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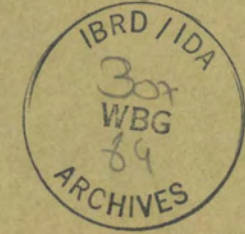
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DETERMINATION OF THE PROFITABILITY OF IRRIGATION  
PROJECTS FROM THE STANDPOINT OF THE NATIONAL ECONOMY



Introduction

1. It was not too long ago that the formulation and preparation of irrigation projects was strictly the domain of the engineers and agronomist. In recent years, however, there has been a growing awareness of the important role which economics should play in the formulation and assessment of projects. The need for a more vigorous appraisal of the economic aspects of a project has been repeatedly stressed by the World Bank. My brief comment today will describe some of the issues encountered by economists in the World Bank during *project* appraisal of ~~the present economic justification~~. I will also attempt to explain some of the methods followed in our work in light of the paper presented by Professor Filangieri.

2. The economic analysis of a project has three broad objectives. First, to establish the project's priority in the context of the overall development effort of the country. Second, to ensure that all feasible technical alternatives are considered in relation to their respective costs and benefits. Third, to help decide whether or not the project would benefit the economy sufficiently to justify its execution. To meet these objectives, the economic analysis must start at an early stage in the process of formulating and designing a project. If the economic evaluation takes place only after the major decisions have been made, its usefulness is much diminished.

3. The first step in the evaluation of a project is to establish its relationship and priority vis a vis other projects in the sector and the economy. Much of this work is done today through economic planning and development plans. In the case of the World Bank, such an analysis takes place through general country economic studies and more detailed in depth sector reviews. Thus evaluation of the project economic viability is usually carried out after its relationship and priority in the country's overall development plan has been established.

#### Definition of Benefits

4. A project profitability can be expressed in terms of its ability to generate over its useful life more value than it consumes. The specific tests applied in evaluating such profitability are mainly concerned with measuring the size of this surplus in relation to the cost of producing it. For projects appraised by the World Bank, measurable benefits normally consist of effects which result in increases in real national income. These effects take two forms: (a) reduction in unit costs (including the prevention of cost increases as one form of cost reduction or, in the case of irrigation rehabilitation projects, a prevention of further declines in production due to such causes as salinity or water logging); and (b) increases in the output of goods and services. Frequently both effects are present in the same project. The definition of benefits used by the Bank is thus limited to an increase in real income using national income concepts except where we use shadow prices to evaluate costs and benefits as shall be mentioned later on.

5. Mr. Filengieri has pointed out in his paper that this approach to measuring project profitability has a serious shortcoming inasmuch as it ignores social considerations like employment, regional income disparities and

poverty. There is a great deal of merit to this criticism. To overcome this shortcoming, growing attention is being paid by the World Bank to the impact of projects on employment and income distribution. Consideration of a project impact on income distribution usually takes place during the selection process of projects to be included in the economic plan. More and more preference is given to projects which can generate a large number of new employment opportunities. As for income distribution, in the case of most developing countries, the shadow pricing of labor and capital, which we shall discuss later, tends to prefer labor intensive projects over capital intensive ones. The main yardstick used in assessing a project, however, has remained the measurement of the increase in income largely because of a general conviction that in order to pay for the cost of development, economic growth must continue to be the main target.

#### Project Benefits

6. In evaluating what should be considered as a project benefit, the first problem is how to define the situation which would occur without the project. Lets assume that the development of a new high yielding variety of wheat is expected to bring about a substantial increase of rainfed wheat yields in an area being considered for the construction of an irrigation project. The question now arises how to treat such a potential yield increase in evaluating benefits from the irrigation project. In order to take account of such potential changes, the Bank economic analysis is based on a "with" project and "without" project concept instead of a "before" and "after" the project approach. Under the with and without concept, the stream of benefits to be generated by the project is taken as the increment to a stream of benefits which takes into account increases in yields, productivity, etc. that could have been reasonably expected to occur in the area even without the project

instead of simply measuring incremental benefits in relation to conditions prevailing in the area prior to the project. The point is often confused when considering the pricing of both inputs and outputs. For example, where prices are expected to change sometime in the future due to factors external to the project, such changes should be taken into consideration under both the with and without project conditions. Thus, if wages in the project area are expected to rise due to the construction of a new industrial estate, the increase should be reflected in both the with and without project conditions. On the other hand, if wages are expected to increase due to higher demand for labor generated by the project, such an increase should only be reflected in the with project conditions.

7. Another related question is what Mr. Filangieri referred to as "secondary direct benefits" (namely, the value added attributable to processing industries or to transportation services and services for distribution to consumers) and "indirect benefits," which are the goods and services produced by other activities than those made possible by the water itself as a consequence of economic development. While such benefits can be substantial at times, in the case of most irrigation projects appraised by the World Bank, no explicit allowance is made for them in the economic analysis. This is partly because information concerning the investment associated with generating secondary benefits is not always readily available and partly because the limits of such secondary benefits are rather difficult to define (this really boils down to the question of how much of the multiplier effect should be taken into account in evaluating an investment decision.) By omitting such benefits we indirectly imply that secondary benefits would be in direct proportion to primary benefits and therefore equal on all projects.



Economic vs Financial Analysis of Projects

8. The method proposed by Mr. Filangieri to evaluate benefits from an irrigation project is to assign to them the same value as that indicated by the consumer's preference, or in other words their value at market prices. This, however, does not distinguish clearly between analysing economic benefits as opposed to financial revenues. When evaluating financial revenues, we look at a project from the narrow point of view of the project itself, or its project entity, primarily to judge the project's effect on the flow of funds into and out of the entity. The evaluation in this case is thus limited to a measure of the entity's ability to meet its financial obligations and to test the project's effects on various parties involved. In measuring economic benefits, however, we are interested in the impact of the project on the whole economy.

9. The economic and financial tests are complementary, not alternatives, and wherever we have a revenue-earning project, both tests should be applied. It is important, however, to keep a clear distinction between them since they are directed at different questions and require a different measurement of costs and benefits.

10. In the case of financial analysis, both costs and revenues are measured at market value. Thus, if we appraise the financial profitability of an irrigation project from the point of view of a farm producing wheat in a country where Government pays wheat producers at 20% subsidy above and beyond the market price, such a subsidy is included in the financial analysis but excluded from the economic analysis. The same would apply in the case of a farmer paying a tax to the Government. The tax, which merely involves a transfer of resources within the economy, would be included in a financial but

excluded in the economic analysis. Put in a more general context, only payments to factors of production are entered in the economic analysis. Furthermore, where market prices are distorted and therefore do not reflect their true scarcity value in the economy, they must be adjusted. Whenever possible, such distortions are corrected through the use of shadow prices.

#### The Use of Shadow Prices

11. Shadow prices, also known as accounting prices, are often used to represent the real economic cost of foreign exchange where prevailing exchange rates fail to do so; to adjust wages where they do not reflect opportunity costs of other employment opportunities due to minimum wage laws or other restrictions; to represent the real value of agricultural commodities where the prevailing market prices are distorted continue by subsidies or other policies. In the case of agricultural commodities which are traded internationally, the Bank practice is to use international prices as the best indicator of their real value in the economic analysis. This approach has three distinct advantages. First, world market prices of agricultural commodities are less distorted than domestic prices. Second, some form of forward price projections are available for most of the major commodities entering world trade. Third, by using project world market prices in association with supply and demand forecasts, planners can have an idea whether a locally produced commodity would be cheaper than imports or whether it would pay the country to attempt to export the particular commodity.

### Measurement of Benefits

12. Once we have quantified all the economic costs and benefits associated with a specific project, the next question is how to measure the profitability of the project by comparison with other projects in the sector of elsewhere in the economy. Since all inputs and outputs associated with a project have a market value, it is easy to decide which project has a higher profitability by expressing profitability as return to capital. Let me emphasize here once more that return to capital is not necessarily the only measurement of a project attractiveness to the economy and that other considerations such as employment, income distribution, poverty and balance of payments effects should, and usually do, enter into the evaluation of a project.

13. The following are some of the tests used in measuring return to capital and economic profitability:

(a) Net Present Value - After having established the stream of costs and benefits on the project, a discount rate considered appropriate for giving future values a proper weight in present decisions. The benefits and costs are then discounted at the selected rate and the Net Present Value is the difference between the present worth of the benefits and costs;

(b) Minimum Present Cost - this test is used to assure that the least-cost method of performing the project has been chosen. It is determined by choosing between alternative cost streams the one whose total cost has the lowest present value at whatever discount rate is considered appropriate. This test is often used by engineers during the formulation of a project in choosing between two or more technological alternatives. The minimum present cost does not, however, give us any indication of the project profitability as such;

(c) Payback Period - the payback period is the length of time required for a project to generate net benefits (i.e., gross cash flow in financial terms) equal to the original investment. It is measured by the length of time (usually in years) required for the cumulative gross cash flow (before all taxes and any debt service payments) to equal the investment which produces it. Here too the payback period provides no indication of a project's rate of return since it says nothing about the level or duration of returns after the payback period;

(d) First Year Yield - this is a test of the timing of investments, mainly to help make certain that a project is not being built prematurely. It consists of the ratio of (a) gross benefits during the first full year of a project operation after completion of construction and (b) total accumulated investment costs, valued to include interest during construction computed at the rate of the project's internal return. This ratio should then be compared with the project's internal economic return. If it is significantly lower, it may indicate that the project is being built earlier than it is economically justified; if it is significantly higher, it provides a strong indication that the project could have well been built a few years earlier.

(e) Benefit-Cost Ratio - this test has been described in detail in yesterday's paper and so we shall not dwell on it again, and;

(f) Internal Economic Return or in its more common use, the economic rate of return, which is the test generally used by the World Bank in appraising most projects.

14. The economic rate of return is an analysis that balances off the benefits and costs, or the advantages and disadvantages, of a project over its entire life by expressing all such benefits and costs in terms of their present value. Thus it is in effect a measure of the potential earning

power of capital used in a particular project. The discounting rate which equalizes the stream of benefits and costs is called the economic rate of return. This discount rate is in turn compared with the opportunity cost of capital in the sector or the economy as a whole. For example, when the opportunity cost of capital in a country is estimated to be around 10%, any project with an economic rate of return that exceeds this rate is economically profitable whereas those falling below this rate are not.

15. A great advantage of the economic rate of return is that it does not require a prior precise definition of the opportunity cost of capital in a country. One shortcoming of the analysis, or rather the way it is commonly used and which incidently also applies to all the other tests associated with measuring return to capital, is that it only provides a single value result without specifying what the probability of the occurrence of the rate would be. A partial solution to this shortcoming widely used in the work of the World Bank is to complement the rate of return analysis with a sensitivity analysis. The objective of this analysis is to observe the behavior of the rate of return in response to controlled changes in the main independent variables such as the construction cost of the project; the projected yield levels; the cropping intensity and pattern; the time interval required to reach the projected yield level; and farm production costs. After making each change the modified benefit and cost streams are recalculated and a new rate of return is obtained. This analysis pinpoints the parameters to which the rate of return is most sensitive and permit the planners to concentrate on these aspects. Even this analysis, however, does not indicate the likelihood of any event occuring during the life of the project.