivity Analysis

73. The EIRR for Bank projects is calculated using the most probable values of the parameters in the cost and benefit streams of a project. The values of the parameters, such as quantities and prices of inputs and outputs, can change over the life of the project for a variety of reasons, and these changes are difficult to predict. The effects of possible changes in these variables on the EIRR must therefore be assessed. If warranted, safeguards should be built into the project to minimize possible adverse effects on the project's viability.

74. A simple method of assessing possible adverse effects is the sensitivity test. The sensitivity test indicates how a possible change in events may affect a project's economic viability. The analysis entails changing the values of key variables and ascertaining how such changes affect the EIRR relative to the values adopted in the base case. A sensitivity indicator (SI) measures the sensitivity of the EIRR to changes in a key variable. The results of the analysis help determine where more effort is needed to narrow the range of uncertainty, to firm up estimates, or identify aspects that may require close attention during project implementation and operation.

75. In practice, it is neither possible nor desirable to examine the effects on the EIRR of all possible changes in project variables. Attention must be focussed on key project variables: (i) quantities and prices of project outputs, (ii) quantities and prices of project inputs, (iii) capacity utilization, and (iv) the time-frame for project implementation. The project analyst should also

determine the impact on project viability of combinations of adverse events. Sensitivity analysis, including calculation of sensitivity indicators, is standard procedure in project analysis.

D. Project Risks

76. After carrying out the sensitivity analysis, the next step is assessing project risks and considering measures for minimizing them. It is neither possible nor desirable to identify and examine in detail all the possible risks associated with a project. However, risks which entail major economic consequences should be identified using the results of sensitivity analysis.

77. Particular attention should be paid to factors or events that would severely affect project implementation or would substantially reduce the project's economic viability. In this context, both the base case EIRR and the sensitivity indicators are relevant. Some projects are more prone to certain types of risks than others. For example, an agricultural project oriented toward export promotion would be more subject to the risk of price fluctuation than one oriented toward domestic consumption. If a high degree of risk is apparent from the results of the sensitivity analysis, the appraisal report should explain the measures proposed to minimize the risk.

78. Risks are inherently greater in projects for which the base case EIRR is only marginally greater than the opportunity cost of capital. This is particularly so if major variables are highly sensitive to adverse changes because even a relatively small change in one variable could render the project unviable. Even if most variables are not very sensitive to such changes, a combination of changes could adversely affect the economic viability of the project. In such cases, the discussion of the risk faced and the measures taken for reducing them should be comprehensive, and the remedial actions proposed should be fully explained.

79. For projects that are known to have high risks, it is desirable to supplement the sensitivity analysis with a probability analysis of the values that each variable may take, since doing so attaches numerical values to the probable outcomes. However, due to the considerable work involved in probability analysis of risks, it is undertaken only for projects carrying a high degree of risk or for large projects where miscalculations could lead to a major loss to the economy.

15 See Appendix 8, "Project Risks."
APPENDIXES

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Appendix 1

FORMAT FOR THE CHAPTER ON ECONOMIC AND FINANCIAL EVALUATION OF PROJECTS IN APPRAISAL REPORTS
FORMAT FOR THE CHAPTER ON ECONOMIC AND FINANCIAL EVALUATION OF PROJECTS IN APPRAISAL REPORTS

I. Introduction

1. This appendix presents a format to be followed in the preparation of the appraisal report chapter on financial and economic evaluation of a loan project. It is hoped that this format will help ensure full coverage of all relevant aspects, bring about consistency in presentation and logical sequencing of the items to be covered, and minimize repetition. The format outlined in paras. 3-8 below relates to projects that are expected to have widespread benefits — quantified as well as non-quantified — and for which the financial internal rate of return (FIRR) or economic internal rate of return (EIRR) is estimated. For projects for which both the FIRR and EIRR are calculated, the discussion on the FIRR and its sensitivity analysis should precede that of the EIRR and its sensitivity analysis. For projects having a relatively limited scope and for which quantification of benefits is not possible, only the relevant sections (i.e., A, B and E) of the format apply.

2. While the general structure of the format should not be altered, there may be variations within each main section (e.g., section B, para. 5) in the sequence of the aspects discussed. Any rearrangement of the material should reflect the relative importance and interrelationships of the items covered.

II. The Format

3. The chapter consists of five main sections: Objectives, Benefits and Beneficiaries, Financial or Economic Internal Rate of Return, Sensitivity

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2 The format outlined here applies to all loan project appraisal reports except those for development finance institutions.
Analysis, and Project Risks. In appraisal reports of projects for which benefits cannot be quantified, the sections concerned, e.g., FIRR/EIRR and Sensitivity Analysis, will be omitted.

A. Objectives

4. This section should describe in one or two paragraphs the relevance of the project to the country's macroeconomic and sectoral objectives (financial and economic) and how the project is expected to help in achieving those objectives. For instance, in an irrigation project, the discussion may include increased production of a food crop to achieve national self-sufficiency as well as resultant savings in foreign exchange. In a health and family planning project it may cover the extension of health services in rural areas, special attention to maternal and child health care and reduction in population growth.

B. Benefits and Beneficiaries

5. All project benefits, both primary and secondary, should be described in this section. The following outline is relevant to projects with widespread benefits, both quantifiable and non-quantifiable (e.g., rural development projects). All items listed below may not be applicable to some projects. For instance, in education projects, items (i) and (v) are not relevant. While all project benefits are covered by items (i) and (ii), items (iii) to (v) deal with certain aspects of those benefits that merit separate discussion.

(i) Quantified Benefits: This subsection on project benefits begins, where appropriate, with quantifiable benefits. This includes information such as that on increases in food production, the output of natural gas, electricity generation, and the supply of potable water.

(ii) Non-Quantified Benefits: As far as possible, all non-quantified benefits are identified and described in this subsection. This includes all benefits (positive or negative) to which monetary values cannot be attached. If the project has any externalities such as positive or
negative environmental impacts, these may also be described here. The project's contribution to institution building should also be discussed in this subsection.

(iii) **Impact on Beneficiaries:** This subsection describes the gains likely to accrue to the various income groups of project beneficiaries. Such information should normally be provided for projects for which data are available on incomes or ownership patterns (e.g., size of holdings) of beneficiaries, generally discussed in the background chapter of the appraisal report.

(iv) **Employment Implications:** This subsection describes the employment impact of the project. Separate estimates should be given for additional employment due to the construction and subsequent stages of the project.

(v) **Foreign Exchange Impact:** Where relevant, such as in agricultural or gas production projects, the net foreign exchange benefit resulting from the project, either from import substitution or increases in exports, is estimated here.

(vi) **Other Benefits:** If a project has benefits other than those listed above, these are described at the end of this sub-section.

C. **Financial or Economic Internal Rate of Return**

6. This section gives estimates of the FIRR or EIRR — the financial or

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3 A detailed discussion of the environmental implications of the project should be provided in the project chapter. Here the discussion should include only the positive or negative economic impacts of the environmental aspects of the project.

4 If both the FIRR and EIRR are estimated, the discussion of each measure and its corresponding sensitivity analysis should be separate. The discussion of the EIRR should follow that of the FIRR. For projects justified on the basis of other criteria such as the least-cost solution, equalizing discount rate, or benefit-cost ratio, the heading for this section should reflect the nature of the analysis provided for justifying the project.
economic internal rate of return of the project over its life. A brief description should be given regarding the procedure by which the estimates were arrived at and the underlying assumptions used in calculating the EIRR or FIRR (or other measures). Cross-references to the appropriate appendixes should be given. Such analysis only relates to projects for which it is possible to ascribe a monetary value to project benefits.

D. Sensitivity Analysis

7. This section should discuss the sensitivity analysis of the project for which FIRR or EIRR is estimated. The discussion should focus on sensitivity indicators and the viability of the project. The positive (+) or negative (-) signs should not be attached to the sensitivity indicators presented in tables.

E. Project Risks

8. The final section should deal with project risks. The risks discussed should essentially be economic risks, though major physical or technical risks (e.g., in gas production and dam construction) and institutional risks should also be mentioned. The sensitivity analysis for projects having quantified rates of return (FIRR or EIRR) serves as a useful basis for describing project risks. In appraisal reports of projects for which benefits cannot be quantified, the risks in achieving the objectives of the project should be identified and discussed. This discussion should include both the costs and benefits of the project and the measures proposed for minimizing these risks.

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5 See Appendix 7, "Guidelines for Sensitivity Analysis in the Economic Analysis of Projects."
6 See Appendix 8, "Project Risks."
Appendix 2

GUIDELINES ON MACROECONOMIC PRIORITIES AND
COMPARATIVE ADVANTAGE OF BANK-ASSISTED PROJECTS
GUIDELINES ON MACROECONOMIC PRIORITIES AND COMPARATIVE ADVANTAGE OF BANK-ASSISTED PROJECTS

1. The purpose of this appendix is to provide guidelines to operations managers, project managers and mission leaders for the evaluation of macroeconomic priorities and comparative advantage of projects assisted by the Bank. It is essential that these aspects be fully considered in the selection and appraisal of projects to be financed by the Bank.

2. The macroeconomic priorities and comparative advantage of Bank-assisted projects must be considered at two distinct stages: (i) determination of the country programs, and (ii) formulation and appraisal of a project. The considerations relevant at these two stages are different and are briefly discussed below.

A. Determination of Country Program

3. The Country Program Paper is the main document in which macroeconomic aspects (including Bank priorities), which form the basis for selection of Bank-assisted projects, should be considered. The rationale of the projects selected should be fully explained and submitted for consideration and decision by the Management. The size and composition of the Bank's lending program for the country concerned must emerge from a thorough examination and analysis of the following three key considerations.

1. Country Development Objectives and Performance

4. This section should interpret the basic political, economic and social trends in the country and identify the government's long-term socioeconomic objectives and their relationships with the main socioeconomic problems and develop-
ment needs. The section should assess the development objectives, the extent of government commitment to them, and the effectiveness with which they are pursued. In this context, a review should be made of the country’s overall development strategy, as well as specific development targets. The constraints affecting these targets, the policy measures and resources needed to overcome these constraints, and the prospect of meeting the necessary requirements should be examined.

2. **External Resources**

5. This section should examine the external resource requirements and capital inflows from bilateral, multilateral and private sources in recent years, projections for the coming years, trends by terms and types of inflows, and evaluation of the country’s creditworthiness on the basis of various economic and financial indicators. Where the country has prepared projections of external resource requirements as part of its development plan, these projections should be carefully examined and their reasonableness assessed. The section should also include a discussion of technical assistance needs and other donors’ programs.

3. **Bank Strategy and Priorities**

6. This section should present the Bank’s strategy and priorities for assisting development in the country on the basis of the discussion and evaluation contained in the preceding sections, taking into account the resource position of the Bank. The section should begin by listing the Bank’s country and sector assistance goals and then discuss these goals in terms of their implications for the socioeconomic issues in (1) above, describe the rationale of the proposed sectoral allocation of assistance, indicate the extent to which the proposed combination of assistance responds to aggregate needs for foreign exchange, technological and institutional requirements, and appraise the relationship of the proposed program to any specific assistance request made by the Government. Any significant changes proposed in the size or sector content of the lending program (compared with those previously approved) should be highlighted and justified. The relationship between the country strategy and overall development policies on which the Bank places emphasis (e.g., greater domestic production of foodgrains and proteins, rural development for enhancing income
of the poor, diversification and increase in exports) should be emphasized. In this context, increasing notice will hereafter have to be taken of such social objectives as public health, population control and protection of the environment. The section should also deal with the blend of ordinary capital and ADF resources, program lending, and local currency financing with appropriate justifications. Where ADF loans are blended with ordinary loans, the ADF loans should be provided, as far as possible, for projects whose benefits are widely distributed. The program for the first year should be as definitive as possible, while that for the next two years should allow for greater flexibility.

7. The rationale of the specific project in the overall or sectoral context should be provided briefly in the Report and Recommendation of the President when submitted for Board consideration and approval.

B. Formulation and Appraisal of a Project

8. While the country program paper is intended to discuss the macroeconomic considerations that form the basis of the Bank's country lending program and its composition by sectors and projects, a detailed justification of a project must be provided in the related appraisal report. However, to do so, it is essential that all data and information relevant to this purpose be available. Therefore, where the Bank provides technical assistance for the preparation of a feasibility study, Bank staff should ensure that the terms of reference for consultant services cover the economic aspects essential to justify the project at the appraisal stage. The important issues that should be discussed in all appraisal reports in justifying the priority and the soundness of the project may be considered under the following two broad aspects:

1. The Sector and the Project

9. The appraisal report should not merely describe the sector, subsector or industry to which the project belongs, but should assess and relate the project's importance to the socioeconomic development of the country. Where the direct impact of the sector, subsector or industry in overall national output and income is not large in relation to its investment (e.g., power and some heavy industries
such as cement and steel), its indirect impact in promoting economic growth should be adequately discussed.

10. The chapter on the project should include a discussion of the following aspects:

(i) The scale of the project should be adequately justified. Wherever relevant, the implications of alternative sizes should be examined in terms of investment, unit costs, employment, technology, pollution and transport access.

(ii) With respect to projects that could normally attract private sources of finance, the report should provide information on whether (and the extent to which) alternative sources of financing are available on reasonable terms.

(iii) The estimated cost of production of the output from the proposed project compared with cost of imports must be shown, if applicable. Special justification should be provided for the proposed project in circumstances where (a) an alternative size would have reduced the unit cost of production; and (b) the unit cost of imports of the product concerned is lower than the unit cost of the product from the project.

2. Economic and Financial Justification

11. The economic and financial rates of return are the most important indicators of the economic viability and financial soundness of a project. While the financial rate of return (FIRR) gives a measure of "private" return, the economic rate of return (EIRR) gives a measure of the return to the society. Given alternatives in the scope of a project, that which yields the highest EIRR should normally be selected. In Bank practice, 10-12 per cent has been accepted as the EIRR cut-off point. A project whose EIRR is less than 10 per cent may be supported only if there are strong justifications in terms of other socioeconomic considerations, which should be adequately described. This will ensure that the project would satisfy the objectives and priorities of socioeconomic development and reflect efficient allocation of resources.
Appendix 3
MEASUREMENT OF ECONOMIC BENEFITS
MEASUREMENT OF ECONOMIC BENEFITS

A. Background

1. The purpose of this appendix is to briefly describe the different approaches used by the Bank in the economic evaluation of projects in various sectors. A rough classification of projects is presented in order to highlight the different situations that are commonly encountered in each sector. The appendix also explains that while a consistent approach to project evaluation may be employed, the actual presentation of the economic analysis must take very different forms for each of the sectors, primarily because of variations in the nature of project benefits and in the objectivity and adequacy of information about them.

2. There are a number of general problems in project evaluation that apply in some degree to all sectors. In a sense, these problems can be seen as part of the data availability problem and include the difficulty of determining the appropriate shadow prices to be used in project evaluation and in the treatment of uncertainty and risk. Other issues, whether explicitly considered or not, that are invariably associated with investment decisions include the evaluation of intangible costs and benefits, externalities, and considerations of social equity, including income distribution. Where quantification of such effects is not possible, efforts should at least be made to describe them in qualitative terms.

3. The economic evaluation generally used for Bank projects is primarily based upon conventional cost-benefit analysis and is normally presented in terms of the economic internal rate of return (EIRR), which is the discount rate that equates the present worth of the costs and benefits that are expected to result from a project. Since cost-benefit analysis rests essentially upon monetary values, the presence of a freely operating market on both the cost and benefit sides of the calculation clearly facilitates estimation. For this reason, it is convenient to categorize projects financed by the Bank in terms of the extent to which market tests can be used to assist project evaluation. Based on this criterion, a categorization of projects ranked in terms of the ease with which standard cost-benefit analysis can be employed is as follows: (i) industrial and agricultural projects,

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Appendix 3
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(ii) transportation projects, (iii) public utility projects, and (iv) social projects. The special difficulties associated with multi-purpose projects (including rural and urban development schemes) are not addressed here, it only being necessary to say that for such projects an EIRR should ideally be calculated not only for the whole project, but also for each subproject and alternative combination of subprojects in order to optimize the scope and composition of the multipurpose investment.

B. Measurement of Benefits in the Various Sectors

1. Industrial and Agricultural Projects

4. Identification and measurement of the economic benefits of industrial and agricultural projects are generally more straightforward than in other sectors. The essential characteristic of typical industrial and agricultural projects is that there is a functioning market for project outputs, which form a relatively small addition to the total supply of the commodities in question. Thus, the benefits of an industrial plant producing fertilizer may be based upon international prices since this is an internationally traded commodity and may be valued either in terms of import substitution or of export earnings. Similar considerations apply to the increased production resulting from agricultural projects such as irrigation.

5. Problems arise, however, when for one reason or another the market works imperfectly. For example, where government intervention takes the form of protective import duties for industrial commodities or subsidization of agricultural products in order to assure access to basic nutritional needs of lower income groups, the observed willingness of domestic consumers to pay for such commodities — the market test — tends to understate the benefits of project outputs as perceived by the subsidizing authority. In these circumstances, the cost-benefit calculation should incorporate an analysis of the consequences of such intervention. The data provided by observed willingness to pay for project outputs should ideally be supplemented by estimates of the impact of protective duties on industrial growth or of the health impact of food subsidies. It is clear that such estimates are considerably more subjective than those based upon market information.
6. The general approach used in the analysis of most transportation projects is that benefits are evaluated in terms of the cost savings that result from the improved infrastructure. It is important to note that it is legitimate to use cost savings only as a measure of benefits when those costs would have been otherwise incurred by users. The least-cost alternative transportation project is not an adequate indicator of the benefits of the project selected, although this comparison is an essential component of the economic justification procedure.

7. In the case of highway projects, ideally a distinction should be drawn between the benefits accruing to the traffic that would exist in the absence of the project on one hand, and to the traffic that will be generated as a result of the project on the other. In the former case, cost savings are an adequate measure of benefits, but evaluation of the benefits to generated traffic requires estimates of the value of the additional traffic itself. Estimates of the economic value of highway projects therefore normally consist of two elements: one that can be established quite accurately, and one much more difficult to predict.

8. Similar problems are encountered in evaluating port and airport projects. To some extent, a cost-saving approach can be used as a partial measure of port benefits, reduction in ship turnaround time often being a critical element, but difficult problems of evaluation arise where such savings form a relatively small proportion of project benefits and where the major effect is to generate or permit additional economic activity in a region. Airport projects are equally difficult to evaluate though various measures of benefits, including revenues obtained from foreign airlines and from tourism, have been used. Alternative port or airport designs and locations should, of course, be considered, but the implied cost savings can only be taken as a measure of benefit if creation of the additional facilities is inevitable. However, when, for instance, port or airport facilities are a necessary complement to a number of industrial and other investments, the implied cost saving is, strictly speaking, not an objective measure of economic benefits. In the case of ports and airports, special problems also occur due to the fact that the benefits of the project may in fact accrue not to the country in which the investment takes place but to foreign shipping and airline operators. In this case, analyses of market conditions should ideally be
conducted to allow a judgement to be made as to the extent to which the benefits of the project will flow back to the country in which the project is located.

3. Public Utility Projects

9. Public utility projects such as water supply and electric power are in a situation very different from that of industrial and agricultural projects. In contrast to the latter, water and electric power supply projects normally operate in a restricted market environment in which, mainly because of economies of scale and the need to avoid duplication of facilities, it is appropriate for the services to be provided by a local monopoly. In the case of typical industrial and agricultural projects, the demand for project outputs tends to be elastic, with market prices of outputs providing a fairly good estimate of economic values. In the case of water and power projects, the reverse is normally true: the revenues obtained from sales of water or electric power may be a significant underestimation of the economic benefits thereby derived, due mainly to the presence of a large "consumer surplus".

10. With the possible exception of simple rural electrification schemes in which cost savings can be used (as in transportation projects) as a partial measure,\(^2\) full quantification of project benefits in these sectors is virtually impossible. In practice, the only way in which a judgment can be made about the justification of system expansion in the water or power fields is by observation of consumers' willingness to pay for incremental output. This in turn requires that tariff levels and structures be related to incremental system costs. If tariff levels and structures are set in this way, the observed willingness of consumers to pay for incremental output gives a fairly rigorous test for project justification.\(^3\) In the absence of such a pricing policy, project justification must rely heavily upon judgments about the threat to human health stemming from

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\(^2\) Even rural electrification benefits often cannot be estimated fully in view of the significant growth in energy consumption (the parallel to "generated traffic") that is usually associated with such schemes.

\(^3\) While due to the presence of "consumer surplus" this procedure does not permit a true cost-benefit calculation to be made, a comparison of costs and benefits at the margin is possible, and this provides an indication as to whether increased output is warranted.
an inadequate water supply or about the costs of industrial closures resulting from power shortages.

11. In certain cases, the benefits from public utilities may be quantifiable in terms of their impact on the consumption of other commodities or services. For instance, the benefits of a power project may be quantifiable in terms of reduced requirements of other fuels. In such cases, the benefits from public utilities may be valued in terms of the social value of the impact on the level of use of other commodities and services.

12. Economic justification of public utility projects should therefore include three main steps. The first should be analysis of the market for the output of the public utility concerned, with special attention being given to the demand forecast. Second, evidence should be given that the project is the least-cost solution or that it is at least an integral part of the least-cost program for supplying the predicted growth in consumption. Third, these costs must be compared with the expected benefits identified in terms of cost savings or impact on consumption of other commodities and services. If that is not possible, an internal rate of return based on incremental revenues in the benefit stream should be presented. These revenues initially should be estimated on the basis of existing tariff levels and structures; the cost side of the calculation should reflect economic costs rather than simply the financial costs incurred by the utility. The interpretation of the resulting rate of return is based upon its relationship with the opportunity cost of capital. If the rate of return is equal to or greater than the opportunity cost of capital, the indication is that consumers reveal, by their observed willingness to pay, that the value they place upon incremental output at least equals the economic cost. The benefit-cost test is therefore positive.

13. However, a converse conclusion cannot be drawn from rates of return that are less than the opportunity cost of capital. In the case of a low rate of

Note that in the case of complex systems, attributing incremental revenues to the project itself may be arbitrary and in any case may not be a useful indicator of long-term trends in incremental costs. Therefore, the procedure should be: (a) carry out a demand forecast, (b) ensure that the project is part of the least-cost program, and then (c) relate incremental revenues to the incremental cost of the whole system expansion (including the project) over an appropriate “time slice.”
return, the interpretation is simply that existing prices are lower than the incremental cost of supply. While the project itself may or may not be economically justified, the relatively low price that is charged means that consumers' willingness or unwillingness to pay for the costs of additional output cannot be demonstrated, and therefore the power or water authority has inadequate guidance as to whether system expansion is economically justified. Such a situation points to a clear institution-building role for an international development institution such as the Bank. Reform of tariff levels and structures, taking into account relevant economic and social considerations and thereby helping supply information necessary for reasonable judgment about project cost-benefit relationships, should be a major objective. For this reason, it is important to show the internal rate of return that results when projected tariff reforms are included on the benefit side of the calculation, although the rate of return itself may not provide adequate evidence as to the value of the project.

4. "Social" Projects

14. "Social" projects include health, education, population, sewerage, and certain categories of housing. These projects tend to involve extreme difficulty in adequately measuring economic benefits and, unlike in public utility projects, pricing structures cannot always be manipulated to help demonstrate project justification. Attempts may be made to estimate some part of the benefits of these projects — for example, the impact on lifetime earnings of beneficiaries of vocational or technical education investments, and estimates of the impact on productivity of health-related projects. In general, however, not only are the monetary benefits of such projects unquantifiable, even physical impact is difficult to measure. Cost effectiveness analysis therefore is also often difficult to employ, although efforts should always be made.5

15. Special mention should be made of housing projects, which do not fall neatly into any one of the four categories of projects mentioned here and thus

5 Cost-effectiveness may be considered at a number of levels. It may refer either to the unit cost of delivering a service, which is normally straightforward even for "social" projects, or to the unit cost of achieving the ultimate benefits (such as health) to be derived from that service, which is clearly much more difficult to establish.
provide a good illustration of the general theme of this note. The appropriate method of valuing the benefits of such projects is determined by the extent to which market forces are relied upon to allocate housing to project beneficiaries. Where the housing market works freely, housing projects might be evaluated in the same way as industrial or agricultural projects. However, housing is often the subject of governmental intervention, which may take the form of subsidized low-income housing, slum upgrading, and sites and services facilities. Even for "social" projects of this kind, some reliance upon willingness to pay is an element of the allocation process and the price of alternative accommodation (a rough parallel to the cost-saving approach used in transportation projects) can be used as a partial benefit measure, the cost-benefit analysis possibly being supplemented by evaluation of rental or pricing policy, as in the case of public utilities. The greater the degree of subsidization, however, the less such indicators can be employed to demonstrate project justification and the greater the reliance that must be placed upon judgments about health or productivity effects of improved housing for project beneficiaries.

C. Conclusion

16. The general conclusion that may be drawn from the foregoing is that while cost-benefit analysis is a valuable discipline to be followed in the processing of Bank projects, the degree of uncertainty about the nature and magnitude of potential benefits imposes severe limitations upon the extent to which the EIRR calculation can be relied upon to determine investment priorities. Indeed, given the complexity of almost every project for which the Bank lends, it would be unlikely that any one calculation would be sufficient to encompass all the economic and social factors that combine to determine the ultimate justification of the project. The unquantifiable elements of projects will frequently dwarf those effects that can be estimated in monetary terms, particularly where social considerations are central to the decision. Because of this, it is not reasonable to expect the approaches to be used in the various sectors to have the appearance of uniformity. Nevertheless, the basic procedure, namely, an analysis of the "market" for the project outputs, followed by selection of the least-cost solution and then by some comparison of the expected economic and social costs and benefits of the selected project, remains appropriate for all sectors.
Appendix 4
GUIDELINES FOR PRICING INPUTS AND OUTPUTS IN THE ECONOMIC ANALYSIS OF PROJECTS
GUIDELINES FOR PRICING INPUTS AND OUTPUTS IN THE ECONOMIC ANALYSIS OF PROJECTS

I. Introduction

1. The purpose of this appendix is to provide guidelines for the pricing of inputs and outputs in the economic analysis of projects. The discussion centers mainly on the general principles to be followed in the estimation of prices. It also deals with pricing issues in some sectors which pose special analytical problems.

2. The valuation of inputs and outputs is part of the general economic analysis of projects, the objective of which is to help determine the most efficient use of a nation's scarce resources in expanding national output. Since the focus of such analysis is on maximization of national output, this analysis is referred to as "economic" or "efficiency" analysis.

3. The economic analysis of projects is carried out in terms of economic prices because the market prices of goods and services in developing countries do not provide a true measure of their costs and benefits to the economy. Discrepancies exist between economic prices and market prices of inputs and outputs because of distortions in the market price structure resulting from import controls, government regulation of prices, taxes and subsidies, unemployment combined with labor market rigidities, and the existence of external economies or diseconomies. Economic analysis does not remove these distortions, but indicates the real costs and benefits of a project to the society given such distortions.

II. General Principles

A. Approach to Economic Pricing

4. In establishing the economic price of a commodity for use in a project, the opportunity cost principle should be applied. The opportunity cost of a commodity represents the benefits forgone by society in withdrawing the commodity in question from its next-best use (see paras. 11-13, 15-17, 24 and 26).

5. The economic analysis of projects is similar in form to financial analysis in that both assess where possible the profitability of an investment in monetary terms. The starting point of the economic analysis is the use of prices prevailing in the market. Market prices are used in the financial analysis of projects as these form the basis of estimation of input costs and output prices and thereby determine the financial viability of the projects.

6. The prices of inputs and outputs prevailing in the market require adjustments to determine economic prices. This is because market prices are often distorted for reasons mentioned earlier. For all goods traded in world markets (traded goods), border prices are used as the basis for determining economic prices. For commodities (both inputs and outputs) exported at the margin by the country concerned, the border prices are the export prices (FOB) net of taxes and subsidies. For commodities imported at the margin, the border prices are the import prices (CIF) net of taxes and subsidies. For commodities which are not traded with the rest of the world at the margin (non-traded goods), opportunity cost may be measured in terms of the cost of production or willingness to pay as measured by the domestic market prices net of taxes and subsidies.

7. The approach described in paragraph 6 gives the values of traded goods in terms of border prices and non-traded goods in terms of domestic prices. The two sets of prices are not comparable and a method of converting domestic prices to border prices or vice versa is necessary. The conversion factor approach, which converts domestic prices to equivalent values at border prices, should
be used. This approach is dealt with in greater detail in the "Guidelines for the Use of Conversion Factors in Economic Analysis of Projects."  

B. Treatment of Inflation

8. Over the life of a project, the prices of inputs and outputs can be expected to rise. In theory, it is possible to project the future rate of inflation and estimate the prices of both inputs and outputs for every year of the life of a project, but as the experience of the past decades has shown, average prices of certain commodities vary considerably from year to year and it is difficult to predict with a high degree of accuracy the prices that are likely to prevail in the future. In order to avoid unnecessary complications, economic costs and benefits are expressed in real terms. It is recommended that the base year be the year of appraisal, and that all prices be expressed in constant prices of the base year.

9. For commodities such as petroleum products whose relative prices may be expected to change over time, account must be taken of such changes in the economic analysis of projects. A relative change in the price of a product implies a change in the amount of resources that must be forgone in using the product and thus a change in the contribution that the project would make to the national output. A change in relative prices therefore has a real impact on the use of national resources and should be reflected in the year in which it is expected to occur, even though such relative changes are generally difficult to predict.  

C. Pricing of Inputs

10. The primary inputs used in production of a project are labor and goods and services (hereafter called commodities). In these guidelines only the pricing

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2 See Appendix 6, "Guidelines for the Use of Conversion Factors in the Economic Analysis of Projects."
3 See Appendix 10, "Guidelines for the Treatment of Price Changes in the Economic Analysis of Projects."
of commodities is considered. For purposes of analysis, commodity inputs can be divided into three groups: (i) locally produced inputs, (ii) imported inputs, and (iii) mixed component inputs.

11. If an input is produced locally and would have been exported without the project, its economic cost is equivalent to its export price (FOB). If the input is not internationally traded and is produced in an industry with excess capacity, the project demand for the input is met from increased production and its economic price is the marginal cost of production. If there is no excess capacity and the project demand is met wholly or partly from diversion from other uses, the market price, adjusted for taxes and subsidies, represents the economic cost of the input. However, in certain cases where the price is controlled by the government, such as power tariffs in many countries, the market price may understate the cost of production or supply. In such a case, the marginal cost should be the basis for valuation.

12. If the input is imported from abroad, the import price (CIF) constitutes the economic cost. What is relevant is not whether the input is imported for the project, but whether the project requirement leads to an increase in imports in the economy as a whole. In estimating economic prices, adjustments should be made to the CIF and FOB prices for incidental costs such as port charges and local transport and marketing costs.

13. In the case of a mixed input composed of traded goods and non-traded goods, the input should be broken down into constituent parts and their economic prices derived separately in the manner discussed above. For example, in the case of domestically produced fertilizer, a portion of the input cost may be attributable to imported raw materials. To arrive at the economic price, the cost should be broken into its foreign and domestic components and the opportunity cost principle applied to each part to arrive at the total economic price of the input.

4 For pricing of labor see Appendix 5, "Guidelines for Determining the Economic Price of Labor."
D. Pricing of Outputs

14. The general approach followed in the pricing of outputs is the same as that for inputs. The output of a project may fall into any of the three categories: (i) exports, (ii) import substitutes, and (iii) non-traded outputs. Many projects produce more than one category of output listed above, and economic pricing of project outputs is better done by separately analyzing the different categories of outputs.

15. The economic value of an exportable output is measured by its foreign exchange earnings. This value is calculated by using the FOB value at the point of export as the basis. The economic price of a project output is derived by deducting from the FOB export price the transport cost from the factory site to the port and handling charges at the port. The local currency equivalent is also referred to as the export parity price.

16. The basis for the economic price of an output which is a substitute for an import is the price of the import. To arrive at the economic price, it is necessary to add to the CIF price the cost of transport and handling from the port to the market and deduct the cost of transport and handling from the project area to the market. The local currency equivalent for the import substitute is also referred to as the import parity price.

17. Non-traded outputs consist of goods and services that would not have been supplied by imports in the absence of the project. This category includes output of utilities such as power and transport services, agricultural goods such as vegetables, and other farm products, bulky construction materials or manufactured goods consumed by the local community. The general rule for valuation of these goods is to use farmgate and ex-plant prices or prices at the point of first sale after adjustment for transport and distribution costs, taxes, subsidies, and other transfer payments, as applicable. As in the case of non-traded inputs, appropriate adjustments should also be made if the price of output is fixed by the government. In such a case the opportunity cost principle should be applied.
III. Pricing Issues in Specific Sectors/Subsectors

18. The general principles for pricing inputs and outputs mentioned above can be applied to most of the sectors and subsectors of the economy. The manner in which these guidelines are applied should be decided upon by the project analyst taking into account the characteristics of the individual project. There are, however, certain sectors with special characteristics that make analysis of projects more complex. The following sectors/subsectors illustrate the application of these guidelines and exemplify their special characteristics and problems.

A. Minerals, Oil and Natural Gas

19. The nonrenewable nature of minerals, oil and natural gas differentiates these resources from those of other sectors. Since the availability of these resources in a country is ultimately given, the pace of their use depends upon the discretion of policy makers. When these resources are depleted, further use of the commodity in question can only occur through imports or through use of domestic or imported substitutes. This presents a special problem of pricing for these products, which is discussed below with reference to natural gas.

1. Valuation of Benefits

20. The pricing of the output of a natural gas project does not pose special problems. If a country is a net importer of fuel, the value of output is the import price of gas or the substitute displaced by the increased domestic supply of gas due to the project. The comparison of values could be made at the point of use on the basis of physical properties such as the calorific values of gas and its substitutes, with adjustments for differences in quality and convenience of use.

21. If, however, the country exports gas, the value of output computed at the wellhead is equivalent to the FOB price minus the transport costs to the

5 Refer to natural endowment. Known reserves of course will increase as new discoveries are made.
port. In both cases, account should be taken of a possible increase in the real price of oil and gas which may be expected during future years for reasons noted earlier.

2. **Valuation of Cost**

22. The complexity of analysis basically arises in estimating the cost of natural gas because of the exhaustible nature of this resource. Once the existing reserves of natural gas are used up, all future demand will have to be met from other sources, such as imports. Therefore, the economic cost of production of gas should not only include the investment required for production and distribution, but also an allowance for depletion of these reserves. The level of depletion allowance to be provided in economic analysis is determined by the switching cost, i.e., the cost of replacing the natural gas reserves with alternative energy resources at the time these reserves run out. The switching cost therefore depends on the size of the known reserves of natural gas in relation to the timeframe within which existing resources would be used with and without the project under consideration. Use of natural gas in the current period brings closer the day of exhaustion and the need to switch to alternative sources. The opportunity cost of gas used in the current year is thus the present value of the cost to the economy of the adjustment that must be made in the future. This present value is derived by discounting the cost of the substitute in the year in which reserves would be exhausted. Normally, a discount rate of 10-12 per cent is applied to arrive at the present value; a higher rate would correspondingly reduce the present value of the depletion premium (see the illustration included in this appendix for the calculation of the depletion premium).

3. **Pricing of Natural Gas as an Input**

23. Natural gas is often used as an energy input, e.g., in a power generation plant, in the manufacture of fertilizer, or as a fuel in an industrial plant. The economic price of gas as an input in these activities should not simply be based on the cost of producing gas. Rather, it should be calculated according to the opportunity cost principle noted earlier. The following illustration clarifies this position.
24. If the output of gas in a country can be used to replace the import of oil products used in the production of electricity or fertilizers, the economic price of natural gas should be the import price of the oil products it replaces. If the country is an exporter of gas, the economic price of gas is its export price net of transport costs to the point of export. However, in no circumstance should the economic price of gas as an input be below the economic cost of gas which includes the production cost, distribution cost and the depletion premium.

B. Fertilizers

25. In the case of a fertilizer project, the general principles discussed earlier can be readily applied. The value of project output should be measured by the world price of fertilizer. If the country is a net importer of fertilizer, the economic price is the import price (CIF), and if the country is a net exporter, its economic price is export price (FOB). On the cost side, the economic price of the input depends upon the source of inputs. If production is based on imported naptha, the CIF price of naptha is the economic cost of the input. If domestic gas is the input of the fertilizer plant, the opportunity cost of the gas is the economic price of the gas.

26. In determining the economic price of fertilizer used as an input in a project, the relevant price is not the cost of production of fertilizer, but the FOB price of fertilizer if the country is a net exporter. If the country must import fertilizer to meet the needs of the project, it is the CIF price. The rationale behind this method of valuation is that if the fertilizer were not used in the project, the country would have earned foreign exchange through exports in the first case, and saved foreign exchange in the second.

C. Agro-Industries

27. One of the distinguishing characteristics of commercial crops is that they can be marketed only after processing. It is thus difficult to distinguish the economic value of the commercial crop from that of the processing of the crop. Another characteristic of these commodities is that both their world supply
and international prices fluctuate widely, making it difficult to predict future prices, and thus to estimate the economic return of these industries. Thus it is essential to consider both recent trends in the world price of these commodities and likely world supply and demand. This is particularly important for tree crops, an investment which requires a gestation period several years, but for which yields continue for many decades.

28. While the pricing of agro-industrial products is rather difficult, the general approach mentioned earlier can be applied with minor modifications. To illustrate, let us take the case of oil palm. The benefit of an oil palm project can be calculated from the levels and prices of the output of the processing of oil palm. If the output is for export without refining, the benefits should be measured in terms of FOB export prices.

29. On the cost side, the cost of the oil palm and its processing should be treated as one entity. The price paid by the factory may not necessarily be the true economic cost of growing palm in the project area. Thus the economic benefits of the processing plant maybe inflated or depressed, depending upon the price paid to farmers. The economic cost of oil palm should include the initial investment cost, e.g., in land development and planting of trees; the recurrent costs of other inputs such as fertilizer, labor, irrigation and the cost of transporting the fruit to the factory; and the investment and operating cost of the factory. However, where landholdings are small and individually cultivated, and the capacity of the processing plant does not match the output from the project area, it may be necessary to separate the economic valuation of cultivation and factory operations. The arbitrary decisions made in evaluating these separately should be explained.

IV. Conclusions

30. The opportunity cost principle should always be kept in view in determining the economic or efficiency price of goods and services. The opportunity cost, that is the cost to society, of using a commodity or service as an input
to a project is the benefit forgone in withdrawing the commodity or service in question from its next best use.

31. For all internationally traded goods, the border prices for imports (CIF) and for exports (FOB) should be used as the basis for determining domestic parity prices.

32. For goods which are not internationally traded, the domestic prices net of taxes and subsidies — ex-farm and ex-factory prices — should be used. However, they should then be converted into their border price equivalents through the use of conversion factors.

33. To simplify the economic analysis, all benefits and costs should be expressed in constant prices. The base year should normally be the year in which the project is appraised.

34. Whenever changes in the relative price of an input or output are anticipated, these should be reflected in the analysis.

35. The costs of production of certain products (e.g., natural gas) which are inputs to other industries (fertilizer and power) should not be taken as the input prices of these goods. The opportunity cost principle should be applied in determining their prices.

36. In the case of projects producing non-renewable resources such as oil and gas, the per unit economic cost should also include the discounted present value of the substitute energy resources that will have to be used when existing resources are exhausted. This element is commonly known as the depletion premium.

37. In the case of commercial crops that have to be processed before being marketed, it is generally difficult to separate the processing component in the economic evaluation of the crop. Where such analysis is carried out, any arbitrariness involved should be clearly noted.
METHOD OF CALCULATING "DEPLETION PREMIUM"
(A SIMPLE ILLUSTRATION)

(i) A country imports 10,000 barrels of oil a day at a cost of $35/bbl, including all costs incurred in delivering the oil to a power generation plant where the entire amount is used.

(ii) The country suddenly discovers a pool of natural gas from which it can produce just enough gas daily to displace the entire oil import of 10,000 bbl/day over the next 20 years.

(iii) It costs only $20,000 daily to produce and bring sufficient gas (58 MMCF/day) to the power plant. This cost is not expected to change for 20 years, when the gas will run out.

(iv) In 20 years, the crude oil cost will be $65/bbl in constant dollars, i.e., oil prices will have increased at 3 per cent per annum in real terms.

(v) The assumed discount rate for estimating the present value of the future benefit stream is 10 per cent.

In the above circumstances, what is the real economic cost to the country of using the gas to displace imported oil? Since using the gas reserve now would necessitate imported crude oil at the cost of $65/bbl at the end of 20 years to meet the country's needs at that time, the real cost of gas or its opportunity cost must include an element of depletion premium or the cost of replacing the gas by a substitute in 20 years' time over the cost of producing and transporting the gas to the plant during the 20-year life of the reserve.
The following example illustrates the calculation of the depreciation premium.

Daily consumption = 10,000 bbls
= 58 million cubic feet of gas (MMCF)

Cost of consumption at depletion date = $65.00 \times 10,000 = $650,000

i.e., $11.20 per thousand cubic feet (MCF) of gas

Depletion premium = Present value of $11.20 at 10% p.a.
= $1.66/MCF

In other words, one must put away $1.66 per 1,000 cubic feet of gas used now to be able to substitute its use in 20 years through oil imports.\(^1\) Therefore,

\(^1\) As is readily apparent, the depletion premium is really the discounted value of the switching cost. An algebraic expression for the depletion premium per unit in a particular year during the production period is as follows:

(i) \( Y_t = \frac{X}{(1 + i)^t} \)
where \( Y_t \) = depletion premium in year \( t \)
\( X \) = switching cost in year \( N \) when switching will become necessary, i.e., the cost of substitute in the year \( N \) multiplied by the conversion factor between the commodity in question and its substitute
\( i \) = discount rate
\( t \) = 0, 1, 2 ..., number of years away from the depletion date \( N \).

For practical purposes it may be necessary to calculate a weighted average depletion premium. In that case it is necessary to take into account the production profile of the industry. The formula is as follows:

(ii) \( Y = \frac{\sum_{t=0}^{N} X O_t/(1 + i)^t}{\sum_{t=0}^{N} O_t} \)
where \( Y \) = weighted average depletion premium
\( O_t \) = production in year \( t \).

When the above formula is used for any period extending several years, it is important not to do time-discounting of the average premium again over the same period in calculating EIRR or NPV.
this cost must be added to the current cost of producing and transporting gas, viz., 34 cents/MCF. The economic cost of the first 1,000 cubic feet of gas thus equals $0.34 + $1.66 = $2.00.

Actually, the analysis is more complex. A more complete analysis would include calculation of the number of years it would take for the gas reserves to run out. This requires estimation of the size of the country's exploitable gas reserves and the rate at which production is expected to expand to meet growing gas demand. The smaller the reserves relative to present and projected demand and the faster their rate of depletion, the larger the depletion premium. On the other hand, if the reserves are very large relative to output, they would last a long time and the depletion premium would thus be small.
Appendix 5
GUIDELINES FOR DETERMINING THE ECONOMIC PRICE OF LABOR
GUIDELINES FOR DETERMINING THE ECONOMIC PRICE OF LABOR

1. The purpose of this appendix is to provide general guidelines for determining the economic price of labor, often referred to as the "shadow wage rate" (SWR). In the financial analysis of a project, money wages and benefits paid to employees are treated as the cost of labor. The wages paid by a large private enterprise or a government entity are determined by a variety of factors such as the structure of the labor market, government regulations and controls, labor unions and collective bargaining. However, while money wages actually paid are financial costs, due to market distortions they do not necessarily represent the economic cost of labor.

2. The SWR is an estimate of the economic price of labor. It thus facilitates determining the economic viability of a project and helps ensure efficient allocation of a country's scarce resources. The SWR can also help in determining the appropriate technology for a project. The general approach and method of estimating the SWR for a project are discussed below.

A. General Principles for Calculating the Shadow Wage Rate

3. The shadow wage rate is frequently defined as the marginal output of labor forgone elsewhere in the economy because of its use in a new project. This definition is based on the opportunity cost principle, which is also applied in the economic pricing of commodity inputs and outputs. The additional demand for labor generated by a project will affect not only the labor market in the sector to which the project belongs, but also other sectors. What is required is an analysis that traces the impact of additional labor demand through interlinked labor markets so as to identify the sectors where the final adjustments will take place. When labor used in a new project is withdrawn from a productive sector or industry, the output of that sector or industry will normally decline. The magnitude of this decline is a function of the marginal productivity of the

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labor withdrawn from that sector or industry. Thus, its effect on national output greatly depends upon the types of skills required for the project and the market for those skills. The SWR will be lower if a particular skill required is in plentiful supply, i.e., if a large number of persons with that skill are unemployed. It is therefore often necessary to use a set of shadow wage rates, one for each skill and location rather than a single rate for the whole country.

4. Due to lack of information, in developing countries it is generally difficult to accurately calculate the marginal product of labor (MPL) forgone. However, a close approximation of the MPL of labor forgone is the prevailing wage rate for the skill in question adjusted for the degree of unemployment in that skill. In the case of skilled workers, market wages may be taken to represent the MPL, as these workers are generally in short supply. In cases in which there is severe unemployment and underemployment that is expected to persist, the shadow wage would be lower than the money wage. However, in these cases, factors such as seasonal fluctuation in the demand for labor, varying degrees of labor mobility, and the possibility of self-employment suggest caution in adopting a very low opportunity cost of labor.

5. As in the case of commodities, it is also important to look at supply. At very low wages, people may prefer leisure to work. This has been the conclusion of the economists who analyzed several large projects in Asian countries where unemployment is high. The supply price of labor depends upon several factors such as family income, the cost of migration, the value placed on leisure and other non-wage activities (such as fishing or house repairs), and the nature of project employment vis-a-vis income and other benefits accruing from that employment. Further, the "reservation wage" below which people may prefer to remain unemployed is influenced by convention or custom. Thus, the reservation wage varies across classes of labor and geographic locations. Thus, the SWR will likely be higher than a narrow interpretation of the opportunity cost of labor would suggest.
B. Estimating the Shadow Wage Rate

6. Since labor is not homogenous (i.e., it consists of various types of skills), the opportunity cost of labor varies across skills and sectors. This makes calculation of the SWR extremely complex. Further, the SWR is to a large extent location-specific. Thus, even in the same sector it is likely to vary with the size and location of the project.

7. To keep the analysis within manageable limits, the following procedure is suggested: estimate the number of workers required for a project and divide them into the three major categories (skilled, semi-skilled and unskilled). Then calculate the SWR for each category separately. Guidelines for estimating the shadow wage rate for each category are given below.

1. Skilled Labor

8. In most developing countries, skilled workers are generally in short supply. Thus, the market wage should be taken as the opportunity cost for this category of workers. In estimating the opportunity cost, benefits other than salaries and wages (such as housing and provident fund contributions) should be taken into account.

2. Semi-skilled Labor

9. In estimating the shadow wage rate for semi-skilled labor, a distinction should be drawn between the “protected” wage sector and the “unprotected” wage sector, particularly with respect to projects in urban areas. In the former, wages can be held above the market-clearing level by minimum wage laws, collective bargaining agreements, or as in the case of large national and international companies operating in developing countries, by the hiring policies of companies. Wage levels in the “protected” wage sector should not be used for estimating the opportunity cost of semi-skilled labor; instead the wage levels paid in the “unprotected” sector should be used. The “unprotected” wage sector is one beyond the effective control of wage regulations and labor unions or workers’ associations.
10. The supply of semi-skilled labor is likely to vary considerably across countries. In many countries the supply of these workers is barely adequate to meet the growing demand. In this case, the market wage rate in the "unprotected" sector should be taken as representing the opportunity cost of labor. This is so because even if workers are withdrawn from the "protected" sector, they will leave vacancies that will be filled from the "unprotected" sector, including recent migrants whose alternative urban employment would most likely be in the "unprotected" sector.

11. In countries where workers with such skills are in oversupply and where there is clear evidence of unemployment, the opportunity cost (shadow wage) should be adjusted downward, taking into account the extent of unemployment in the skills concerned. However, care must be taken in assuming very low SWRs for semi-skilled workers; this is because these workers can also find employment as unskilled workers. The SWR of semi-skilled workers should thus not be below the "unprotected" wage which unskilled workers receive in the project area.

3. Unskilled Labor

12. Most of the discussion on SWRs concerns the opportunity cost of unskilled labor. Most developing member countries report a high degree of unemployment and underemployment in both rural and urban areas, with most of the unemployed being unskilled. In determining the SWR for such workers, the starting point, as in the case of semi-skilled workers, should be the "unprotected" wage for unskilled workers in the project area. In determining the SWR, it should be borne in mind that unskilled employed workers in urban areas can engage in such unorganized activities as peddling, hawking and shining shoes. The income from such activities should be taken into account in estimating SWR. In rural areas, the unemployed may provide help on family farms, doing seasonal work in nearby industries or working on construction projects. These alternative activities should also be taken into account when estimating the SWR.

13. The above suggests that where direct information on the annual income of unemployed and underemployed workers is available, it could be used in estimating the SWR. Where such direct estimates are not available, the annual SWR of unskilled workers could be estimated by multiplying the
“unprotected” wage rate by the estimated number of days of gainful employment per year. However, once again, project staff are cautioned against using a very low SWR.

14. It should be noted that the procedure outlined thus far establishes the SWR in terms of the value of output forgone at domestic market prices. This value of output forgone may be equal to or less than the market wage rate. The value of output forgone must sometimes be converted from domestic market prices to border prices in order to get a SWR defined in border prices. This can be done by applying appropriate conversion factors, a subject treated separately in the guidelines for the use of conversion factors.²

C. Basis of Estimation

15. The major task in estimating shadow wage rates is to secure reliable data concerning the variables listed below.

(i) Regulated and unregulated, or open market wage rates for skilled, semi-skilled and unskilled workers in the project area. Unskilled workers form a fairly homogenous group and the wage rate applicable to them is likely to be more or less uniform in the project area. For skilled and semi-skilled workers, if the number of skills involved and the range of wage levels is large, an average wage rate should be estimated for the project.

(ii) The degree of unemployment and underemployment situation in the project area and its environs, and its nature and duration. Data regarding farm employment during peak and slack periods as well as non-farm income earned over the year should also be carefully examined. These data are normally available in national censuses, labor force surveys, and household income and expenditure surveys. Independent surveys made in the project or

² See Appendix 6, “Guidelines for the Use of Conversion Factors in the Economic Analysis of Projects.”
surrounding areas, wherever available, may also be used to confirm the estimates obtained from official sources.

16. In countries where reliable and up-to-date data are available from the above sources, it may not be difficult to estimate shadow wage rates. Where such data are not available, it may be necessary to perform limited surveys as part of the feasibility study for a project. In any case, most of the work in estimating SWRs should be carried out at the feasibility study stage. The terms of reference for project preparatory technical assistance should include, as part of the economic evaluation of the projects, the gathering of adequate information for the estimation of shadow wage rates.

17. Estimation of SWRs is particularly important in projects where the wage component in the total cost or benefit stream is significant, and where technological options exist in formulating labor-intensive projects. In projects where the wage component is small relative to other components it may not be necessary to calculate SWRs. This is the case in projects that involve few and mainly skilled workers and where technological choices are limited. However, for projects for which SWRs are necessary, these should be estimated at a fairly early stage of project processing, even though the available data limit the estimate to only a rough approximation and may call for further refinements later.

18. A convenient and useful approach in ascertaining the need for such refinements is to subject SWRs to sensitivity tests. If the tests show that the EIRR of a project is relatively insensitive to changes in the wage rate, further refinements may not be required. If, on the other hand, the EIRR is found to be relatively sensitive, further refinements may be warranted or justification may be required to show that the SWRs used provide an appropriate measure for the opportunity cost of labor.

D. Summary and Conclusion

19. According to the opportunity cost principle, the economic price of labor or the shadow wage rate (SWR) may be defined as the marginal product of labor (MPL) forgone elsewhere in the economy due to its use in the project.
20. Since in developing countries it is difficult to estimate the MPL, a more direct approach based on the prevailing wage rates for the various types of skills and locations and the degree of unemployment relating to those skills may be used to estimate the SWR. For purposes of analysis, workers may be divided into three categories: skilled, semi-skilled and unskilled.

21. Since skilled workers are generally in short supply in developing countries, prevailing market wages in the project area may be taken as a proxy for their economic wage. In estimating the SWR, benefits other than wages should also be included.

22. For semi-skilled workers, wages in the "unprotected" wage sector adjusted for the degree of unemployment in the project area should be used as the basis for estimating the SWR. Where there is no unemployment for such skills, the "unprotected" wage should be taken as the SWR.

23. For unskilled workers, who normally account for the bulk of wage expenditure, the annual SWR should be estimated on the basis of the "unprotected" wage rate and the number of days of gainful employment during the year.

24. Data on wage rates and unemployment in or around the project area available from national surveys and other such sources should be used in estimating the SWR. Where such data are not available, it may be necessary to carry out limited independent surveys during the project feasibility stage.

25. In projects for which wages constitute a very small proportion of the total cost and benefit streams, and where technological options are limited, it may not be necessary to estimate the SWR.

26. The SWR should be estimated at an early stage of project processing, preferably at the project feasibility stage. Sensitivity tests should be applied to SWRs and further refinements carried out for projects with EIRRs found to be sensitive to the SWR.
Appendix 6
GUIDELINES FOR THE USE OF CONVERSION FACTORS IN THE ECONOMIC ANALYSIS OF PROJECTS
GUIDELINES FOR THE USE OF CONVERSION FACTORS IN THE ECONOMIC ANALYSIS OF PROJECTS

I. Introduction

1. Economic analysis of Bank projects emphasizes maximizing net output or income. This implies that project inputs and outputs should be valued at the real cost of providing the inputs or the real value to society of the outputs produced. Discrepancies between market prices and the real cost of inputs or real value of outputs are due to indirect taxes, non-competitive pricing and other market distortions. Typically, commodities and services used as inputs for or produced as outputs of a project fall into two categories: "traded" and "non-traded" goods. "Traded goods" include all commodities and services imported or exported at the margin by the country in which the project is located. "Non-traded goods" include all other commodities and services used or produced by the project. The purpose of conversion factors is to correctly align the prices of traded and non-traded goods.

II. The Conversion Factor Approach

A. The Concept

2. According to the "Guidelines for Pricing Inputs and Outputs in the Economic Analysis of Projects," traded inputs and outputs must be valued at "border" prices and non-traded inputs and outputs at their opportunity costs measured in domestic prices. In these definitions, "border" prices are CIF or FOB prices expressed in units of domestic currency at the official exchange rate. Thus, some inputs and outputs will be valued at one set of prices and others according to another set. One approach to make these two sets of values
comparable is to convert border prices into domestic price equivalents. Another is to convert domestic market prices into border price equivalents. It is proposed that the latter approach be adopted for economic analysis of Bank projects (see also paras. 10 and 11).

3. A conversion factor is the ratio of the border price of a commodity to its domestic market price. By applying a conversion factor to the domestic market price of a commodity, its border price (or its equivalent) can be determined. For example, in a project that uses electricity as an input, the cost of electricity used will be expressed in the financial accounts at domestic prices, which may be equivalent to, say, 50 cents per kWh. The first step in the conversion is to correct any discrepancy between the domestic market price of 50 cents equivalent per kWh and the actual cost (say, 60 cents equivalent per kWh) of producing and supplying electricity to the project. Since the actual cost of the inputs used to produce the electricity will be expressed in domestic prices, the second step is to determine the cost of production of 60 cents per kWh at border prices for all inputs. For instance, the fuel oil price for power plants may be below the world market price of fuel oil. Expressing these costs in terms of border prices corrects this discrepancy. Assuming that the converted price is 75 cents per kWh, then the conversion factor for electricity is 75 cents per kWh divided by the market price of 50 cents equivalent per kWh, i.e., 1.5. The conversion factor of 1.5 means that an expenditure of $100 on electricity requires direct and indirect use of tradeable commodities worth $150 at border prices to produce this electricity.

4. The discrepancies between the domestic prices of non-traded items and their border price equivalents are due to two main reasons. The first is the possibility that domestic prices may not reflect marginal costs; the second is the discrepancies between market prices and border prices for the inputs that define this marginal cost. Conversion factors take both these elements into account.
B. Types of Conversion Factors

5. Conversion factors are applied to the cost of all the non-traded commodities and services used or produced by a project. In principle, a separate conversion factor should be estimated for each non-traded commodity used in a project. In practice, this is seldom possible, and frequently a common conversion factor is calculated for a group of commodities. The extreme form of the conversion factor is a single conversion factor calculated for all commodities produced (or consumed) in the economy. Hence, three types of conversion factors may be distinguished: (i) commodity conversion factors (CF) for specific commodities or services, (ii) group conversion factors (GCF) for a group of related commodities or services, and (iii) standard conversion factor (SCF) for all commodities and services produced (or consumed) in the economy.

C. Commodity Conversion Factors

6. Commodity conversion factors are used for converting the values of specific commodities used as inputs or produced as outputs in a project. The illustration for electricity given earlier is an example of a commodity-specific conversion factor. The use of such specific conversion factors is generally restricted to a few major non-traded project inputs or outputs.

7. The major advantage of the conversion factor approach is that it corrects the distortions specific to each project. The principal non-traded element in one project may be electricity, for which the conversion factor may be 1.5, while for another project the principal non-traded element may be road transport, for which the conversion factor may be 0.9. If the non-traded component of both projects is corrected not with these specific conversion factors but with an SCF of, say, 1.2, the real resource cost of electricity at border prices will be understated in the first project, and the real resource cost of road transport at border prices will be overstated in the second.
D. Group Conversion Factors

8. A GCF is required when project costs or benefits cannot be specified readily in terms of individual commodities and services, but only in terms of aggregates of such commodities and services. In the cost estimates, these aggregates may be, for example, the costs of civil construction, domestic machinery, and transport and distribution margins. The analyses of these costs in terms of individual commodity components would be time-consuming. To avoid this, a set of group conversion factors can be used for adjusting cost and benefit items common to several projects. A GCF for consumption, for example, helps in the valuation of consumer surplus whenever it arises. In such cases, a group conversion factor for consumers whose welfare has increased on account of the project would be relevant.

E. Standard Conversion Factor

9. The SCF may be thought of as a type of GCF applicable to all commodities consumed or produced in the economy. It represents an average of all discrepancies between domestic prices and border prices. If commodity-specific or group conversion factors are not available, then the cost of non-traded items can be partly adjusted for a few critical items. The first step in the adjustment is correction for underpricing or overpricing relative to marginal cost. The second step is segregation of the cost of some key traded inputs used to produce non-traded goods and to revalue them at border prices. When these adjustments are made to the values of key non-traded items, the more significant causes of discrepancies between domestic prices and border prices have been taken into account. The SCF can then be applied to the remaining non-tradeable items to convert their aggregate cost into its equivalent border price.

10. In certain cases, even where the data required for the adjustments described above are not available, the SCF may be applied to the entire cost of non-traded items without any adjustment. In such cases, the conversion factor approach is equivalent to the shadow exchange rate (SER) approach, the only difference being that the first approach expresses the costs and benefits of a project in terms of border prices and the second expresses them in terms of
domestic prices. The SCF indicates the border price of goods worth one unit when valued at domestic prices, while the SER indicates the domestic price of goods worth one unit when valued at border prices. For any economy, the SCF and the SER are inversely related\(^1\). For instance, if the standard conversion factor is 0.8 then the equivalent shadow exchange rate is 1.25 (i.e., 1.0/0.8) times the official exchange rate.

11. The SCF and SER do not measure the extent of foreign exchange imbalance, but measure only the average discrepancy between domestic and border prices. For example, a country's balance of payments may be in equilibrium at the prevailing exchange rate, yet the SER as defined above would still differ from the prevailing exchange rate if there are distortions due to factors such as duties and quotas. This is true for any country irrespective of whether its balance of payments position is favorable. The SCF or SER should not be regarded as an equilibrium exchange rate or as a way of attaching a premium to foreign exchange in a situation of foreign exchange scarcity. The SCF and SER only compare values expressed in domestic prices with values expressed in border prices.

### F. Supply Price and Demand Price Conversion Factors

12. The conversion factors defined above reflect the impact of a change in the availability of a non-traded item in terms of border prices. However, this varies depending on whether the impact is on production (i.e., input) or consumption (i.e., output). In the electricity example above (in para. 3) it was assumed that the additional electricity demand from the project would lead to increased production of electricity in the economy. Such an assumption is generally relevant when dealing with non-traded inputs. Since the impact was on production, the effects were analyzed in terms of the inputs required by the increase in electricity production. However, in the case of a project that produces electricity (as an output), a plausible assumption is that the additional output of electricity would lead to increased consumption of electricity in the

\[ \text{SCF} = \frac{1}{\text{SER}} \times \text{OER}, \]

where OER stands for the official exchange rate and SER for the shadow exchange rate.
economy. Increased consumption of electricity normally leads to diversion of funds spent on substitutes. If, for example, 60 per cent of the additional expenditure on electricity results from a reduction in diesel consumption and 40 per cent from a reduction in coal consumption, and if the border price of diesel is twice its domestic price and the border price of coal is 1.5 times its domestic price, then the conversion factor for electricity would be 1.8 = (2 x 0.6 + 1.5 x 0.4).2

13. The two types of conversion factors described in para. 12 above are "supply price conversion factors" (SPCF), which are used when the impact is on production, and "demand price conversion factors" (DPCF), which are used when the impact is on consumption. The SPCF generally relates to non-traded inputs and the DPCF to non-traded outputs. There may be cases in which the impact of a project is partly on production and partly on consumption. For instance, the additional electricity requirements of a project may be met partly by increased production and partly by reduced consumption of electricity elsewhere in the economy. In that case a weighted average of the SPCF and DPCF should be used.3

G. Conversion Factors for Traded Goods and Services

14. Conversion factors are required basically for valuing non-traded commodities. Traded goods and services can generally be valued directly at border prices. However, since the conversion factors for non-traded outputs are derived from the conversion factors of closely related substitutes and complements, it is necessary to derive conversion factors for traded items.4 Further, the latter are also useful in estimating group conversion factors for both inputs and outputs. For example, to estimate a consumption conversion factor, which is a GCF, conversion factors of both traded and non-traded goods should be included in the consumption basket.

2 Excluding transport and distribution costs, though these should be normally taken into account.
3 In algebraic terms: \( CF = \frac{aE + bN}{E + N} \) where a and b are the SPCF and DPCF, respectively. E and N are the (absolute) values of the demand and supply elasticities.
4 For instance, the conversion factor for fresh fish that is not traded could be derived on the basis of the conversion factor for dry salted fish that is traded.

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15. The conversion factor is generally the ratio of the border price to the market price. However, the border prices of some traded goods change when the project is implemented. This may be the case for a project that produces an exportable output for which the country already has a major share of the world market. In such cases, which are likely to be rare, instead of the border price, the marginal revenue from export should be used in calculating the conversion factor.

H. Use of Conversion Factors in Shadow Wage Rate Calculations

16. Conversion factors are particularly useful in shadow wage rate (SWR) calculations using border prices. While the shadow wage rate is defined in terms of output forgone in the rest of the economy, the output forgone must be valued in terms of border prices. Generally, output forgone in the case of skilled labor is industrial output, and a GCF is necessary to identify industrial commodities whose output is affected by the diversion of skilled labor. Similarly, in the case of semi-skilled and unskilled workers, the SWR is defined in terms of the output forgone in the “unprotected” sector. In such cases, a group conversion factor for converting the value expressed in terms of domestic prices to its border price equivalent will also be required. This could be a group conversion factor for industrial output or agricultural output, depending on the nature and location of the project.

I. Sensitivity Test

17. It is standard practice to ascertain the sensitivity of a project’s rate of return relative to changes in the major variables used in economic analysis. Such tests help indicate the degree of change in a project’s EIRR due to changes in major variables and they help the analyst to improve the estimates or to incorporate safeguards. Conversion factors should also be subjected to sensitivity tests. A high degree of sensitivity to the SCF or to any of the conversion factors used indicates a need for further disaggregation and improvement in the estimation procedure for the various component variables.


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III. Method of Calculation

A. Approach

18. This chapter suggests how the various types of conversion factors can be estimated from available data. The main objective of the estimate is to arrive at a central value for each conversion factor. This includes all major corrections required. The method of calculating the SPCF and DPCF is presented, followed by a discussion of methods for estimating the GCF and SCF. These methods require the use of trade data, which is explained in the final part of this chapter.

B. Commodity-Specific SPCF

19. The first step in estimating the SPCF for a commodity or service is to establish whether its domestic price reflects the marginal cost of producing it. The financial performance of enterprises that supply the non-traded commodity or service should be examined. If the enterprises operate at a loss or show financial rates of return that are abnormally low or high, there is prima facie evidence that market prices and costs diverge. Further examination may show whether this divergence affects the supply price paid by users. For example, in many countries tariffs for rural power supply are particularly low relative to the cost of supplying such power. Thus, when analyzing a ground water irrigation project based on electric pumpsets, the cost of electricity must be adjusted upward.

20. The analysis of supply enterprises should be combined with analysis of the non-traded inputs required by the project. These input requirements may impose certain additional costs that would not be incurred in the absence of the project. For instance, a new transmission line may be required for power supply, or a road may have to be widened and the tariff charged may not reflect these additional costs. Similarly, the costs may be overstated if, for example, the project is to use an existing facility that otherwise would have remained
idle. Such project-specific variations in costs can be estimated if the project report identifies all linked investments.

21. Correction of the discrepancy between prices and costs requires a large measure of judgment and can be readily justified only when there is an obvious discrepancy. A useful way of quantifying the discrepancy is to examine similar projects. For instance, if an estimate of the costs of rural power is needed for a lift-pump irrigation project, the data for a rural electrification scheme in the same country may provide a reasonable approximation of them.

22. Having established the cost of production that reflects the real resource cost in terms of domestic prices, the next step is to express this cost in its border price equivalent. The method of decomposition should be used to do this. In this method, the cost of production in terms of input costs is first analyzed. The inputs that are traded commodities and services can be valued directly at border prices. Portions of the cost that are clearly transfer payments should be excluded. The remainder will consist of labor, which can be valued at the shadow wage rate expressed in terms of border prices, and of other non-traded items. The remaining portion of the cost should likewise be disaggregated, with each part being analyzed in terms of cost of production, the traded part of this cost being valued at border prices, labor at the shadow wage rate, and the non-traded items being analyzed further. Normally, two or three rounds of decomposition produce most of the corrections required.

23. When the representative commodities used for deriving the conversion factors differ from the commodity that will be used in the project, the use of commodity-specific conversion factors introduces an element of approximation. For instance, for a railway system as a whole, a commodity-specific conversion factor may be based on the mix of traction (steam, diesel, electric). However, a project may only use rail transport with one type of traction. In that case the commodity-specific conversion factor for rail transport may need further adjustment. However, if commodity-specific conversion factors are available for each mode of traction separately, then they may be used for different types of projects without introducing large errors in the analysis. This could greatly reduce the amount of work involved in the analysis.
C. Commodity-Specific DPCF

24. Demand-price conversion factors for specific commodities are required mainly for valuing major non-traded outputs such as electricity and rail transport. Such conversion factors are more project-specific since they require analysis of the change in consumption of other commodities that will occur when the project output becomes available. The changes will vary from project to project: one rail project may mainly replace road transport while another replaces water transport.

25. Calculating demand-price conversion factors entails finding the weighted average of the conversion factors for closely related complementary and substitute commodities and services. Since it is difficult to trace all likely changes in the consumption of other commodities, in practice, demand-price conversion factors should be based on the changes likely to occur in a few directly competing (or complementary) commodities or services. In the case of electricity, these may be other sources of energy, such as coal and petroleum products. In the case of any one mode of transport, it may be other modes of transport. The impact of a project must be assessed in some detail for all principal outputs.

26. In general, the benefits from infrastructure projects are expressed in terms of cost savings. For instance, in a road project this may be in the form of savings in fuel costs and other operating costs. In a port project it may be in terms of the savings in freight charges. In such cases, the cost savings must be disaggregated into components and the proper conversion factor applied to each component.

D. Group Conversion Factors

27. Group conversion factors are defined as weighted averages of commodity conversion factors. Apart from certain key commodities in a project, it is adequate to use group conversion factors. There are two major advantages in doing so. First, the GCF may be based on weights derived from a more general body of readily available data and will be of use when project-specific weights are
not available. Second, the GCF can be based on group-level data of the ratio of border prices to market prices, which may be easier to estimate than similar ratios for individual commodities. Therefore, it may be easier to calculate the GCF than specific CFs.

28. Group conversion factors may be calculated only for commonly encountered aggregates. On the project cost side, these may include civil construction, domestic machinery, transport and distribution margins. The shadow wage rate calculation requires GCFs for industrial output and agricultural output and a GCF for low-income consumption.

29. Each GCF should be calculated as a weighted average of the ratios of border prices to market prices for commodities directly or, as suggested below, from foreign trade and border tax data. Even when trade data are used, the weights for GCFs can be obtained from independent sources. The weights for the GCFs for civil construction, domestic machinery, transport and distribution margins can be derived from enterprise accounts, project reports or input-output tables. The weights for the GCF for industrial output may be obtained from a census of manufacturing or a similar source. Weights for the GCF for agricultural output from agricultural production statistics and those for the GCF for consumption may be based on available consumer expenditure surveys. GCFs can be estimated by averaging the conversion factors of the traded goods and non-traded goods using suitable weighting systems discussed above. For non-traded goods included in the weighting systems for which conversion factors are not available, the SCF can be used.

E. Standard Conversion Factor

30. The standard conversion factor is a group conversion factor for which the group covers all commodities produced or consumed in the economy. Hence, it should be calculated as the weighted average of the conversion factors for specific commodities or groups of commodities. However, certain short cuts can be used for calculating the SCF.
31. The commodities produced or consumed in the economy include both traded and non-traded commodities. The conversion factors for non-traded commodities could in principle be derived in terms of traded commodities. As in the case of GCFs, a suitable weighting system should be established. For example, instead of using trade weights, a weighting system derived from input-output tables may be used. However, trade weights, which generally are relatively easily available, would normally be adequate.

F. The Use of Trade Data

32. The ratios of border prices to market prices for a variety of commodities must be known in order to calculate GCFs and SCFs. These can be approximated from foreign trade data and net border taxes on the commodities concerned. This approximation is given by the "border value formula" as follows:

\[
\text{CF} = \frac{M + X}{(M + T_m) + (X - T_x)}
\]

where \( M \) and \( X \) are values of imports and exports in border prices, respectively, where \( T_m \) is revenue from import duties net of subsidies, and where \( T_x \) is revenue from export duties net of subsidies.

33. By use of this formula, conversion factors can be derived at any level of disaggregation permitted by the trade and revenue data. Generally, the limiting factor is the level of disaggregation of the revenue data. The GCF for any group can then be derived as a weighted average of a subset of these ratios, the weights being derived from consumer expenditure surveys, crop production estimates, or censuses of manufacturing.

34. The approximation suggested above may not be suitable if it appears that the spread between domestic prices and border prices is not fully accounted for by border taxes and subsidies. This is the case where significant non-tariff distortions exist. In such cases, a direct comparison of border prices with domestic prices should be attempted.
35. The simplest approximation for the SCF is given by the border value formula given above. However, this is a rather crude approximation because (i) it assumes that the shares of the various commodities in the total value of trade approximates the shares in production (or consumption), and (ii) it does not take into account the possibility that for some commodities the spread between domestic prices and border prices is greater than the net border tax.

36. A better approximation can be obtained by separating agricultural commodities from industrial commodities. A GCF for agricultural commodities can be calculated directly from data on domestic prices and border prices and the weights derived from agricultural production statistics. For industrial commodities, the GCF can be approximated by the border value formula. The SCF is then defined as the weighted average of these two GCFs:

\[
\text{SCF} = W_a C_a + W_m C_m
\]

where \(C_a\) and \(C_m\) are the GCFs for agricultural and industrial output and \(W_a\) and \(W_m\) are the weights attached to them, the weights being the relative shares of agriculture and industry in total production. 6

6 This is a supply-price SCF suitable for valuing non-traded inputs. Non-traded outputs generally should be valued in terms of border prices. However, if a demand-price SCF is required it can be calculated from the same formula, the relative weights being the shares of agricultural and industrial commodities in national expenditure rather than in national output.
IV. Conclusion

37. The guidelines presented here use conversion factors to value inputs and outputs in a way that reflects their real value to the economy and present methods for calculating them. The methods suggested use commonly available data and economize on user effort. However, since problems may arise in deriving conversion factors required immediately, a phased program is suggested for introducing conversion factors into the economic analysis of projects.

38. In the first stage an SCF is derived from trade and border tax data and the decomposition method is applied to a few major non-traded items. In the second stage, CFs and GCFs are estimated for major non-traded inputs and outputs and for major categories of inputs and outputs commonly encountered in project analysis. In the third stage, specific conversion factors for commodities and services in each country are derived. In each successive stage, further refinements may be introduced as more and better data become available.
ILLUSTRATION OF THE DECOMPOSITION METHOD

A. A Conversion Factor for Electricity

The numerical example regarding the conversion factor for electricity given in paragraph 3 can be used to illustrate the method of decomposition.

The first step is to estimate the cost of production which is, say, 60 cents per kWh. This may have been derived from the accounts of the national electricity agency or from a recent project report. The same source may also disaggregate this cost. Let us assume it is as follows:

- Fuel oil : 0.27 cents per kWh, i.e., 45%
- Operation & Maintenance (O&M) : 0.03 cents per kWh, i.e., 5%
- Capital charges : 0.30 cents per kWh, i.e., 50%

This is the first-round decomposition. Fuel oil is tradeable and can be valued directly at border prices. While the O&M component is small, and further decomposition is unnecessary, a second-round decomposition is desirable for capital charges.

The decomposition of capital charges may be based on the structure of capital costs from enterprise accounts, or, more likely, from a recent project report. Let us assume that it is as follows:

- Civil works : 10%
- Imported machinery : 58%
- Other domestic costs : 2%
- Transfer payments : 30%

These shares are then applied to the share of capital charges in electricity production. The imported machinery component can be valued directly at border prices. Transfer payments (mainly duties on imported machinery) should be excluded. Since the other domestic costs are small, only the civil works component should be decomposed further.
The third-round decomposition of civil works may be based on data on the structure of costs in factory construction, e.g., from more detailed project estimates. Let us assume that disaggregation of civil works costs is as follows:

- Cement: 20%
- Steel: 20%
- Unskilled labor: 40%
- Other domestic cost: 20%

These latter shares should then be applied to the civil works component in the second-round decomposition. Cement and steel can be valued directly at border prices, and unskilled labor is valued at the shadow wage rate. The other domestic cost component forms a substantial proportion of civil works costs, but its impact on the shadow price of electricity is limited since it constitutes only 2 per cent of the capital charge of 30 cents per kWh. Thus it need not be disaggregated further.

The conversion factor for the cost of production of electricity is derived from the decomposition presented above as follows:

- 0.45 times the CF for fuel oil
- plus 0.01 times the CF for steel
- plus 0.01 times the CF for cement
- plus 0.29 times the CF for imported machinery
- plus 0.02 times the SWR as a proportion of the market wage
- plus 0.07 times the SCF

The weights total 0.85 because the transfer payments were excluded from the capital charges component, these payments accounting for 30 per cent of capital costs and hence 15 per cent of electricity costs.

An SCF of 0.9 is assumed for the country; the ratio of the SWR to the market wage is estimated at 0.7 after valuing output foregone at border prices. The other elements are basically traded goods, and the conversion factor is simply the ratio of their border price to the market price implicit in the cost data. For imported machinery, we assume a CF of one since tariffs have already been
netted out. For steel and cement, we assume that domestic prices are 25 per cent higher than CIF prices, i.e., that the CF is 0.8. In the case of fuel oil, we assume that while the country is a net exporter, as a matter of policy, the price charged to power plants is kept well below the FOB export price. Thus the conversion factor is 1.93, i.e., the border price for fuel oil is 93 per cent higher than the domestic price paid by electricity plants. Assuming these values, the conversion factor for the cost of production of electricity is 1.2515, or 1.25.

The conversion factor is normally defined in terms of market prices since it is applied to project financial account data which are expressed in market prices. Hence the conversion factor defined above for the cost of production should be expressed in terms of market prices. To define the conversion factor in this way, simply multiply the ratio of the cost of production to the market price by the conversion factor calculated above, i.e.,

\[
\frac{\text{Border price}}{\text{Cost of production}} \times \frac{\text{Cost of production}}{\text{Market price}}
\]

In the example, the cost of production is 60 cents per kWh against a market price of 50 cents per kWh, i.e., thus the cost of production is 20 per cent higher than the market price. Hence the conversion factor for electricity is \(1.2 \times 1.25 = 1.5\).

B. A Conversion Factor for Road Transport

The second example illustrates the calculation of supply-price conversion factors. Since road transport is a commonly encountered non-tradeable item, it is used in the following example.

It is assumed that the road transport freight rate is 30 cents per ton-kilometer (tkm). There is no serious underpricing relative to costs but there is a freight tax of 2 cents per tkm; thus the "cost of production" of road transport is 28 cents per tkm.
Representative data on trucking operations are available, and the cost data are reconstructed in the following manner.

(i) A new truck costs $150,000 and is used for long-distance hauling for five years, after which it is sold for $50,000. Assuming a capital recovery factor of 12 per cent for five years, and taking account of the resale value at the end of five years, the annual capital charge is $33,750.

(ii) The truck's diesel consumption is one liter per 5 km and the domestic cost of diesel is $3 per liter. The cost of lubricants is 5 per cent of fuel costs.

(iii) The cost of drivers and other staff is $25,000 per year.

(iv) The cost of maintenance is 10 per cent of capital costs, i.e., $15,000 per year.

(v) The truck can carry 10 tons and it covers 50,000 km per year; 25 per cent of this represents unloaded return trips.

(vi) It is assumed that there is no other capital cost (e.g., for roads or terminal facilities).

Assuming these data, the cost of road transport can be disaggregated as follows:

<table>
<thead>
<tr>
<th>Cost per tkm (in cents)</th>
<th>% Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital charges</td>
<td>8.9</td>
</tr>
<tr>
<td>Fuel and lubricants</td>
<td>8.4</td>
</tr>
<tr>
<td>Drivers and staff</td>
<td>6.7</td>
</tr>
<tr>
<td>Maintenance</td>
<td>4.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>28.0</strong></td>
</tr>
</tbody>
</table>
This is the first-round decomposition. We assume that fuel and lubricants are traded goods, and that drivers and staff are semi-skilled workers. Capital charges equal only the cost of the truck which is assumed to be imported. Maintenance expenditures must be disaggregated further.

The composition of maintenance expenditures for a road transport corporation is as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labor</td>
<td>50%</td>
</tr>
<tr>
<td>Imported components</td>
<td>40%</td>
</tr>
<tr>
<td>Other costs</td>
<td>10%</td>
</tr>
</tbody>
</table>

The labor used in maintenance is assumed to be semi-skilled, and the SWR used is that for drivers in the first-round decomposition. The tariff on imported components is the same as that on imported trucks. The other costs component covers a large number of small items not analyzed further, but converted by the SCF.

Assuming the decomposition presented above, the conversion factor for road transport is calculated as:

\[
0.376 \text{ times the CF for trucks and components} \\
0.300 \text{ times the CF for fuel and lubricants} \\
0.310 \text{ times the SWR as a proportion of the market wage for semi-skilled labor.} \\
0.014 \text{ times the SCF.}
\]

We assume that trucks and imported spare parts are subject to a tariff of 20 per cent. Thus the CF for the trucks and spare parts is 0.83. Since we assume that fuel and lubricants are subsidized, the CF is calculated at 1.3. The SWR for semi-skilled labor is 0.8 times the market wage and the SCF is 0.9. Thus the CF for the cost of production of road transport is 0.9627.

Since cost of production of road transport is 28 per tkm and the market price is 30 cents per tkm, the CF for market prices is 0.8985, or 0.9.
Appendix 7
GUIDELINES FOR SENSITIVITY ANALYSIS IN
THE ECONOMIC ANALYSIS OF PROJECTS
A. Introduction

1. For projects for which most benefits can be quantified, standard Bank practice is to judge the economic viability of a project by its economic internal rate of return (EIRR). Calculation of the base-case EIRR essentially involves comparing the project’s expected cost and benefit streams, which in turn are based on the most probable values of key variables. Both the magnitude and the distribution of these streams over time are influenced by a wide variety of factors, and changes in these streams cause the EIRR to change. Sensitivity tests show the extent to which the EIRR changes when the values of key variables change. They thus provide additional information about the economic viability of a project that can be of considerable value when making decisions about extending Bank assistance.

2. The purpose of these guidelines is twofold. First, they inform new Bank staff as to how sensitivity tests are carried out in Bank project appraisal. Second, they ensure uniformity in the presentation of the results of sensitivity tests in future appraisal reports.

3. The procedures presented here should be followed for projects for which costs and benefits are fully or for the most part quantifiable. Sensitivity tests are also used to verify the cost effectiveness of projects for which the EIRR cannot be estimated because the benefits are for the most part not quantifiable. Projects in areas such as public health, education and family planning are clearly of this type. Sensitivity tests are not appropriate for projects comprising credit lines to development finance institutions since the subprojects to be financed have not been identified at the time the projects are appraised.

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2 The discussion here is limited to sensitivity analysis of the EIRR. Sensitivity tests should also be applied to the financial rate of return following the procedures presented here. They can also be applied to other indicators of the economic viability of a project such as benefit/cost ratios and net present value.
B. The Purpose of Sensitivity Analysis

4. Sensitivity analysis is carried out to determine how possible changes in events affect a project’s economic viability. While the EIRR is determined by the relative magnitudes of the project’s cost and benefit streams, sensitivity analysis estimates how changes in the values of key variables affect the EIRR. Examples of key variables include the prices and quantities of project inputs and outputs and the time required to bring project facilities into operation and to achieve target capacity utilization.

5. Sensitivity analysis involves three steps. The first step is to determine the changes in the value or quantity of each key variable most likely to occur. The next step is to determine the effect of each change on the cost and benefit streams and to calculate the EIRRs implied by these changes. Finally, the results obtained are interpreted and the implications explained.

C. Key Variables Affecting the EIRR

6. It would not be practical to examine the effects on the EIRR of all possible changes in every variable. Attention should therefore be focussed on the following key variables:

   (i) the prices and quantities of project outputs,
   (ii) the prices and quantities of project inputs, both for construction and operation of the project facilities,
   (iii) the level of capacity utilization of the project facilities, and
   (iv) the amount of time taken to commission the project facilities and to achieve target capacity operation.

7. The prices of project outputs\(^3\) partly determine the size of the benefit stream, while the prices of project inputs influence the cost stream. These sets

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\(^3\) Constant prices are used in calculating IRRs. Thus the changes in prices in these guidelines refer to relative price changes unless otherwise noted. See Appendix 10, “Guidelines for the Treatment of Price Changes in the Economic Analysis of Projects".
of prices can be most important in determining the viability of a project. Prices of some commodities, particularly primary products, often fluctuate widely and changes are difficult to predict. The prices of manufactured goods generally do not vary widely or rapidly.

8. The quantities of goods and services required for constructing project facilities may also be greater than originally estimated; if so, this may increase the project’s investment cost. Such a possible increase should always be considered.

9. The quantities of project outputs may also be less than anticipated for a variety of reasons. These include inadequate supplies of spare parts, power, or irrigation water. Such shortfalls will clearly affect project benefits. Further, the quantity of project outputs produced per unit of inputs may not reach the rate assumed in the calculation of the base case EIRR because of similar reasons such as inefficient use of inputs, a shortage of skills, difficulties in adjusting to a new technology, or inefficient management. All such possibilities should be considered.

10. The level of capacity utilization of the project facilities may also be lower than projected, thereby affecting both the project’s benefit and cost streams. The extent of capacity underutilization in power, transportation and industrial projects can be expressed as a percentage of the level of utilization assumed in calculating the base case EIRR. In irrigation projects, underutilization as indicated by the expected reduction in cropping intensity can be expressed as a percentage of that assumed in the base case EIRR. A lower-than-optimum level of capacity utilization reduces output and hence project benefits, even though it also reduces operating costs. The effects of capacity underutilization should therefore be expressed in terms of the net effect on the project.

11. The amount of time taken to commission project facilities and to achieve the target level of capacity utilization may be longer than that envisaged at appraisal. If project facilities are not completed as specified in the implementation schedule, both the cost and benefit streams will be different from those assumed in calculating the base case EIRR. It is further possible that even when the project facilities are completed on schedule there may still be a delay in
attaining the target level of output. In this case both the cost and benefit streams will likewise be affected. The effects of such a delay should therefore be expressed in terms of the net effect.

12. In cases where project benefits are derived from a single output, a given percentage change in the level of output will change the benefit stream by the same percentage. If the benefit or operating cost stream comprises a small number of items and the mix of these items remains constant, a given percentage change in one item will result in a percentage change in the former equal to the change in the item times the percentage share of the item in the benefit or cost stream. Where the cost or benefit stream comprises numerous items, the effect of a change in one item could be small. In such cases it would be sufficient to indicate the overall change in the cost or benefit stream and its effect on the project's EIRR.

13. Where several important items in the cost or benefit stream are likely to change during the project life, sensitivity tests for each should be performed.

D. Sensitivity Analysis and Presentation of Results

14. This section presents the guidelines for sensitivity analysis and presentation of results for Bank-assisted projects. A numerical example follows.

(i) The key variables should be examined and all relevant possible changes in them stated.\footnote{Favorable changes would enhance the viability of the project. Since the purpose of sensitivity analysis is to show whether the project would remain viable if circumstances less favorable than those assumed in calculating the base case EIRR prevailed only unfavorable changes are to be considered.} The basis for assuming these changes should also be clearly stated.

(ii) Changes in the prices or quantities of inputs and outputs that will affect either the benefit or cost stream should be expressed in terms of the resulting percentage change in the benefit or cost streams.
Where several factors affecting a benefit or cost stream are being considered, the expected maximum change due to simultaneous adverse changes should be assessed.

(iii) The range of EIRRs implied by the assumed changes in the benefit or cost stream should be calculated and presented.

(iv) Since several unfavorable changes may be considered, the results of simultaneous adverse changes should also be presented. In particular, the combinations of changes which have common causes or which tend to occur together should be tested. The combinations of changes tested and presented should be based on the project analyst's judgment.

(v) In cases in which EIRRs are calculated for individual subprojects, sensitivity tests should also be applied to each subproject.

(vi) A sensitivity indicator (SI) which shows the sensitivity of the EIRR to changes in the variable tested should also be presented. 5 SIs should be calculated for changes in benefit and cost streams, the rate of capacity utilization, and other key variables to which sensitivity tests have been applied.

(vii) If sensitivity analysis reveals that the viability of a project is highly sensitive to changes in any key variable, the assumptions made when examining the likely effects of changes should be carefully examined. If necessary, safeguard measures for alleviating or obviating such changes should be recommended. The measures so recommended or taken should be justified in the appraisal report after presentation of the results of the sensitivity analysis.

5 The sensitivity indicator (SI) is calculated as follows: SI = percentage change in EIRR/percentage change in the variable tested. For example, when the SI for the operating cost stream is 1.5, it means that a 10 per cent increase in operating costs leads to a 15 per cent decrease in the EIRR (say from 20 per cent to 17 per cent).
SENSITIVITY ANALYSIS: A NUMERICAL EXAMPLE

In this example, the purpose of the project is to construct a mill for producing two products: A and B. Product A is to contribute 60 per cent of total sales revenue while product B is to contribute 40 per cent. The mill is to be commissioned in four years and operated for 20 years, after which it will be scrapped.

A. Key Variables

Table 1 shows the quantities and values of the key variables used in the calculation of the EIRR for the base case and those chosen for the sensitivity tests.

The behavior of the prices of the project outputs in the past were examined and the likely future supply and demand for both were considered. It was then assumed that the worst case scenario would be a 10 per cent reduction in the prices of the outputs on the average throughout the project life.

Table 1. Quantities and Values of Key Variables Used in Base Case and Sensitivity Analysis

<table>
<thead>
<tr>
<th></th>
<th>Base Case</th>
<th>Sensitivity Analysis</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price of A</td>
<td>$10/kg.</td>
<td>$9/kg</td>
<td>-10</td>
</tr>
<tr>
<td>Price of B</td>
<td>$33.33/kg.</td>
<td>$30/kg</td>
<td>-10</td>
</tr>
<tr>
<td>Productivity for A</td>
<td>10 mt/day</td>
<td>9.0 mt/day</td>
<td>-10</td>
</tr>
<tr>
<td>Productivity for B</td>
<td>2 mt/day</td>
<td>1.6 mt/day</td>
<td>-20</td>
</tr>
<tr>
<td>Cost of Raw Materials</td>
<td>$500/mt</td>
<td>$600/mt</td>
<td>+20</td>
</tr>
<tr>
<td>Cost of Fuel Oil</td>
<td>$20/barrel</td>
<td>$28/barrel</td>
<td>+40</td>
</tr>
<tr>
<td>Capacity Utilization</td>
<td>300 days</td>
<td>270 days</td>
<td>-10</td>
</tr>
<tr>
<td>Construction Costs</td>
<td></td>
<td></td>
<td>+10</td>
</tr>
<tr>
<td>Commissioning of Project</td>
<td>Sept. 1991</td>
<td>Sept. 1992</td>
<td>Delay of 1 year</td>
</tr>
</tbody>
</table>

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While the agency responsible for operating the project has experience with the processes for producing both A and B, part of the labor force has no experience, particularly with respect to the production of product B. It is therefore possible that productivity might lag. Lower-than-expected productivity would reduce the cost of materials, but have no effect on other costs. To examine the sensitivity of project benefits to this possible decline in productivity, a productivity decline of 10 per cent for A and 20 per cent for B are tested.

While the cost of raw materials fluctuated widely before 1980, in that year a buffer stock arrangement came into operation that stabilized the prices of these commodities. Since changes in the prices of raw materials have been within a range of 20 per cent since 1980, an increase in the cost of raw materials of 20 per cent is tested.

The price of fuel oil has also fluctuated considerably during recent years and further increases may occur. An increase of 40 per cent in fuel oil costs above the base case level is chosen for testing. It is assumed that this increase will persist throughout the project life.

Other production costs, including salaries and wages, are expected to increase at the same rate as the domestic inflation rate. The mix of inputs and therefore in their shares in total operating cost is expected to remain constant.

There have been frequent interruptions in the electricity supply in the project area in recent years and these may continue during the period being examined. A reduction in capacity utilization of 10 per cent is therefore tested.

The prices of the materials used in constructing the project facilities are expected to increase, but at a rate equal to the domestic inflation rate. The quantities of inputs, however, could exceed those allowed in the estimates. The effects of a 10 per cent increase in construction costs are therefore tested.

The project is scheduled to be completed in September 1991, but because the executing agency is not familiar with Bank procedures, some delay is possible. The effects of a delay of one year are therefore tested.
B. Results of Sensitivity Tests

The results of the sensitivity analysis are presented in Tables 2 and 3. Table 2 shows the effects of changes in key variables on the benefit and operating cost streams. Table 3 shows the range of EIRRs calculated for the various assumptions and the sensitivity indicator for each.

The EIRR is most sensitive to changes in the benefit stream arising from changes in prices and productivity. However, past trends indicate that the prices of both A and B have been very stable. Further, analysis by consultants and other independent experts of the future demand for and supply of these products suggest stable or slightly increased prices for these goods. Thus a sharp fall in the prices of project outputs is not likely. As regards productivity, a fall below the base case level is a distinct possibility, at least for the first few years of operation because of lack of experience on the part of the labor force. In order to minimize the impact of such an eventuality, a specially designed training program for workers is included in the project.

The EIRR is also sensitive to reductions in capacity utilization, which could result from power supply interruptions. The Government has, however, given an assurance that priority will be given to improving the reliability of power supply in the project area during its next plan period, i.e., 1990-1995.

Three combinations of adverse changes are tested (see Table 3). The first combination includes a delay in project completion, a cost overrun (since these two generally occur together) and an increase in operating costs. If all three occur simultaneously, the project is still viable. The second combination tests increases in both investment and operating costs and a decrease in the prices of the outputs. The third combination tests a delay in construction, a decline in productivity and a reduction in capacity utilization. These tests show that if these combinations of adverse changes occur simultaneously, the EIRR decreases substantially, but the project remains viable.
Table 2. Effects of Changes in the Values of Key Variables on Operating Costs and Benefits

<table>
<thead>
<tr>
<th>Changes in the Values of Key Variables</th>
<th>Percentage Shares of Total (%)</th>
<th>Changes in Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From</td>
<td>To</td>
<td>(%)</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>1. Fuel cost</td>
<td>$20/barrel $28/barrel</td>
<td>+40</td>
</tr>
<tr>
<td>2. Raw materials</td>
<td>$500/ton $600/ton</td>
<td>+20</td>
</tr>
<tr>
<td>3. Combination of (1) and (2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**A. Operating Costs\(^a\)**

1. Price of A                           | $10/kg $9/kg                 | -10 | 60 | -6 |
2. Productivity of A                    | 10 tons/day 9.0 tons/day     | -10 | 60 | -6 |
3. Price of B                           | $33.33/kg $30/kg             | -10 | 40 | -4 |
4. Productivity of B                    | 2 tons/day 1.6 tons/day      | -20 | 40 | -8 |
5. Combination of (1) and (3)           |                               | -10 | 100 | -10 |
6. Combination of (2) and (4)           |                               | -14 | 100 | -14 |

\(^a\) The remaining 40 per cent comprises of labor and other costs.
Table 3. Sensitivity Analysis

<table>
<thead>
<tr>
<th>Change (%)</th>
<th>EIRR (%)</th>
<th>Sensitivity Indicator&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Case</td>
<td>—</td>
<td>22.01</td>
</tr>
<tr>
<td>1. Investment Costs</td>
<td>+10</td>
<td>20.36</td>
</tr>
<tr>
<td>2. Operating Costs</td>
<td>+15</td>
<td>20.66</td>
</tr>
<tr>
<td>3. Output Prices</td>
<td>-10</td>
<td>19.24</td>
</tr>
<tr>
<td>4. Productivity</td>
<td>-15</td>
<td>18.52</td>
</tr>
<tr>
<td>5. Capacity Utilization</td>
<td>-10</td>
<td>19.81</td>
</tr>
<tr>
<td>6. Delay in Construction</td>
<td>one year</td>
<td>20.21</td>
</tr>
<tr>
<td>7. Combined Unfavorable Assumptions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(a) Combination of (1), (2), and (6)</td>
<td></td>
<td>17.63</td>
</tr>
<tr>
<td>(b) Combination of (1), (2), and (3)</td>
<td></td>
<td>16.32</td>
</tr>
<tr>
<td>(c) Combination of (4), (5) and (6)</td>
<td></td>
<td>15.33</td>
</tr>
</tbody>
</table>

<sup>a</sup> The sign of the indicator (positive or negative) need not be shown.
Appendix 8
PROJECT RISKS
PROJECT RISKS

1. It is normal Bank practice to include a short summary of project risks in each appraisal report. The purpose of this appendix is to provide general guidelines for presenting this summary of project risks in order to help ensure uniformity and consistency in appraisal reports. Section I relates to projects for which economic benefits can be quantified and Section II deals with projects for which such quantification is not possible.

I. Projects with Quantified Benefits

2. The economic internal rate of return (EIRR) is the measure most often used to indicate the economic viability of Bank-financed projects. Calculation of the EIRR requires a set of assumptions regarding the conditions faced by the project which in the judgement of the appraisal mission are most likely to prevail during its life. However, since Bank-financed projects normally have a very long life, the conditions faced by the project may change for a variety of reasons. Sensitivity analysis is therefore carried out to determine the effects of possible changes in the values of key variables (costs, yields, and prices of inputs and outputs) on the project's EIRR.2

3. The number of risks facing a project could be large, and it is neither possible nor desirable to identify all possible risks associated with a project. The risks discussed in the appraisal report should essentially be those which entail major economic consequences. These should be identified from the sensitivity analysis and described in descending order of importance with regard to their impact on the EIRR.

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2 See Appendix 7, "Guidelines for Sensitivity Analysis in the Economic Analysis of Projects".
4. Particular attention should be paid to risks that would substantially reduce the project's EIRR or render the project uneconomic by reducing its EIRR below the opportunity cost of capital.\(^3\) In this context, both the base-case EIRR and the sensitivity indicators are relevant. If the base-case EIRR is high, the discussion of project risks should generally include risks to which the project is highly sensitive. For example, the EIRR of most projects is highly sensitive to changes in project output, which may in turn depend on a number of factors. A discussion of the safeguards employed to minimize the risk of the outputs falling substantially below the level expected should therefore be included. For example, in an irrigation project, apart from availability of water, output may depend on the supply of other inputs, provision of extension services, effectiveness of water management by farmers' groups, and availability of adequate infrastructure and storage facilities. Measures taken to ensure adequate and timely availability of each should be briefly explained.

5. In road projects, the major risk may be confined largely to securing a right-of-way. Failure to obtain it may not only increase project cost, but may delay or reduce the project benefits. Thus the mission should specify the measures taken or proposed for minimizing these risks. Mention should also be made of the relevant assurances obtained from the Government or Executing Agency.

6. Risks are obviously greater in projects for which the base-case EIRR is only marginally higher than the opportunity cost of capital. These larger risks are even greater if the EIRR is highly sensitive to changes in key variables since even a small reduction in the EIRR would render the project unviable. Even when the EIRR is relatively insensitive to changes in key variables, combinations of adverse changes might easily affect the project's viability. Thus in such cases the remedial actions proposed or adopted should be fully explained.

7. Many projects provide for establishing a project management office and for recruiting consultants to ensure smooth project implementation. While these arrangements should be discussed in the appropriate sections of the appraisal

\(^3\) While the opportunity cost of capital varies among countries, a minimum EIRR of 10 to 12 per cent is generally acceptable to the Bank.
report, they should be summarized under the discussion of project risks if the EIRR is relatively sensitive to delays in project implementation, and especially if such a delay would adversely affect project viability.

8. If the project output is traded internationally, one risk may be future changes in the price of the output, particularly if the share of a project or country output is small relative to the world market. In such cases, a review of world demand and supply forecasts for the good in question should be included.

9. By their very nature, certain types of projects such as gas and oil exploration involve very high risks. For such projects, it is necessary to supplement the sensitivity analysis with a probability analysis. The latter provides a range of possible outcomes in terms of a probability distribution and based on that project-related decisions could be made more intelligently. But the analysis is more complex and requires more information about events affecting the project. Due to the considerable work involved, probability analysis of risks is usually undertaken only for projects carrying a high degree of risk or for large projects where miscalculations could lead to a major loss to the economy. For such projects, the nature of the risks involved and the measures taken or recommended to minimize the risks together with results of the analyses should be discussed in the appraisal report.

II. Projects for which Benefits are not Quantifiable

10. For projects in certain sectors or subsectors such as education, health, sanitation and family planning, project benefits cannot be quantified and the risks cannot be measured by sensitivity analysis. In such cases, the relationship of project risks to the project's objectives should be explained. The eventualities that might impede realization of the objectives should be discussed in relation to the project cost and output, and also in relation to the socioeconomic objectives sought by the project.

11. As in the case of projects for which benefits can be quantified, the risks relating to both the costs and benefits of the project should be discussed. In
projects of this type, investment costs primarily relate to construction of buildings and provision of equipment and supplies. The risks on the cost side thus relate to factors which could delay project implementation. These may include timely provision of local currency funds, the implementation capacity of the project authority and the availability of land.

12. In such projects, the risks are greater on the benefit side than on the cost side. For instance, in education projects, school buildings and equipment are provided to help achieve a prescribed annual output of graduates with a certain skill level. However, provision of the facilities alone may not ensure achievement of the project objectives. Their achievement may depend more upon the availability of trained teachers, provision of sufficient funds for the recurring expenditures of the institutions, curriculum and admission standards, and motivation of the students.

13. While it is not possible to eliminate all such risks, it is essential to minimize them. Major risks of this type should be identified and explained along with the remedial measures proposed in the section in which project risks are discussed.

14. The real benefits of this type of project relate to broad socioeconomic goals. For education projects, these may include increased income levels for the trainees and a higher level of industrial and agricultural productivity. For family planning projects, the broad goals may be an increased number of acceptors and a consequent reduction in the rate of population growth. The success of such projects thus depends not merely on the facilities provided, but also on the continued favorable conditions assumed by the appraisal mission. For such projects, the assumptions made regarding the relationship between the facilities provided and project's long-term objectives should be clearly explained. The conditions or facilities necessary but external to the project should also be identified, together with relevant assurances received from the Government. For projects such as these, this is one of the most important aspects to be discussed in the section dealing with project risks.
III. Conclusion

15. As the problems and risks facing each project are unique, it is not possible to prescribe a standard format. The selection of project risks to be presented must thus be based on the appraisal mission's judgment. Nevertheless, the discussion of the project risks in the appraisal report should be concise, and should normally not exceed two or three paragraphs.
Appendix 9
GUIDELINES ON THE TREATMENT OF WORKING CAPITAL
IN THE ECONOMIC ANALYSIS OF PROJECTS
Appendix 9

GUIDELINES ON THE TREATMENT OF WORKING CAPITAL
IN THE ECONOMIC ANALYSIS OF PROJECTS

1. The purpose of these guidelines is to describe the concept of working capital and discuss its treatment in the financial and economic analysis of projects. Working capital is generally defined as the amount of current assets provided by a firm or project entity from long-term sources, such as long-term debt or shareholders' equity, for running an enterprise. The common measure of working capital in financial accounting is the excess of current assets over current liabilities. While this concept has an important application, particularly in assessing the ability of an enterprise to meet its short-term obligations, some adjustments are called for in estimating the financial and economic rates of return of a project.

2. Working capital is generally distinguished from long-term investment in fixed assets of an enterprise, though both represent costs, and both must be taken into account in estimating total project cost. These guidelines explain the need for the inclusion of working capital in project cost and the method for estimating it. The guidelines also describe the components of working capital usually included in financial accounting and those components that constitute real economic costs, which should be included in the economic analysis of projects.

A. Justification of Working Capital in Project Analysis

3. Fixed investment in projects is required to create the necessary capacity to produce the desired output. The capacity created is utilized in production processes by applying current inputs — materials, labor and other services — to realize the output. The production process may be continuous, as in the case of most manufacturing processes, or may be seasonal or periodic, as in the case of agricultural production. In any case, a certain period of time elapses between the application of inputs and the realization of outputs; a certain amount of time is also required between production and marketing. In order to make full use of productive capacity over time for a given process, it is necessary that the enterprise hold at any given time a certain minimum stock of raw materials,
goods in process, semifinished goods, and finished products. The monetary value of these inputs mainly constitutes the working capital requirement of an enterprise.

4. By convention, one year is normally taken as the accounting period in project analysis. During the course of one year, the working capital of a project or enterprise may be turned over a number of times, depending on the nature of the production process or processes involved. The greater the turnover, the lesser the requirement for working capital in relation to the output or returns of the project.

5. The need to take working capital into account and the different ways this can be done can be illustrated in a simplified hypothetical example. Suppose a project with an initial fixed investment of $1,000 produces a net annual return of $250 for 15 years, the return of $250 being the difference between sales revenues of $1,000 and operating costs of $750. The amount of working capital the project uses is $375. If the working capital is ignored, the project's cash flow is as follows:

- Outflow of capital for fixed assets in base year: -$1,000
- Inflow of annual returns for years 1-15: +$250

With these cash flows, the IRR for the project works out to 24 per cent.

6. If, on the other hand, the working capital is taken into account, one would reach the very different result, shown below:

- Outflow of capital for fixed assets in base year: -$1,000
- Provision for working capital: -$375
- Inflow of returns for years 1-15: +$250
- Value of working capital at end of year 15: +$375

The working capital is added to the capital cost estimate, but since the working capital remains intact at the end of project life, this is listed as a credit.
in the last year. The IRR for this cash flow works out to about 17 per cent.\(^1\)

7. It is proposed that this method be used in the economic analysis of projects in which benefits and costs accrue to the same entity.\(^2\) However, there may be situations in which costs are incurred by one entity while benefits accrue to another entity (such as agricultural projects). In such a situation the real cost of working capital should be deducted from the cost of the former and added to the cost of the latter in estimating the net benefits of the entities.

**B. Application to Financial and Economic Analysis**

8. The standard accounting definition of working capital includes the following:

   (i) stocks of raw materials and stores,
   (ii) work-in-progress,\(^3\)
   (iii) stocks of finished goods
   (iv) advance payments for purchases less advance receipts from sales,
   (v) sales on credit less purchases on credit, and
   (vi) cash and bank balances.\(^4\)

9. Financial analysis should take account of all of these items. All of them generally appear in the accounts of industrial projects; for projects in other sectors, working capital requirements should be clearly identified and included in the financial cost of the project.

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1 In this example, fixed investment is assumed to take place without much time lag. Therefore, working capital is also assumed to be needed in the base year. In practice, fixed investment occurs over several years, but the full amount of working capital is required in the first year of full operation.

2 Where IRRs are being recomputed (for review missions, supplementary loans, PCRs and PPARs), account must be taken of inventory changes from year to year for ex-post data.

3 Work-in-progress includes the value of goods, services and labor in the production process as of the end of the accounting period.

4 This also includes marketable securities.
10. The first three items listed in paragraph 8 clearly represent stocks of goods that would be available for other uses if the project were not implemented. Thus the first three items represent a real cost and should be taken into account in the economic analysis. The provision for work-in-progress relates to the gap between the application of inputs and the production of outputs which was dealt with earlier (in para. 3). It is essential that the provision for work-in-progress not only include the cost of material inputs used, but also the cost of non-material inputs such as labor and electricity.

11. The fourth and fifth elements in the accounting definition do not represent real costs, but are merely credit transactions. Because no resources would be released for other uses if the project were not implemented, these items should not be taken into account in the economic analysis.

12. The "cash and bank balances" element is likewise not a real resource cost except in a very indirect sense. If the project were implemented, the reduced requirement for money in the economy would not release any real resource for any other use. Thus the cash requirement included in the project’s financial accounts should also be excluded from the economic analysis.

13. The definition of working capital for economic analysis has, as noted earlier, been based on the project’s financial accounts. The provision for inventories and work-in-progress in these accounts is based on domestic market prices. For purposes of economic analysis, these must be revalued in terms of border prices. This may be done by using CIF or FOB prices in the case of traded goods and by applying relevant conversion factors in the case of non-traded goods.

14. Demand for inventories of raw materials and finished goods by the project varies with the nature of the production process and the institutional arrangements for purchase and sale. It is quite possible that additional stocks of

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5 Including finished goods, raw materials and stores.
6 See Appendix 6, "Guidelines for the Use of Conversion Factors in the Economic Analysis of Projects."
raw materials and finished goods will be held in part by organizations other than the project entity. Thus, it is desirable that inventory requirements be assessed on the basis of norms that relate to the level of consumption of inputs and production of outputs. All increases in inventories held by the project entity or other entities due to the project should be taken into account in the economic analysis.

15. Working capital may be underestimated or overlooked in a project in which fixed assets are created by the project entity, but in which the production process is undertaken by other entities. Irrigation projects and other projects in agriculture or related sectors provide many examples of this. In these projects, the cash flow used for rate of return calculations is usually specified as an outflow from the capital account and as an inflow resulting from a series of net returns in crop production, fishery production or some other activity accruing to beneficiary households or enterprises. The net return is calculated as the difference between sales revenue and operating cost. However, if this procedure is used, the analyst may ignore or underestimate the working capital necessary for realizing the net return. This can be avoided by ensuring that the working capital requirements of the project as a whole, including those of individual production units, are explicitly estimated and taken into account.

C. Conclusions

16. The analysis presented above suggests the following:

(i) For financial analysis of projects, working capital should be defined according to usual accounting conventions and added to the fixed cost of a project.

(ii) For the economic analysis of projects, working capital should include only inventories and work-in-progress.

(iii) The value of stock of inventories and work-in-progress required for sustaining the project’s production process should normally be included in the economic cost of the project.
Appendix 10

GUIDELINES FOR THE TREATMENT OF PRICE CHANGES IN THE ECONOMIC ANALYSIS OF PROJECTS
GUIDELINES FOR THE TREATMENT OF PRICE CHANGES IN THE ECONOMIC ANALYSIS OF PROJECTS

A. Purpose of the Guidelines

1. Prices are basic parameters that determine the economic viability of projects. Therefore, proper treatment of the prices of inputs and outputs is crucial in the economic analysis of projects. Prices do not remain unchanged over a long period of time. Since the life of most projects extends over several years, the project analyst is required to make assumptions regarding likely changes in the prices of at least the major inputs and outputs of the project for several years into the future. This is a difficult task as a multitude of factors influence price changes. The purpose of these guidelines is to clarify major issues in the treatment of price changes in the economic analysis of projects and to recommend approaches to price projection.

B. Characteristics of Price Changes

2. All prices are subject to change. While some prices remain stable for a considerable time, others change more frequently. The prices of some commodities such as fresh fish change daily depending on the supply of these commodities to the market. While the supply of and demand for commodities and services determine their respective daily, monthly and yearly prices, they are in turn influenced by a variety of factors. These include weather conditions, length of gestation period, the flow and character of investment, ease of storage and distribution, fashion, taste, technology, general business conditions and income levels, government interventions and natural calamities.

3. These influences may be characterized as secular or long-term, seasonal, cyclical, or random. Some of these influences reinforce one another while others counteract each other. Consequently, projecting the prices of commodities for several years into the future is difficult. Even with the best of effort and judgment, price projections are subject to considerable error.

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C. Measuring Price Changes

4. Changes in prices over time may be either "real" or "nominal" or both. If the nominal prices of commodities increase at a uniform rate, their relative prices remain unchanged and therefore no "real" price changes have occurred. On the other hand, if the price of a commodity remains unchanged while the prices of all other commodities rise, then a real price decline has occurred for that particular commodity. Thus it is only when the price of a commodity changes more than or less than the prices of other commodities that there is a real price change for that commodity.

5. Prices may or may not move in the same direction at the same time. Even when they do move in the same direction as in times of high inflation, they do not move at the same rate. Some prices change quickly while others change relatively slowly. A change in the real price of a commodity should therefore be measured in relation to the change in the general price level over the same period. When changes in real prices need to be measured over several years as in project analysis, the reference prices must remain "constant" or "fixed" in order to obtain consistent results. Thus the recommendation that "costs and benefits should be measured in constant prices" implies that changes in prices should be measured with reference to prices prevailing in the year of appraisal of a project. In this context, the term "base year prices" refers to average nominal prices prevailing in a particular year used for reference when measuring real price changes in succeeding years. "Current" prices refer to the average nominal prices prevailing in the preceding or succeeding years.

D. Price Projections

6. Since the economic life of most Bank-financed projects extends over many years, it is necessary to make use of relevant price projections for project inputs and outputs. However, even when price projections are available from reputable sources, the project analyst should carefully assess the validity of these estimates. When in the judgment of project staff these price projections are not appropriate, alternative price projections should be used, provided adequate justification is given in the appraisal report. For commodities for which no price forecasts
are available, the project analyst must make his own estimates. The choice is then between using base year prices or making estimates based on the analyst's own judgment. If the base year prices are likely to change, the analyst should take past trends into account and use demand and supply projections to make price projections for use in the project analysis. In all cases the project analyst should describe the sources, method and assumptions underlying the price projections used.

7. While there are a number of international and private agencies engaged in price forecasting, a major exercise in real and nominal price forecasting of 42 key agricultural and non-agricultural commodities including mineral and fuels is carried out biennially by the World Bank covering a 10 to 15-year time horizon. The individual commodity forecasts are updated at six-month intervals to take account of emerging trends. The World Bank Commodity Price Projections (WBCPP) are the product of a large pool of resources for obtaining international information, modeling competence and judgment of experienced staff. Despite these very distinct features, a review of the projections done in the past ten years has shown that there was large divergence between projections and actual prices and that the projections themselves had undergone large revisions in relatively short periods of time. This implies that the task of the project analyst is extremely difficult.

8. Despite these limitations, there are several advantages in using the World Bank's price projections: (i) the projections are readily accessible and regularly revised; (ii) they incorporate both minor and major expected shifts in relative

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2 The projections are derived from two linked modelling exercises. First, a central macroeconomic scenario is compiled to portray the expected evolution and interaction of the main determinants of world development. The major inputs to this exercise are assumptions concerning GDP growth in the world's major trading blocs, and demographic trends. Second, the prospects for each commodity are considered on a case-by-case basis by using models which fall into two broad categories: formal market price clearing models and less formal long-run marginal (or average) cost models. Exogenous information concerning production developments in key countries and likely changes in market structures and demand patterns are used by the analyst in modifying results.
prices, particularly those resulting from changes in the relationship between the value of commodities and the value of manufactured goods; (iii) the projections extend beyond the medium term, which makes them particularly relevant to projects with long gestation or development periods; and (iv) their use promotes interinstitutional consistency as they are widely used by other international lending agencies.

E. Recommendations

9. It is recommended that in all projects for which costs and benefits extend over long periods, analysts give explicit consideration to the projection of price relativities. The WBCPP should normally be used in estimating project benefits and costs. The projected prices should be expressed in terms of prices prevailing in the year of appraisal. When the base year used in the WBCPP is different from that used in project appraisal, the MUV index should be used to arrive at base year prices. Since project benefits often continue to accrue 20 to 30 years after project completion, the latest year for which projections are available should be used for estimating project benefits. For example, if the latest price projection given by the WBCPP is for the year 2000, then the prices of the inputs and outputs projected for that year should be used in estimating the net benefit of the project for that year and beyond. For the intervening period (i.e., for the period between project completion and the year 2000) a trend line could be used in estimating the prices of inputs and outputs for each year based on the WBCPP.

10. Since the prices prevailing in the base year are often very different from those projected, an estimate of the EIRR using base year prices should be included in the sensitivity tests. The implications of this price sensitivity should be fully discussed in the section dealing with project risks.

11. For commodity program loans, where costs and benefits normally accrue over two to three years, the base year prices of inputs and outputs should be

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3 The manufacturing unit value (MUV) index is used as a deflator for estimating the real projected prices of primary commodities.
used in estimating the net benefit of the projects since price changes over a short period are not likely to be significant.

12. The recommendations made in paragraph 9 above should not preclude exercise of judgment on the part of the project analyst regarding price projections. If the World Bank Commodity Price Projections do not seem to be realistic, alternative price projections may be used, provided that adequate justification is given for using them. Care should be taken to ensure that the price estimates used are consistent for all projects in the same sector or subsector appraised in the same year.

13. If price projections for major outputs and inputs are not available from the WBCPP, the project analyst should make his own estimates based on the prices prevailing during the year of appraisal, recent trends, foreseeable changes in supply and demand, and the projections, if any, made by other organizations. In cases where base year prices appear to be representative and no major shifts in supply and demand are expected, the base year prices of inputs and outputs may be used. In all cases the project analyst should describe the sources, methods and assumptions underlying the price projections. If necessary, the Economics Office could be consulted regarding the projections to be used.

14. The above recommendations apply to commodities which are internationally traded. In most projects some inputs or outputs are non-traded. Where these constitute only a small part of the total, the prices prevailing in the year of appraisal may be used for the entire life of the project. For commodities which are close substitutes of internationally traded goods for which World Bank Commodity Price Projections are available, the price ratios between the traded substitutes and non-traded input during the base year could be used in extrapolating the prices of non-traded inputs.

15. In the economic analysis of projects, the capital cost is generally estimated on the basis of the base year prices of the major items of machinery, equipment and construction materials required by the project. The rationale for doing so is that the construction period is generally short and the changes in relative prices which do occur during the period are not likely to be significant. The provision for general price inflation used in estimating the financial cost is
excluded from the estimate of the real capital cost. While the present practice of estimating the real capital cost of projects is appropriate and should be continued, care should be taken to ensure that if expenditure on commodities included in the WBCPP (e.g., oil) constitutes a significant portion of the investment cost, then changes in the relative prices of these commodities should be taken into account in estimating the real cost of the project, particularly if substantial real price changes are expected. Further, for projects for which the construction period is quite long and for which the domestic construction cost component is large, changes in construction costs which exceed or fall short of the general increase in prices should also be taken into account in estimating the economic cost of construction.

F. Conclusion

16. In a world of rapid changes, the relative prices of commodities tend to change because of a variety of factors influencing demand and supply relations. Since relative price changes alter the claim of different commodities on the real resources of a country, these should be taken into account in the economic analysis of projects. The World Bank makes price projections for 42 commodities biennially and revises them every six months. Although the track record of these projections is mixed, there are several advantages in using them. It is recommended that where possible and appropriate, these projections should be used in estimating the real value of outputs and inputs in project analysis. However, base year prices should also be used in estimating price sensitivity of projects. In situations where the World Bank Commodity Price Projections are not available, the project analyst should exercise his own judgment in estimating project benefits and costs, taking into account procedures mentioned in these guidelines (see paras. 11 to 15).
Appendix 11
GUIDELINES FOR THE ECONOMIC ANALYSIS OF EDUCATION PROJECTS
GUIDELINES FOR THE ECONOMIC ANALYSIS OF EDUCATION PROJECTS

I. Introduction

1. These guidelines relate to the economic analysis of education projects. They do not discuss technical or pedagogical aspects of education. Instead, they refer to economic considerations relevant to education projects, and to methods of assessing the costs and benefits of such projects. In large part, they reflect the methodology currently in use in the Bank.

II. Sectoral Objectives

2. The economic analysis of education projects should begin with discussion of sectoral objectives. The objectives of the education system in the country concerned, the existing institutions and their performance, and the role of the government should be included in this discussion.

A. Objectives

3. The objectives of the education sector and the institutions instrumental in realizing them should be assessed in relation to the overall development goals of the country. A brief overview of the economy and the social development of the country concerned should therefore be included.

4. The multifaceted nature of the objectives of education should be recognized. The primary goal of education is that of providing knowledge and skills that enhance productivity and thus contribute to economic growth. Other goals include promoting national unity, developing individual’s personality, promoting both ethical behavior and culture, and fostering equality of opportunity.

5. It is necessary to state clearly the goals and objectives as well as the priorities in education in a coherent and consistent manner in order to appraise the policies, programs, projects and activities that are undertaken to realize them. This may not always be easy especially in situations where the social and economic goals which predetermine those relating to education are themselves stated loosely in general terms. However, clarifying the goals and priorities is a necessary process of appraisal where the means and ends need to be related in a meaningful manner.

B. Review of the Education System and the Role of the Government

6. While in many developing countries, private educational institutions are important elements of the education system, government plays a key role, since policies and standards are formulated and supervised by it. The government also gives financial support to private educational institutions in addition to directly administering state-run schools and universities. A brief review of the system and how efficient it is in fulfilling national educational goals should be included in the appraisal report.

7. The performance of the education system in part depends on the level of priority given by the government to education, particularly in terms of budgetary allocations. The current level of budgetary allocations and the planned changes in the near future are important factors in reviewing the education system and the individual project or program. This aspect is particularly important when a project or program calls for an abrupt or substantial increase in budgetary allocations.

III. Project Objectives and Assessment of Needs

A. Project Objectives

8. An education project is normally an extension or improvement of certain
aspects of the education system. Its objectives must therefore correspond to the country’s overall educational goals. Since a project constitutes a part of the system, its objectives would have to be limited but more specific in terms of targets. For example, a project aiming at eliminating illiteracy would have to spell out its objectives in terms of area, level, and target group. This normally presents no problem. However, there can be cases in which the project objectives though corresponding to some of the general objectives might be in conflict with another general objective. For instance, an expansion of tertiary education might be in conflict with the general objective of promoting equity and this might require some compromise or trade-off. In such a case the appraisal should clearly spell out the need for and the extent of the trade-off between objectives.

B. Assessment of Needs

9. Once the objectives are established, a project is designed to provide certain facilities, services, activities or products to fulfill them within the resources made available. A review of the existing education system is necessary to bring out the areas where improvements would be needed and thus help in formulating both the project objectives and the activities in broad terms. In formulating a project proposal as well as in its appraisal, a more thorough analysis should be carried out to establish that the facilities, services, products, or activities to be provided by the project are essential to meet the educational objectives and that limited resources are put to most effective use.

10. Two approaches for the assessment of needs are generally used in the education sector. These are the “social demand approach” and the “manpower requirements approach”.¹

¹ There is another approach popular in some circles which may be termed “intrinsic value approach”. In this approach education is taken as intrinsically good in any amount. While no one would deny the intrinsic value of education, this approach is not useful for determining the need, since the need is simply taken for granted in this approach.
1. **Social Demand Approach**

11. The social demand approach accommodates the will or desire of the government and the people to provide a certain level or type of education to the citizens on the basis of ethical, social or political considerations. Specifying primary education as a basic need of the people illustrates the social demand approach. Sometimes the need is defined more specifically. For example, instead of saying that primary education is a basic need of all citizens, it might be specified that all citizens in a certain age group (say between five and ten years) should have access to primary education. Flow models based on population and income growth, etc., are often used to specify the targets.

12. The social demand approach is obviously a sociopolitically oriented approach. It is the expression of the desire of the general public expressed through the country's political leadership. A major weakness of this approach is that there is no clear link between capability or means on the one hand and objectives and goals on the other. Moreover, the objectives are seldom attainable in the short or medium term. However, the approach provides a broad framework within which national long-term educational objectives may be defined. In the case of primary and mass education, this approach is generally regarded as adequate in assessing the needs. For technical and higher level education this should be supplemented by the manpower requirements approach.

2. **Manpower Requirements Approach**

13. The manpower requirements approach is more directly oriented towards the development goals. In this approach, education is seen as instrumental in attaining national development objectives. It is operationally more concrete and yields results which are amenable to a quantitative assessment. The basis of this approach is a realization that in order to achieve development objectives, investment in physical capital alone is not sufficient, and a complementary investment in human capital is necessary. Skilled manpower is as necessary as plants, machinery, equipment and tools to boost national production and productivity and to achieve other national development goals. In this approach, it is assumed that there is a functional relationship between the development objectives and manpower needs. This relationship is usually expressed in terms
of manpower coefficients. Thus, given the development objectives, manpower needs can be determined for the whole economy or any branch thereof provided the coefficients are known.

14. One major practical problem with this approach is lack of sufficient data. Some countries may have only rough or rudimentary manpower planning. In most cases the analyst will have to rely on some basic data such as the population census and labor and employment statistics. Manpower coefficients in another country with a similar background, if available, could also be used as proxies. Where such proxies are used similarities as well as dissimilarities in conditions and background should be fully taken into account. In some countries where even basic data are not available, a limited survey should be conducted at the feasibility study or pre-appraisal stage. In all cases, the experience and judgment of the analyst would be crucial.

C. Target Group and Impact Identification

15. Once the need for a project is established either through social demand consideration or manpower requirements approach (or through both) the appraisal should identify the target group to which the project is directed. This is essentially part of the project designing process. Ultimately, the project might benefit the whole population but the immediate impact of the project will be only on a limited number of people. They are the people who may bear the cost (or part of the cost) and may also be the direct beneficiaries of the project. In addition to their number, the beneficiaries should be identified to the extent possible, by location, income level and social and educational stratification so as to enable an assessment of the project impact. Outlining an impact tableau could be useful as it will facilitate the assessment of the project impact not only for the appraisal but also for the preparation of project completion and post-evaluation reports and in the project benefit monitoring and evaluation processes.
IV. Financial Implications

16. Education, whether formal or informal, involves some expenditure on space, equipment, services of instructors, etc. Although financial costs may not always constitute the total cost of a project, they are an integral part of it. A detailed analysis of the financial costs of a project is necessary in order to assess the funding arrangements, determine cost-effectiveness, and appraise the distributive impact of the project.

A. Budgetary Implication

17. In most education projects, the government is the primary source of funds which are provided out of the budgetary receipts. The budgetary allocations to education vary among countries generally ranging from 3 per cent to 15 per cent of their budgets. In most countries, while the recurrent expenditure on education is financed through current budget, investment expenditure for the establishment of new facilities is met through the capital budget. The capital expenditure can vary substantially even though recurrent expenditure on education as a proportion of total recurrent expenditure may remain more or less constant. The appraisal should assess the adequacy of the budgetary allocations to meet the estimated project expenditure in a sustained manner. When a large and abrupt increase is expected as a result of a project, the appraisal should explain the nature of the increase, assess the capability of the government to mobilize the resources and its funding arrangements as well as its commitment to implement the project. A similar assessment should also be made of private institutions if they constitute a component of the project under consideration.

B. Financial Impact on Target Group

18. When funding arrangements involve recovery of whole or part of the project cost, the impact of such a recovery scheme should also be taken into account. This involves two important considerations. The first relates to the
question of affordability and the second relates to the question of equity. In
government education projects, fees usually constitute a fraction of the total
cost though the financial impact on the beneficiaries may be significant in relation
to the level of income of the target group.

19. The question of affordability may not be fully answered from the study of
the financial impact alone, since education also involves other costs. In
addition to fees, there are out-of-pocket costs for a student such as expenses
for the purchase of books and transport as well as the opportunity cost of forgone
earnings. Where such costs are significant, they should also be taken into account
in assessing the financial impact on the target group.

C. Distributive Impact

20. Most education projects have some distributive impact when education is
provided at less than its full cost. This subsidy involves a transfer of resources
from one section of the general public to another. When such a subsidy is mainly
enjoyed by the low-income groups, the project has a positive distributive im-
 pact. An education project could have either a positive, neutral or negative
distributive impact depending on the objectives and design.

21. Generally, tertiary education projects involving large budgetary subsidy tend to have a negative distributive impact, while primary education projects are likely to have a positive impact. A possible adverse effect in many cases could be mitigated by raising the fees and introducing a suitable cross-subsidization scheme for students from low-income families. Similarly, the positive impact of primary education can be reinforced, for example, by free distribution of textbooks and school lunch to poor students. The project feasibility and appraisal reports should assess the possible distributive impact of an education project and the measures designed to mitigate or reinforce the impact.
V. Comparison of Cost and Benefits

A. Cost-Benefit Approach

22. Once the need for an education project is established and the availability of resources ascertained, the appraisal must address two fundamental issues: whether the project is worth the cost and whether the society and the target group can afford it. These issues can be resolved only when all the costs involved and the benefits expected from the project are fully taken into account. For instance, a national manpower plan may indicate that a few nuclear engineers are needed to maintain the country’s research reactors. For most developing countries it would not be worthwhile to train the engineers within the country since the cost of in-country training would be too high and would far outweigh the expected benefits. A careful assessment of both cost and benefits is necessary in the economic evaluation of education projects. Consideration of cost in relation to benefits is commonly known as the cost-benefit approach.

23. Since most education projects are supported by governments, special emphasis should be placed on social costs and benefits of education projects. However, a discussion of private costs and benefits is equally important. Some education programs have not achieved their intended objectives because private costs were not considered when they were formulated and appraised. Students would pursue education and their families would support them only if the cost is affordable and the perceived benefits justify the cost.

1. Private Cost of Education

24. The direct or out-of-pocket private costs of education are relatively easy to identify and evaluate. These mainly include tuition and other fees and cost of textbooks, transportation, and board and lodging if the school is beyond the normal commuting range. In addition, there is an opportunity cost in the form of forgone earnings of the student. The opportunity cost depends upon the level of skill or educational attainment which the student had before entering school or college, the time required to complete the course, the ease or difficulty in getting a job and the expected wage rate.
25. Perhaps the most crucial part of the above analysis is the estimate of forgone earnings. It depends upon the nature of skills and employment opportunities in the country concerned for people with those skills. Where self-employment in family is involved, it would depend on loss of income to the family. The cost of sending a child to a primary school may, for instance, be relatively high if the child’s mother could not work during the child’s absence to supplement the family income. Private costs partly explain the problem of over crowded colleges while school classrooms are empty in many villages and slums in some developing countries.

26. In general, the out-of-pocket costs and the opportunity cost of forgone earnings taken in relation to the income of the target student families provide the basis for determining whether education is affordable. Generally, some information is available on income and employment to assess affordability. But in situations where such information is lacking, a limited sample survey at the pre-appraisal stage may be advisable.

2. Private Benefits from Education

27. Project objectives will be realized only if the education offered by the project is demanded by the target group. It is therefore necessary during the feasibility study or appraisal to assess the demand. In addition to the question of cost, demand is largely a function of the anticipated benefits from the education proposed under the project. The assessment of private benefits to the target group is an essential element in the appraisal process. People seek education because of monetary and non-monetary benefits that accrue from it. Education imparts skills and knowledge about certain disciplines and activities thereby contributing to higher productivity and an increase in earning power. There are, however, several other benefits which cannot be readily quantified. For, education also widens one’s intellectual and spiritual horizons, modifies attitudes

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2 In some instances, education may also involve non-quantifiable cost in the form of physical or psychological hardship such as living away from family. A format for identification and assessment of such cost, if significant, is provided at the end of this appendix.
and perceptions and enhances appreciation of social, ethical and economic values thereby enabling one to tackle the problems of physical, social and economic environment. These benefits may be individual or family-related or society-related. Every effort should be made to identify the non-monetary benefits and assess them qualitatively.

28. The most tangible benefit of education is a higher income that a beneficiary earns over his lifetime. Measurement of these earnings requires an assessment of both the level of earnings over time and the earning lifespan, which may not be easy. Such an assessment could, however, be based on average lifetime earnings of individuals with a similar level or type of education. Existing income and employment data with adjustments for foreseeable changes in the future could provide a basis for such an assessment.

29. All earning differentials cannot be assumed to be due to an individual's level or type of education. Other factors such as differences in ability, motivation, preschool training and family background also influence earnings. These should also be taken into account. The portion of earnings attributable to education is commonly known as the "alpha coefficient" which might differ from country to country.

3. Social Cost and Benefits

30. All private costs (direct and indirect) net of taxes and subsidies are also a cost to society to the extent that they represent the use of resources. However, social cost comprises more than the private costs. A government's capital and current expenditures are an important part of the social cost of education. Governments usually spend large sums of money every year on education. Part of these funds may be used to expand physical infrastructure (for example, school buildings and laboratories), but most of these funds are used to meet the

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3 See the format for identification and assessment at the end of this appendix.
4 An estimated two-thirds of increased earnings in developing countries are generally taken as the alpha coefficient. This figure may be modified according to data and country experience.
recurrent expenditures on staff's and teachers' salaries, teachers' training, school supplies, scholarships and subsidies to private institutions. All these are part of the social cost of education.

31. The share of public expenditure in the social cost of education may be large or small, depending on the relative roles of private and public education and the amount of subsidies given to students and institutions in a particular country. Both private and public costs (net of transfers) should be taken into account in determining the social cost of education.

32. Private benefits from education also constitute social benefits since greater earnings generally reflect improved productivity and, hence, larger social output. When earnings are subject to income-tax, it is the gross earnings that represent social benefits. Social benefits from education would, in addition to increased earnings and output, include several other benefits such as improved sanitation and health conditions, family planning and a lower crime rate. While these benefits are real, they cannot be easily quantified and, therefore, must be identified and assessed in qualitative terms. The impact on equity should also be taken into account in social cost-benefit analysis.

33. Once the costs and benefits are identified and evaluated, a comparison can be made to assess whether the benefits justify the costs. A comparison of private costs and private benefits provides a basis to assess whether the education to be provided or supported by a project would be affordable and attractive enough to the target group and to ensure that sufficient demand exists to justify the project. A comparison of social cost and social benefits provides a basis for assessing whether the project is worth undertaking from the viewpoint of society. Because a large part of the assessment will be in qualitative terms, the appraisal should clearly spell out the reasons for justification of the project in terms of cost and benefits, both private and social (see the format for identification and assessment of costs and benefits).

4. **Rate of Return Analysis**

34. The internal rate of return (IRR) is a discount rate which equalizes the flows of cost and benefits over a relevant period which is generally the lifetime
of a project. The private rate of return relates private costs to private benefits just as the social rate of return relates social cost to social benefits. Obviously, the rate of return analysis cannot be applied to those benefits which could only be assessed in qualitative terms.

35. In the Bank's education projects, most of the investment has been made to improve the quality of education through improved facilities, equipment and curricula and training of teachers. It is extremely difficult to measure in monetary terms the qualitative improvements which generally tend to be cumulative. For this reason, estimation of internal rate of return is not recommended for all education projects.

36. Despite the difficulties involved, the rate of return analysis can be particularly useful in allocating a given amount of resources among various levels or types of education. This is especially true if the non-measurable benefits are considered to be more or less uniform among various types of education. By transferring resources from those areas of education which yield lower rates of return to those which produce higher rates of return, the benefits of investment in education can be substantially increased. This is of particular relevance to national governments in determining priorities in the education sector. Moreover, there are many education projects which are primarily intended to improve the internal efficiency such as centralized textbook printing and production of science apparatus whose benefits can be measured in terms of cost savings. For such projects, IRR estimates could be used for their justification.

37. Whether the IRR is actually estimated, the cost-benefit approach is frequently used in the process of planning and management. What is suggested here is that a detailed analysis of various economic costs and benefits of an education project being appraised should be undertaken in a systematic manner so as to provide a sound basis for decision making.

B. Cost Effectiveness Approach

38. Because of the difficulty of estimating IRR, the justification of education projects is frequently based on the role of the project in achieving the sectoral
objectives and ensuring that the project goals and needs are met in the most cost-effective manner. This is really a limited application of the full cost-benefit approach because it deals only with the cost aspect. This approach works best when the need for a particular project and its justification is already established.

39. Cost-effectiveness means either of two things: (i) given the desired end results, cost-effectiveness means the least-cost method of achieving them; or (ii) given the resource constraints it means the maximization of end results. The least-cost analysis is most often applied in engineering studies because the objective is more easily defined in terms of capacity or output. Once the objective is defined, the cost may be minimized in terms of alternatives in technology, design, location or time phasing of the project. The second method is more often used in analyzing projects in the social sector where resource constraints are generally given. The essence of this approach is the ability to compare alternative options and select the one that is most effective within the given constraints. This approach is only as effective as the analyst's ability to define precisely project objectives, options and constraints.

40. Once the objectives of an education project are defined, alternative options in terms of standard, design, location, coverage, time-phasing and technical and pedagogical considerations should be considered within given constraints. This is an essential aspect of the approach and it is necessary to describe in the appraisal report at least the best alternative options considered. For example, in most countries standards are well established with respect to physical infrastructure and recurrent activities in education. Since construction costs are a major part of the investment cost of a project, construction design standards under a project must be compared with those of the existing ones and when departures are proposed, adequate justification should be given. Similar justification should also be provided whenever variations from standards are proposed for recurrent expenditure. Establishing the cost-effectiveness of a project is indispensable to project appraisal so as to ensure that unnecessary cost (or waste) is avoided.
VI. Conclusions

(i) A brief review and assessment of the educational system of the country concerned and the role of the government should be made at the outset of the appraisal of an education project.

(ii) The relevance of the project should be determined on the basis of its priority in the education program of the country concerned. Project-specific objectives should be in conformity with general educational objectives of the country concerned; and the project's scope and components should be defined and described clearly.

(iii) The appraisal should then assess the need for the project. This could be done by means of the social demand approach or the manpower requirements approach or both. For technical and higher level education, the manpower requirements approach should be used, alone or in conjunction with the social demand approach. Where limitations of data to determine manpower requirements are apparent, a limited survey should be conducted at the feasibility study or pre-appraisal stage.

(iv) Once the need for the project is established, the appraisal should identify the target group in terms of number, location, income level and social and educational stratification to the extent possible.

(v) The appraisal should also assess the financial impact of the project on the target group and its likely response.

(vi) Budgetary implications and the capability and commitment of the government to mobilize necessary financial resources should also be assessed.

(vii) The appraisal should undertake a detailed analysis of the financial costs of the project and source of its financing.

(viii) The appraisal should also assess the distributive impact of the project and the measures designed to mitigate or reinforce the impact as appropriate.

(ix) The final justification of the project should be based on a comparison of costs and benefits, both private and social. Quantifiable as well as non-quantifiable costs and benefits should be identified and assessed.
(x) Private costs of education should be inclusive of both out-of-pocket costs and forgone earnings.

(xi) Where income and employment data available are inadequate to determine forgone earnings or probable life-time earnings, a limited survey is advisable. When earning differentials are considered, such other factors as differences in ability, motivation and pre-school training should also be taken into account.

(xii) Internal rate of return (IRR) analysis is not proposed for all education projects. But IRR could be used in projects where benefits can be readily assessed in quantitative terms.

(xiii) Cost-effectiveness approach should be undertaken in all education projects. In doing so, alternative options considered should be described.
FORMAT FOR IDENTIFICATION AND ASSESSMENT OF COSTS AND BENEFITS

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### V. OVERALL ASSESSMENT
Appendix 12

GUIDELINES FOR THE ECONOMIC ANALYSIS OF
HEALTH SECTOR PROJECTS
GUIDELINES FOR THE ECONOMIC ANALYSIS OF HEALTH SECTOR PROJECTS

I. Introduction

1. The health sector covers a wide range of activities concerned with the prevention and treatment of disease and disability, and with prolonging human life. Recent advances in health science and medical technology have vastly improved the effectiveness of health care services, and have brought people everywhere the hope of living longer and healthier lives. At the same time, these improved services demand an increasing share of the resources of both nations and individuals. Thus, there tends to be a widening gap between advances in medical technology, and the amount that individuals in most developing countries can afford to spend on health care. This problem is often made worse by misallocation of resources. It is therefore extremely important that resources allocated to the health sector be distributed in a way that is consistent with the priorities of the sector, and that these resources be used in the most efficient manner possible. Only in this way will maximum benefits be achieved.

2. Bank support to the health sector in developing member countries (DMCs) aims at improving efficiency and effectiveness in the distribution and delivery of health care services. Bank-supported health sector projects and programs must therefore be designed and appraised in a way that is consistent with this objective. This is not always easy due to the heterogeneous character of health care services, problems of data availability, and time and staffing constraints. The purpose of these guidelines is thus to suggest a workable framework for analysis, and to draw attention to important issues and possible pitfalls. Some practical steps are also recommended for overcoming difficulties frequently encountered in the appraisal of health sector projects.
II. Macroeconomic Considerations

A. Review of the Health Care System

3. Since the Bank's goal in financing health sector projects is to improve the efficiency and effectiveness of the health care system in the country concerned, the proposed project must of necessity be within the capability of the existing system. It must also support the national health care plan, the objectives of which must be consistent with national health goals. The appraisal should therefore begin with a review of the health sector and the national health plan or program of the country concerned.

4. The primary objective of this review is to define the country's health problems in terms of deficiencies and disease groups, and to determine the ability of the health care system to respond to the country's health sector needs. It should also assess the availability of health sector manpower, and the overall organization of the health care system. This should include the relative roles of the public and private sector, and an evaluation of the system's strengths, weaknesses and potential for improvement and expansion. Essentially, this review should provide an appropriate background for assessing the country's health care plan or program and its scope for improvement.

B. Review of the National Health Plan

5. The national health plan should be reviewed with respect to its overall direction, coverage, comprehensiveness, flexibility, and equity in responding to the country's health needs. Its viability should be examined in terms of technology, manpower, institutional capability, and budgetary requirements and availability of funds. In countries where there is no comprehensive national health plan, a review should be made of the programs and projects contemplated, the objectives of the latter, and government policy statements relating to the health sector. The purpose of this exercise is to assess the plan's or program's strengths, weaknesses, and potential for meeting the country's health sector needs, the government's goals for the sector, and its degree of commitment in achieving them.
C. Justification in Terms of Sectoral Needs

6. The appraisal should then turn to a review of the project's objectives and how they relate to the objectives of the national health plan. In particular, the appraisal mission should be satisfied that both the overall objectives and the specific targets of the project are feasible and realistic, and are in accordance with the priorities of the sectoral plan. In the case of projects which address particular regions or target groups, the objectives must also be consistent with the needs of the particular region or target group. The appraisal mission should also be satisfied that both the design and scope of the project are consistent with available resources. In the case of a large project which requires a substantial increase in government health expenditure, the sources of funding should be identified, and where necessary, measures for mobilizing the required resources should be defined and relevant commitments from the government secured. In addition to funding requirements, the appraisal mission should be satisfied that the technology envisaged is appropriate, that the manpower required is available, and that institutional requirements will be fulfilled.

III. Efficiency Considerations

7. Once a project is justified on grounds of sectoral needs and objectives, the next step is to assess it in terms of efficiency and equity. Efficiency aspects are discussed in this section, and equity aspects in the section immediately following.

8. Cost-benefit analysis (CBA) is a recommended approach for testing project viability and is discussed elsewhere. Two often-used variants of this approach are cost-effectiveness analysis (CEA) and internal rate of return analysis (IRRA). Due to difficulties in quantifying the benefits of health care

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3 For other variants of this approach, see Guidelines, 1987.
projects, the usefulness of IRRA in appraising projects in the health care sector is limited. CEA is thus generally used instead.

A. Cost of Disease and Cost of Intervention

9. When performing CEA, a clear distinction should be made at the outset between the cost of disease and the cost of intervention. While the full burden of a disease cannot be captured in a single measure, the total cost of a disease generally has four components.

(i) The direct costs of a disease include all costs involved in preventing, diagnosing and treating the disease (i.e., expenditures associated with hospital care, services of medical practitioners and other health personnel, drugs, medical equipment, and long-term care).

(ii) The incidental costs of a disease include travel and transport costs to and from the clinic or hospital where immunization or diagnosis and treatment of the disease is received, and the cost of attendants where necessary.

(iii) The indirect costs of a disease include loss of wages due to illness, premature death, and loss of productivity due to disability.

(iv) The psychic costs of a disease are generally unquantifiable and include pain, suffering and disruption of normal lifestyle, and other costs not captured in the other three categories.

10. The costs under categories (i) and (ii) are relatively easy to quantify. Hospital and health care records, and sample surveys (where necessary) normally provide reasonably reliable estimates. Quantifying the costs which fall under category (iii) is much more difficult. Use of a “lifetime costing” methodology creates several problems. One of these is how to quantify the loss to society of a premature death. While many approaches are possible, one solution which is frequently used is the human capital approach which values loss
of life in terms of lost earnings, actual or imputed. However, this approach involves many unresolved conceptual and practical issues. The costs under category (iv) are of a totally different nature. Most disease-costing studies do not attempt to quantify the costs falling under this category. There is little doubt, however, that pain per se leads to a significant demand for health care.

11. Health care intervention on the other hand is concerned only with prevention or treatment of disease. The cost of health care intervention therefore includes only the cost of prevention or diagnosis and treatment of disease, and costs incidental to prevention or treatment. The cost of intervention thus relates only to categories (i) and (ii).

B. Cost-effectiveness Analysis (CEA)

12. The purpose of CEA is to find the means (activity, process or intervention) by which the desired results are achieved with a minimum expenditure of resources; or when resources are fixed, the means by which maximum results are obtained. Since CEA is concerned with internal efficiency or the least-cost means of achieving the stated goal of a project or intervention, it helps avoid waste. CEA essentially involves ranking the alternative means of fulfilling a stated objective by their costs. In practice, at least two or three alternatives should be compared, and the least-cost means chosen. This comparison should be done in terms of incremental costs. For projects or programs which consist of several mutually non-exclusive interventions, a cost-effectiveness comparison of alternatives should be done for each intervention.

13. The advantage of CEA is that the objective of the process or intervention need not be measurable in monetary terms. It can be applied to any process or intervention, provided the objective is quantifiable. For this reason, CEA is widely used in project analysis in the health sector.

14. Quantification of the objectives of health sector projects in terms of a common denominator is not always easy, since the ultimate objective of health care is good health and long life. While the objective of a health sector project may be a reduction in the incidence of illness, death, or disablement, illnesses
tend to be of varying durations and severities, and the same is true of disable-
ment. Thus, without a common denominator, one cannot say that it is more
cost-effective to spend a dollar on treating one disease than on another. A com-
mon denominator is therefore necessary if the impacts of individual health
disorders and the cost-effectiveness of various interventions are to be assessed.
The expert services of an epidemiologist and a health statistician are indispens-
able in this regard. Several methodologies have been suggested for this pur-
pose, the least controversial of which is the disease impact assessment (DIA)
methodology described below.

C. The Disease Impact Assessment (DIA) Methodology

15. DIA is a method for ranking health disorders. As everyone knows, the
effect of a health disorder is illness. Illness, of course, leads to loss of healthy
days, the number of which depend on the nature and severity of the disorder.
DIA ranks the impact of health disorders in terms of days of healthy life lost.
Instead of imputing a monetary value to healthy days lost, DIA assumes that
a day of healthy life lived by any person is of the same value, irrespective of
that person's age, sex, or income. This assumption makes it possible to rank
health disorders according to their severity and prevalence, i.e., according to
the number of healthy days lost (see pages 167-168).

16. By relating the impact of each intervention to the cost of intervention,
a measure of the cost-effectiveness of each intervention can be obtained. For
example, if the impact of one intervention for a disorder is the saving of day
of healthy life at the cost of $1.00, whereas the impact of an alternate interven-
tion is the saving of a day of healthy life at the cost of $1.50, then the first
intervention is clearly more cost-effective. By comparing interventions in this
manner, the most cost-effective solution can be identified.

17. A major advantage of the DIA technique is that in addition to project-
ing costs, it can be used to find efficient solutions to sectoral allocations. The
health sector is normally allocated a certain portion of the government budget.
How should this amount be allocated among various projects? The DIA technique
allows the cost-effectiveness of various health interventions to be compared, and the most cost-effective package identified.  

18. Although the DIA technique is conceptually simple, its application entails fairly substantial data requirements. Estimates of the parameters for the most important diseases must be obtained from all available sources such as census data, hospital discharge data, special survey data and data on the cause of death. In developing countries where the statistical systems producing health care and vital statistics are fairly well developed, there is likely to be an adequate data base from which the required data set can be derived, with the aid of a few sample surveys where necessary. When a sample survey is contemplated for this purpose, it is advisable for it to be undertaken during the feasibility or pre-appraisal stage. For countries in which national statistical systems are not well developed, the parameters from other countries with similar health profiles can sometimes be adapted. However, it is clearly desirable to build up health sector profiles including unit cost statistics for each DMC.

19. The discussion of DIA above is intended more to highlight the problems involved in the application of DIA and to explain certain basic concepts than to recommend its universal application. In any case, the possibility of universal application of DIA is not likely in the near future for most DMCs because of data constraints. However, for major health care programs and projects, use of the DIA approach on a selective basis is desirable since data bases are usually fairly complete for such programs and projects.

D. Internal Rate of Return Analysis (IRRA)

20. As applied to projects, CBA examines the costs and benefits of various project alternatives as a means of determining which is the most desirable. For Bank-financed projects, internal rate of return analysis (IRRA) is generally

4 Where a reliable DIA model is available, the objective function can be defined in terms of “days of health life saved.” The problem then becomes one of optimization. A solution is reached when the marginal cost of one day of healthy life saved is the same for all programs and projects. However, this suggestion should not be construed as a blanket invitation to mechanistic application of the model (see Annex).

used because it gives an indication of which alternative is the most attractive. However, use of IRRA requires that both costs and benefits be measurable in terms of a common denominator. For this purpose, monetary units are generally the most convenient numeraire. Unfortunately, while costs are generally quantifiable in terms of monetary units, the benefits resulting from health sector projects rarely are.

21. However, for some health sector projects, both costs and benefits can be defined in monetary units. For these projects IRRA can be used. Usually the benefits of such projects are cost savings. This technique is thus often applicable to hospital renovation and equipment maintenance programs, and to projects relating to hospitals and rural health centers. In fact, IRRA can generally be applied to all projects which increase operational efficiency.

E. Acceptance and Demand

22. It was noted earlier that in order to initiate a project, there must be clear evidence of need for the project. But need for a project, or rather for the services provided by the project, is not always the same as demand for these services. This is because need is often defined on the basis of what health authorities consider to be necessary or desirable for the target population. Demand, on the other hand, reflects what the target population is prepared to pay for. In the case of free services there must be acceptance. For demand to occur, the services or goods concerned must be perceived as having value, and there must be ability and willingness to pay on the part of the target population. For many health sector interventions, target groups often have little knowledge of the benefits likely to accrue from them. In such cases, it is desirable to disseminate information regarding the benefits of specific interventions and to cultivate knowledge of their values. This often takes time and expenditure of a substantial amount of resources. Further, the need for disseminating such information is greater in projects which require active community participation. Where such needs are apparent, dissemination of information should generally be made a component of the project or intervention.
23. Another cause of divergence between the perception of health planners and that of the beneficiaries of a health project or intervention is the existence of externalities. Externalities are benefits (or costs) accruing to persons other than the direct beneficiaries of the project or intervention; they are a common occurrence in health projects. Where externalities exist, direct beneficiaries may not be willing to bear the full cost of the project. To generate a level of demand sufficient to reap the full benefit of such a project, a subsidy may be necessary.

24. It should be noted that if demand does not materialize as envisaged for whatever reason, then estimates of cost-effectiveness and/or project viability may not hold, because both assume a specific level of demand. It is therefore important to have a firm estimate of demand or acceptance when designing or appraising a project or intervention. In the case of a new or large intervention, it is advisable to ascertain in advance the possible response of the target population. In estimating the level of demand or acceptance, both direct and indirect costs should be taken into account.

F. Sustainability

25. Another aspect of efficiency is sustainability. Sustainability is an important issue in all projects for which the project life extends over several years, but particularly for projects where investment in infrastructure (i.e., buildings and equipment) is large, such as in hospital projects. If sustainability fails to occur, estimates of cost-effectiveness will no longer be valid. Much waste could thus result if the level of service is not sustained as envisaged. Provision of service may fall below the projected level for many reasons such as lack of money, materials, manpower, expertise or proper maintenance of infrastructure facilities. Although lack of funds is most often blamed for failure to sustain the level of service envisaged, equally important in this regard are availability of trained personnel, suitability of the technology adopted, availability of service facilities for maintenance and repairs of facilities and equipment, and the viability of the administrative setup providing the latter. All of these aspects should be

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6 See para 31.
thoroughly considered at appraisal, and where necessary, assurance from the government concerned for the provision of adequate funds and other facilities throughout the life of the project should be sought.

G. Providers of Health Care Services

26. Another consideration relates to the nature of the institutions providing health services and facilities. In developing countries these are provided both by the government and the private sector, including non-government organizations (NGOs). At issue here is which body can provide health services most efficiently. However, in comparing levels of efficiency, one should not forget that public health care institutions, unlike private institutions, do not normally have the privilege of charging or choosing patients or diseases. In any case, private health care services lessen the demand for public health care services, which are generally overtaxed. They therefore tend to complement public health care services. Where the existence of externalities and economy is obvious, subsidies can be given to private organizers of health care services to complement or supplement public health services. While the scope for private sector participation may be limited in the provision of rural health services, there is large scope for private sector provision in urban centers, especially in the areas of hospital and other clinical services. This efficiency criterion should be kept in mind when formulating and appraising health sector projects.

IV. Equity Considerations

A. Access

27. Since health care is a basic human need, equity considerations assume special significance in health sector projects. Proper identification of project beneficiaries is extremely important in this regard.7 Two main equity aspects

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in health care projects are access and affordability. Access refers to physical access to health care services. Equity suggests access to health care services and facilities at reasonable cost by all who need them. Access is particularly important for those living in rural areas, as health care facilities tend to be concentrated in urban centers. The need for more equitable distribution of services and facilities should be recognized when appraising health sector projects.

28. Apart from locational constraints, access to health care services may also be limited by the cost of the services themselves. Thus, although all types of health care services may be available in large cities, the urban poor may not have access to them because of inability to pay. Affordability is therefore an important equity issue in the provision of health care services.

B. Affordability

29. Affordability depends both on the cost of the services in question and on the income of those who need the services. Therefore, the cost of health care services should be considered from the viewpoint of the user and should take account of both direct costs and costs incidental to patients and their families. Most developing country governments provide basic health services free of charge or at a nominal cost on grounds of equity, externalities and national welfare. With regard to secondary health care — particularly clinical and hospital care — the manner in which costs are shared requires careful scrutiny because the costs of these services are generally rather high. Nevertheless, since health care is a basic human need, affordability, especially with respect to low-income groups, should be given due consideration in every program of cost recovery.

C. Cost Recovery

30. Cost recovery should be examined from both the efficiency and equity points of view. In most developing countries, what the government can afford to spend on health care generally falls short of what is needed to finance the full cost of the health care program. In such circumstances it is necessary to
distribute available resources in the most efficient way possible, while at the same time ensuring the maximum degree of equity. This suggests price discrimination according to users' ability to pay.

31. Where there is clear evidence of ability to pay, it is generally advisable to charge the full cost of the services received; charges below that level invite excess demand and waste. This is particularly important in the case of large hospital projects requiring substantial financial outlays on the part of the government. However, levying charges for health care services for the sake of efficiency does not mean full cost recovery if externalities exist. Where externalities are substantial, full cost recovery does not lead to optimum service levels. Interventions where externalities are most obvious occur in primary health care, including immunization and treatment of contagious diseases. Where externalities exist, a full or partial subsidy may be necessary.

32. A broader approach to cost recovery is to consider it in relation to total health care financing. In this regard, several options are possible. One is to maintain government health care service systems and institutions, but instead of providing services at zero cost, to levy differential charges according to users' ability to pay. Another is to subsidize private health care institutions by an amount large enough to cover the cost of services to the needy. A third is to subsidize other health care inputs such as medicines. A fourth is to give direct subsidies (as under medicaid programs) to needy patients. Still another approach is medical insurance or risk-sharing among potential users. This approach does not necessarily involve public funds, but could be used to channel public funds to patients. In evaluating a cost recovery program, in addition to resource constraints, the appraisal mission should take into account customs and traditions, the government's social and political orientation, and the social and economic conditions prevailing in the country. However, it should be noted that cost recovery is in general a sectoral issue, and thus it should be examined at the sectoral level except for large and costly hospital projects. Even with regard to the latter, appraisal should be carried out in the sectoral context.
THE DISEASE IMPACT ASSESSMENT (DIA) METHOD

DIA is a method for assessing and ranking the major health disorders in a country. DIA ranks the impacts of health disorders in terms of "healthy days lost". The method does not, however, attempt to impute any monetary value to healthy days lost. In fact, it assumes that a day of healthy life to any person is of the same value, irrespective of that person's age, sex, or income. This makes it possible to rank health disorders according to their severity and prevalence, i.e., according to their impact on health in terms of healthy days lost.

Thus, healthy days lost due to a disease = (a) days lost due to premature death + (b) days lost due to disability before death + (c) days lost due to chronic disability + (d) days lost due to illness.

Although DIA is conceptually simple, its data requirements are substantial because estimates of the parameters for the most important diseases must be arrived at. Generally, the information required must be assembled from a number of sources, including census data, hospital discharge data, special surveys and data on cause of death. The following parameters for the most important diseases must then be developed with the help of epidemiologists and health statisticians:

1. incidence per thousand population (I)
2. the case fatality rate (C)
3. average age at disease onset (Ao)
4. average age at death from the disease (Ad)
5. life expectancy at these ages from life tables \[E(Ao),E(Ad)\]
6. the percentage disablement from the onset of each disease until death among those who die of the disease (Dd)
7. the percentage of those affected by the disease who do not die of the disease, but who are permanently disabled (P)
8. the percentage disablement of those permanently disabled (Pd)
9. the average number of temporary disablement days (t) among persons who are affected, but who neither die nor are disabled permanently.
From the data listed above, the total number of healthy days lost (L) can be computed for each disease category as

\[
L = C \cdot [E(Ad)] \cdot 365 + C \cdot (Dd) \cdot (Ad-Ao) \cdot 365 + P \cdot (Pd) \cdot (1-C) \cdot [E(Ao)] \cdot 365 + (1-C-P) \cdot t
\]

The total number of healthy days lost by the nation or region on account of each disease can be related to the incidence data (I) and expressed in terms of per thousand population. Thus LI gives healthy days lost per thousand population due to each disease. The result of these computations will resemble Table 1, which should then be converted into a table similar to Table 2 which ranks all major diseases by healthy days lost. From these two tables it is possible to obtain a crude estimate of the potential impact of alternative interventions.

By relating the probable impact of each intervention to the cost of the intervention, a measure of cost-effectiveness can be obtained for each intervention. For example, if the impact of one intervention for a disorder is the saving of a day of healthy life at a cost of $1.00, whereas the impact of another intervention for the same or another disorder is the saving of a day of healthy life at a cost of $1.50, then the first intervention is clearly more cost-effective than the second. By comparing alternative interventions in this manner, the most cost-effective solution can be identified.

It should be noted that the DIA model is not concerned with the cost of a disease or disorder in monetary terms, but rather in terms of healthy days of life lost. Since the latter is what a health care intervention is intended to avoid, there is no need to evaluate this cost in monetary terms. Thus under the DIA method, one must only ascertain the cost of intervention or treatment. It is important to note that loss of earnings due to illness is not included in the DIA computation because it is part of the cost of disease and not of the treatment. Loss of earnings due to illness is a cost that would be borne in any case, i.e., whether any treatment is taken or not.
Table 1. An Illustration of the Cost of Disease Measured in Terms of Days of Healthy Life Lost Per 100,000 Population Per Year

<table>
<thead>
<tr>
<th>Disease¹</th>
<th>Life Expectancy at Onset (Ao)</th>
<th>Life Expectancy at Death (Ad)</th>
<th>% Disability due to Death (Dd)</th>
<th>% Permanent Disability (P)</th>
<th>Days of Temporary Disability (t)</th>
<th>Incidence (I)</th>
<th>Days of Life Lost (IL)</th>
<th>% IL due to Premature Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cholera</td>
<td>27 43.0 34.5</td>
<td>27 43.0 0 0 0 14 0.9</td>
<td>4,882 99.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Typhoid</td>
<td>28 42.1 12.8</td>
<td>28 42.1 0 0 0 60 10.4</td>
<td>21,000 97.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Dysentery</td>
<td>11 57.0 3.4</td>
<td>11 57.0 0 0 0 14 90.8</td>
<td>65,457 98.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Diarrhea</td>
<td>11 57.0 5.5</td>
<td>11 57.0 0 0 0 14 529.2</td>
<td>612,552 98.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Tuberculosis</td>
<td>43 29.0 26.9</td>
<td>54 20.4 25 0 200 204.5</td>
<td>494,723 82.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Diphtheria</td>
<td>4 63.6 27.1</td>
<td>4 63.6 0 0 0 30 3.5</td>
<td>22,095 99.7</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Pertussis</td>
<td>3 64.4 0.4</td>
<td>3 64.4 0 0 0 30 33.4</td>
<td>4,138 75.9</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Viral encephalitis</td>
<td>3 64.4 1.2</td>
<td>4 64.4 0 0 0 30 1.0</td>
<td>312 90.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Polio</td>
<td>11 57.0 26.5</td>
<td>14 54.5 0 95 25 0 0.7</td>
<td>6,232 59.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Measles</td>
<td>3 64.4 21.2</td>
<td>3 64.4 0 0 0 21 84.1</td>
<td>420,485 99.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Malaria</td>
<td>27 43.0 2.0</td>
<td>31 39.5 0 97 2 0 105.9</td>
<td>62,136 49.1</td>
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<td></td>
<td></td>
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<tr>
<td>12. Syphilis</td>
<td>29 41.4 15.7</td>
<td>36 35.2 2 0 0 35 0.2</td>
<td>411 98.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>13. Gonococcal infection</td>
<td>23 46.5 0.04</td>
<td>47 25.9 2 0 0 35 25.7</td>
<td>998 9.7</td>
<td></td>
<td></td>
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<tr>
<td>14. Leprosy</td>
<td>34 36.9 7.7</td>
<td>50 23.4 50 75 25 0 2.2</td>
<td>7,069 20.5</td>
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<td></td>
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<tr>
<td>15. Chicken Pox</td>
<td>7 61.1 0.8</td>
<td>7 61.1 0 0 0 14 3.6</td>
<td>692 92.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>16. Hepatitis</td>
<td>24 45.6 6.8</td>
<td>33 37.8 0 0 0 60 18.4</td>
<td>18,292 94.4</td>
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<td></td>
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<td></td>
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<td>17. Tetanus (a) neonatal</td>
<td>0 62.5 9.8</td>
<td>0 62.5 0 0 0 0 2.0</td>
<td>4,471 100.0</td>
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<tr>
<td>(b) other</td>
<td>26 43.8 44.9</td>
<td>26 43.8 0 0 0 30 3.6</td>
<td>25,901 99.8</td>
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<td></td>
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<tr>
<td>18. Schistosomiasis</td>
<td>24 45.6 13.1</td>
<td>39 32.6 4 96 1 0 6.6</td>
<td>11,394 90.3</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>19. Influenza</td>
<td>21 48.2 0.5</td>
<td>37 34.3 0 0 0 21 493.6</td>
<td>41,212 75.0</td>
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</table>

(continued next page)
Table 1 (Continued)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Average Life Expectancy at Onset (Ao)</th>
<th>Average Life Expectancy at Onset E(Ao)</th>
<th>CFR % (C)</th>
<th>Average Life Expectancy at Death (Ad)</th>
<th>Average Life Expectancy at Death E(Ad)</th>
<th>% Disablement to Death (Dd)</th>
<th>% Permanent Disability (P)</th>
<th>Days of Temporally Disablement (t)</th>
<th>Incidence (I)</th>
<th>Days of Life Lost due to Premature Death (IL)</th>
<th>Days of Life Lost to Permanent Disablement (I)</th>
<th>% IL due to Death</th>
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<td>20. Pneumonia</td>
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<td>65.0</td>
<td>36.5</td>
<td>2</td>
<td>65.0</td>
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<td>(a) child</td>
<td>2</td>
<td>65.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>191.9</td>
<td>1,664,341</td>
<td>99.8</td>
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<tr>
<td></td>
<td>(b) adult</td>
<td>48</td>
<td>52.5</td>
<td>48</td>
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<td>0</td>
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<td>21</td>
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<td>0</td>
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<td>24. Bronchitis</td>
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<td>0.6</td>
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<td>0</td>
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<td>14</td>
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<td>25. Malignant Neoplasms</td>
<td>52</td>
<td>21.9</td>
<td>69.6</td>
<td>53</td>
<td>21.1</td>
<td>75</td>
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<td>0</td>
<td>0</td>
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<td>26. Food Poisoning</td>
<td>23</td>
<td>46.5</td>
<td>16.9</td>
<td>23</td>
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<td>27. Leukemia</td>
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<td>53.6</td>
<td>80.0</td>
<td>30</td>
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<td>75</td>
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<td>0</td>
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<td>45.6</td>
<td>55.0</td>
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<td>45.6</td>
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<td>29. Diabetes Mellitus</td>
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<td>30. Nutritional deficiencies and metabolic disorders</td>
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<td>65.4</td>
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<td>1</td>
<td>65.4</td>
<td>0</td>
<td>0</td>
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<td>337,917</td>
<td>99.3</td>
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<td>(a) child</td>
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<td>20.4</td>
<td>20.0</td>
<td>59</td>
<td>16.7</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>42.8</td>
<td>55,109</td>
<td>94.7</td>
</tr>
<tr>
<td>(b) adult</td>
<td>20.4</td>
<td>59</td>
<td>16.7</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40</td>
<td>42.8</td>
<td>55,109</td>
<td>94.7</td>
</tr>
<tr>
<td>31. Meningitis</td>
<td>10</td>
<td>58.3</td>
<td>20.0</td>
<td>10</td>
<td>58.3</td>
<td>0</td>
<td>0</td>
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<td>(% of Deaths)</td>
<td>DI (x1,000)</td>
<td>MI (% of DI)</td>
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</tr>
<tr>
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<td>17.4</td>
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<td>52</td>
<td>21.9</td>
<td>50</td>
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<td>25</td>
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<td>70.0</td>
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<td>21.9</td>
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<td>62.5</td>
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<td>0</td>
<td>0</td>
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<td>39.5</td>
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<td>0</td>
<td>21</td>
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<td>38.6</td>
<td>0</td>
<td>5</td>
<td>25</td>
<td>30</td>
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<td>294,688</td>
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<td>TOTAL</td>
<td>13.6</td>
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<td>8,082,801</td>
<td>89.5</td>
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</table>

1 Diseases listed accounted for 84.0% of mortality in the country.
Table 2. An Illustration of the Cost of Disease Measured in Terms of Days of Healthy Life Lost Per 100,000 Population Per Year (Summary Table)

<table>
<thead>
<tr>
<th>Disease</th>
<th>Days of Life Lost (IL)</th>
<th>Per Cent of Total</th>
<th>Per Cent Cumulative</th>
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<tbody>
<tr>
<td>1. Pneumonia</td>
<td>1,878,928</td>
<td>23.25</td>
<td>23.25</td>
</tr>
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<td>2. Birth diseases</td>
<td>1,327,802</td>
<td>16.43</td>
<td>39.68</td>
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<tr>
<td>3. Diarrhea</td>
<td>612,552</td>
<td>7.58</td>
<td>47.26</td>
</tr>
<tr>
<td>4. Rheumatic and other heart diseases</td>
<td>555,165</td>
<td>6.87</td>
<td>54.12</td>
</tr>
<tr>
<td>5. Tuberculosis</td>
<td>494,723</td>
<td>6.12</td>
<td>60.25</td>
</tr>
<tr>
<td>6. Measles</td>
<td>420,485</td>
<td>5.20</td>
<td>65.45</td>
</tr>
<tr>
<td>7. Nutritional deficiencies</td>
<td>393,026</td>
<td>4.86</td>
<td>70.31</td>
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<td>8. Ulcers and other digestive diseases</td>
<td>298,944</td>
<td>3.70</td>
<td>74.01</td>
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<td>9. Accidents</td>
<td>294,688</td>
<td>3.65</td>
<td>77.65</td>
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<td>10. Malignant neoplasms</td>
<td>278,593</td>
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<td>11. Pulmonary and other respiratory diseases</td>
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<td>2.96</td>
<td>84.06</td>
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<td>1.29</td>
<td>91.54</td>
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<td>92.72</td>
</tr>
<tr>
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<td>1.06</td>
<td>93.79</td>
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<tr>
<td>18. Dysentery</td>
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<td>20. Leukemia</td>
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<tr>
<td>21. Pregnancy complications</td>
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<td>22. Influenza</td>
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<td>29. H-Fever</td>
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