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FORM NO. 57

| INTERNATIONAL DEVELOPMENT ASSOCIATION | INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT | INTERNATIONAL FINANCE CORPORATION |

OFFICE MEMORANDUM

TO: Mr. Robert S. McNamara   DATE: May 15, 1970

FROM: Abderrahman Tazi

SUBJECT: Some reflections on the opportunity of the adoption by the Bank of a largely expanded scheme to allow for a continuing evaluation of the actual economic effects of Bank-assisted projects after they have become operational.

1.   A pilot study was performed by the Bank in this field and resulted in the publication of Occasional Paper No. 7 entitled: "Reappraisal of a Road Project in Iran". The scheme I am suggesting should allow not only for the conduct of such studies, but also for the performance of cross-section analyses of projects of the same type in different countries or in different time periods.

2.   I am told that an experiment in this field is already being conducted within the Bank, covering some six countries or so. The expansion of this scheme would result, it seems to me, in many benefits to us. A rough list would include:

- a continuing evaluation over time of the Bank's techniques of projects appraisal and analysis, and possibly the introduction of improvements in the latter by a better grasp on our part of the essential features which result in a project's varying degrees of success;

- a highlighting of the interrelationships between a given set of features in a project and other factors in the economic environment which have a feed-back effect on the project and on how the latter fares;

- the promotion of a better allocation of resources on the part of our member countries, based on the lessons derived from the analysis of how and why projects fare differently in different countries;

- the provision to our member countries, as a result of this, of a useful insight into the dynamics of economic development, from which we would also benefit, so that we would find ourselves in a better position to give advice and counsel to them based on the lessons derived from a cross section analysis of the fate of similar projects which are already in the operational stage;

President has seen

- the development of a more realistic evaluation of the actual contribution made by our institution in furthering the economic development of our member countries through our assistance to their projects; and

- the promotion in Part 1 countries of a better understanding of the usefulness of the assistance provided by the World Bank Group, which could result in the long run in a greater willingness on their part to increase the volume of development aid given to Part II countries.

3.   I am aware of the fact that the above propositions should not, and cannot be taken at face value. On the other hand, it seems to me that the Bank is in a unique position to carry out such work, thanks to the availability to it of a continuing stream of data and other items which it is impossible to assemble in any other context. Therefore, if this opportunity we have is in fact as promising as it appears to be, we could make an outstanding contribution in this field.

4.   Therefore, I would like to suggest that it be proceeded to an assessment of the actual benefits which could be derived from the adoption of such a scheme. Simultaneously, we will need to evaluate the cost to us in adopting the expanded scheme, as well as the feasibility of development of simple follow-up techniques which would not be too cumbersome for our Borrowers, and yet would permit us the greatest flexibility in the conduct of these analyses over a wide range of options.

5.   In the light of the ever-increasing role the World Bank Group is assuming in the provision of financial and technical assistance to our member countries, and since the proposed scheme could greatly enhance the contribution we are making in both fields, it seems to me that this is an appropriate time to give some thought to this suggestion and see if it can pass the appropriate tests.

6.   I would of course greatly appreciate receiving your own comments on this proposal at your convenience.

Mr. Robert Sadove   June 11, 1969

W. Hughes *WH*

<u>Criteria for Economic Evaluation of Projects</u>

June 11/69

        In view of our discussion on June 2 which touched on the measure-
ment of economic benefits, I prepared the attached memorandum and annex
which outline my views as to why I think the net present value is the cor-
rect project evaluation method.

WHughes:mcr

Attach.

cc: Sir Gordon Mackay

Mr. Robert Sadove   June 11, 1969

W. Hughes

Criteria for Economic Evaluation and Selection
of Transportation Projects

1.   The selection of Bank projects is usually based on the internal
rate of return (IRR). This criterion can be subject to severe criticism
(by consultants and government alike). The purpose of the attached Annex
is to show that this method is inferior to the commonly called net present
worth or value method. The Annex may appear somewhat academic in nature
for a Bank document; this is necessary, however, to lead to the conclusion
that employment of the net present worth (NPW) method is recommended for
Bank use.

2.   The internal rate of return may be defined as the rate of discount
which would convert the stream of future benefits to a present value equal
to the present value of future costs. This rate is arrived at by 'trial and
error'. Projects with the highest internal rates of return are accepted.

3.   The main criticisms of the use of this measure are:

   (a) The computed rate of return may be below the opportunity
        cost of capital but accepted because we are uncertain as
        to what the opportunity cost of capital is.

   (b) Where alternative projects are examined, e.g. a highway vs.
        a railway, the wrong project might be selected. If several
        projects are to be selected, e.g. highways in a master plan,
        the ranking of priorities may be incorrect and the wrong
        investment decisions made. This can be because of different
        construction schedules, etc.

   (c) The measure implicitly assumes that benefits, e.g. cost
        savings, are reinvested at the same rate as the internal
        rate of return, whereas they can, in fact, only be reinvested
        at the lower opportunity cost of capital.

   (d) In certain circumstances, more than one rate of return may
        be obtained for the same basic data.

4.   The net present worth measure simply discounts benefits to a present
worth by some assumed appropriate rate, and from this are deducted all costs,
which are also discounted. If the benefits exceed the costs, the project is
acceptable (the excess of benefits over costs being, in effect, an unrealized
capital gain). If alternative projects are considered, the one with the highest
net present worth is preferred. Thus, incremented analysis, a time consuming
and necessary step with other methods, is eliminated. When the internal rate
of return and net present worth criteria lead to different decisions, the latter

measure will indicate the correct choice. The only criticism raised against
the net present worth method is that an appropriate discount rate (the op-
portunity cost of capital) must first be selected. This problem, however,
must also be faced when using the internal rate of return although it is met
at a later stage; detailed discussion of the methods of project evaluation
and appraisal is presented in the Annex. In summary it is recommended that in
view of the superiority of the net present worth measure of selecting projects,
it be used by this Department rather than the internal rate of return criterion
which has commonly been employed.

WHughes:mcr

cc: Mr. Hogg
     Sir Gordon Mackay

CRITERIA FOR EVALUATION AND SELECTION OF PROJECTS

Background

1.   The question of the superiority of the NPW method over the internal rate of return (IRR) in the selection of projects has long been argued. The essential arguments have been spelled out by Fisher in his 1907 and 1930 works[1]/, by Samuelson in 1936[2]/ and by the U.S. Federal Government in 1950[3]/. Despite an apparent resurgence, especially in the U.K., of the IRR under the name of Discounted Cash Flow (DCF), the Bank is probably the only major public body that evaluates and selects projects by the magnitude of the internal rate of return.

2.   The most likely explanation for the internal rate of return ever having been respectable is that Keynes[4]/ confused his marginal efficiency of capital (the internal rate of return) with Fisher's rate of return[5]/. The latter will, under many circumstances, indicate the correct investment choice by maximizing net present worth but the Keynes measure will not. The most common methods of selecting projects are discussed below.

Net Present Worth

3.   Net Present Worth (NPW) is simply the difference between the present value of benefits and the present value of costs. Projects with NPW less than zero are rejected, while for mutually exclusive projects, that with the highest NPW is selected[6]/. The selection of these projects is the same as maximizing the value or worth of owners' equity in a business. Owners will always attempt to do this by maximizing the present worth of expected income. The method is computationally easier than others, easy to understand, and will in all cases lead to the correct investment decision. Timing of projects can also be easily estimated.

Payback

4.   Payback is the time required for the benefits from a project to return the investment, those projects with the shortest payback period being selected. The method has serious drawbacks, e.g. benefits accrued after the investment is recovered are ignored and the best project may easily be rejected. If, for example, a railway were being compared with a highway or a bridge with a ferry, the railway and bridge would almost certainly be rejected on the grounds of longer construction schedules. Another weakness of this method is that it fails to give weight to the timing of benefits realized before the cutoff date. The argument is sometimes made that the payback method has the advantage of favoring the projects with least risk. This aspect is, however, more satis- factorily looked after by risk analysis. Payback cannot be taken as a serious candidate for Bank appraisal methodology.

Benefit/Cost Ratio

5.   The benefit/cost ratio is the ratio of the present value of future benefits to the present value of the present and future costs. The benefit/ cost ratio is sometimes used to select a project, i.e. that project with the

highest ratio is selected. While the method will usually result in the selection of the right project, the scale, or size of the project may be wrong. This is illustrated.
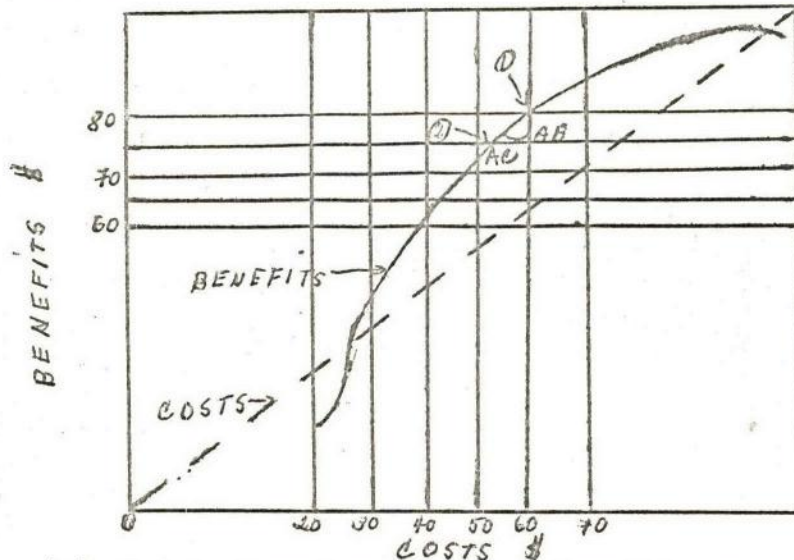
(i) Point of maximum excess of benefits over costs. (Point where incremental benefits = incremental costs.) This equals maximum net present worth.

(ii) Point of maximum ratio of benefits to costs.

6.　　　The diagram illustrates that used properly, the <u>incremental</u> bene-fit/cost ratio will lead to the same project selection as the net present worth method, i.e. it will select the project which has the maximum excess of benefits over costs. Used incorrectly, as is so often done, it is no tool at all for project selection. Even if used properly the benefit/cost ratio can be confusing, however, the ratio depending on the way in which the benefits and costs are put into the fractions, e.g.

(Benefits)　　　(Minus maintenance)

$$\frac{100 \quad - \quad 20 \text{ costs}}{40 \text{ (capital costs)}} = 2\text{:}1$$

vs.

(Benefits)

$$\frac{100}{60} \text{ (capital \& maintenance costs)} = 1.7\text{:}1$$

<u>Internal Rate of Return</u>

7.　[1]　　There are two concepts of the internal rate of return, that of Fisher[1] and that of Keynes[4]. Both have been used in Bank appraisals and both can lead to incorrect project selection.

(a) Keynes' rate of return (marginal efficiency of capital)

This rate of return is the rate of discount that will
equate the present worth of benefits and costs. For
example, investment in a feeder road may be discounted
to equal the benefits of increased agricultural production.
If two highway locations are presented, the one with the
highest rate of return might be selected.

(b) Fisher's rate of return

This rate of return also equates benefits and costs by a
discount rate. The benefits, however, are measured by
reference to an alternative - e.g. savings in vehicle
operating costs on the present road vs. a new road. This
is the usual Bank transport project evaluation measure, and
if the project promises a return higher than the notional
cost of capital, the project is accepted.

8.   The two methods can lead to opposite choices. For example[5]:

	Project A	Project B
Outlay	25	25
Benefits	5 per year, 10 years (total 50)	1 in 1st year, 2 in 2nd year etc. up to 10 years (total 55)

The Keynes internal rate of return for Project A is about 17% and for Project B
about 12.5%; therefore A is preferred. Fisher's rate of return shows that B is
preferable, having a rate of return of 6% (the rate of return from Project A
cannot be calculated, e.g. it may be the present road).

9.   While Fisher's rate of return is superior, it can also lead to a wrong
choice of project on two grounds:

(i)   where there are mutually exclusive projects, incremental
       benefits and costs are neglected[8];

(ii)   the internal rate of return implicitly assumes that benefits
       are reinvested at the same rate of return. On the other hand,
       the net present worth method assumes that they are reinvested
       at the cost of capital. The two methods thus give different
       project selection:

	Project A	Project B
Project life	30 years	10 years
Investment, year 0	$1 mn.	$1 mn.
Cost of capital	6%	6%
Annual benefits	$76,577	$142,377
Net present worth	$54,082	$47,752
Rate of return	6.5%	7.0%

The rational investor would wish to maximize net present worth by selecting Project A, even though the rate of return is higher for Project B. There are implicit assumptions that benefits from Project B are reinvested at 7% during the project life, and they continue to be reinvested at 7% up to 30 years. In fact, there is no particular reason to think that they would be reinvested at more than the cost of capital. If this were done, the rate of return for Project B would be less than 6.5%.

10.   The internal rate of return method therefore fails as a measure for selection as it does not consider the reinvestment rate, for which an <u>external</u> rate must be used. If this were done, then, of course, the method would be converted to one of net present worth. As McKean says, the internal rate applied to reinvestment "is no more appropriate than the internal rate of return on Saturn"9/. An example will clarify this:10/

"Assume that there are two investment opportunities available. Both are profitable in an absolute sense, but only one can be undertaken because the two are mutually exclusive. Project X requires an outlay of $100 now, at time t_o, and promises to return $120 exactly one year hence at time t_1. Project Y also requires an outlay of $100 now and promises to return $174.90 exactly four years hence at time t_4. Assume also that the degree of certainty attaching to each project is identical and that the investor's present "cost of capital" is 10%. The "rate of return" on Project X is 20%, and on Project Y it is 15%. The present value of Project X, discounted at the cost of capital, is $109.09. For Project Y, the present value, discounted at the cost of capital, is $119.46. If the two projects are ranked by their rate of return, Project X is the better one. If, on the other hand, they are ranked in terms of present value, Project Y is the better one. Which should the investor choose? In order to resolve the problem correctly, it is necessary to isolate the source of the conflict between the two approaches. The easiest way to do this is to compare the two investment proposals in terms of their relative value as of the terminal date (t_4) of the longer-lived project. According to the data given, proposal Y will provide the investor with $174.90 at time t_4. All we know about proposal X is that it provides $120.00 at time t_1. What happens to these funds between time t_1 and t_4 is obviously an important piece of necessary information. Neither the rate-of-return approach nor the present-value approach answers this question explicitly. But they both answer it implicitly and in different ways. This is the source of the conflicting results that they yield. Those who use the rate-of-return approach, as it is usually defined would choose Project X over Project Y. Hence they must assume that this choice will yield a larger terminal value than that promised by Project Y, i.e. $174.90. This, in turn, implies that the $120 obtained from Project X at time t_1 at a rate lucrative enough to accumulate to more than $174.90 by time t_4. In general, the implicit assumption made by the rate-of-return approach is that the reinvestment rate is at least equal to the rate promised by the longer lived of the two projects, in this case, 15%. The present-value approach, as usually defined, assumes

that the funds obtained from either project can be reinvested at
a rate equal to the present cost of capital, i.e. 10%. Using
this assumption, the investor will end up at time t_4 with only
$159.72 if he chooses Project X. With Project Y, he would have
$174.90. Thus, according to this approach, Project Y is the
better choice."

11.　　Sometimes there is more than one rate of return for a project, but
this is rare in transport cases. A typical case is one in which there are
negative benefits in the terminal years. The only solution to a multiple
rate problem is to accept a project if the net present worth is positive at
the cost of capital - again leading right back to the present worth cri-
terion.[11]

Cost of Capital

12.　　An argument often used to support the internal rate-of-return method
is that the cost of capital problem is eliminated. This is not so; the rate
of return must at the last stage of selection be compared with the cost of
capital. The net present worth method tackles this question at the outset.

13.　　The cost of capital to be used for discounting certainly should not
be the interest rate on government bonds, as recommended in the "Green Book".[12]
Nor should it be based on the borrowing or lending rate of the Bank, because
such interest rates do not allow for riskiness of projects. Government pos-
sesses taxing powers and can print money, thereby eliminating risks of default.
The Bank has the remedy of not lending to the country again if a loan is de-
faulted - also it has substantial reserves. A more accurate measure of the cost
of capital is its marginal productivity in the sector from which it is withdrawn.
If the capital does not earn a return equal to this marginal productivity there
is a clear loss to society. That there are computational difficulties is not
to be denied - the source mix of Bank and local funds is complex. Nevertheless,
the attempt to ascertain the cost of capital can and should be made by analysts.[13]

Summary and Conclusions

14.　　In the evaluation and selection of project, alternatives should always
be considered - such alternatives are available in "master plans" or at the
project identification stage. The internal rate of return may lead to erroneous
selection decisions, in that ranking of projects may be erroneous and there is
no indication given of the scale of project that should be undertaken. Bene-
fit/cost ratios are confusing and will not lead to correct project selection
in all cases. Payback is incorrect in that total benefits from a project are
not considered. The only method of evaluating and selecting projects that
will give the right answer in all cases (and the method that is used by private
investors) is the one of net present worth.

Notes:

1. Irving Fisher, *The Rate of Interest*, (New York: MacMillan Co., 1907) and *The Theory of Interest*, (New York: The MacMillan Co., 1930).

2. Paul Samuelson, "Some Aspects of the Pure Theory of Capital", *Quarterly Journal of Economics*, 1936-37, pp. 469-96.

3. Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs, *Proposed Practices for Economic Analysis of River Basin Projects*, (May 1950). (Usually called the "Green Book".)

4. J. M. Keynes, *The General Theory of Employment, Interest and Money*, (London: The MacMillan Co., 1936).

5. See, for example, Armen A. Alchian, "The Rate of Interest, Fisher's Return over Cost, and Keynes' Internal Rate of Return", *American Economic Review*, Dec. 1955.

6. The argument that "the Bank is usually presented with only one project" is spurious, in that there is always a selection to be made, i.e., two or more ways of achieving the same objective.

7. See "Green Book", p. 12.

8. See H. Bierman, Jr. and S. Smidt, *The Capital Budgeting Decision*, (New York: The MacMillan Co., 1960), p. 37. But note that the incremental benefits and costs can be taken into account, though only with computational difficulty. The rate of return of the incremental benefits over costs must be calculated for each increment in costs. As long as this is greater than the cost of capital, successively larger increments are compared.

9. The best discussion of this point can be found in Ezra Solomon, "The Arithmetic of Capital Budgeting Decisions", *Journal of Business*, April 1956. Martin Wohl and Brian V. Martin, *Traffic System Analysis*, (New York: McGraw-Hill, 1967) pp. 237-241; Roland N. McKean, *Efficiency in Government Through Systems Analysis*, (New York: John Wiley and Sons Inc. 1958) pp. 76-87; and p. 85. J. Hirshleifer, "On the Theory of Optimal Investment Decision", *Journal of Political Economy*, August, 1958.

10. From Solomon, *op. cit.*

11. A. David Quirin, *The Capital Expenditure Decision*, (Homewood: Richard D. Irwin, Inc. 1967) p. 55. Other discussions of the multiple rate problem are to be found in: J. A. McLean, "How to Evaluate New Capital Investment", *Harvard Business Review*, Nov-Dec, 1958. J. F. Wright, "Notes on the Marginal Efficiency of Capital", *Oxford Economic Papers*, July, 1963. Bierman and Smidt, *op. cit.* pp. 40-45.

12. "Green Book", *op. cit.* p. 24.

13. Among the best discussions of the cost of capital are to be found in: Quirin, *op. cit.* Chapter 7 and 8. Otto Eckstein, *Water Resources Development*, (Cambridge: Harvard University Press, 1961) pp. 97-104. W. J. Baumol,

<u>Welfare Economics and the Theory of the State</u>, Cambridge: (Harvard University Press, 1952) pp. 91-93. R. Winfrey, "Concepts and Applications of Engineering Economy in the Highway Field", <u>Highway Research Board Special Report 56</u>, 1960. E. L. Grant, "Interest and the Rate of Return on Investments", <u>Highway Research Board</u>, <u>loc. cit</u>. Wohl and Martin, <u>op. cit</u>. pp. 217-222.

Other References:

1. Eugene L. Grant and W. Grant Iveson, <u>Principles of Engineering Economy</u>, (New York: The Ronald Press Co., 1964) Chapter 7 and 8.

2. J. Lorie and L. J. Savage, "Three Problems in Capital Rationing", <u>Journal of Business</u>, October 1955.

3. Joseph Koopman, "Evaluation of Investment Projects", in <u>Cost-Benefit Analysis</u> (ed. Anwar Tahmasp Khan Lahore: National Institute of Public Administration, 1965).

4. Edward F. Renshaw, <u>Toward Responsible Government</u>, (Chicago, Idyia Press, 1957).

Messrs. Balassa and van der Tak   March 18, 1969

George Kalmanoff

<u>Evaluation of Economic Benefits in Industrial Projects</u>

    The attached paper on the "Evaluation of Economic Benefits
in Industrial Projects", prepared by Bertil Walstedt, arose out of a
recent request by the European Department that we participate with
them in developing guidelines for the appraisal of economic benefits
in industrial projects, with particular reference to the fifth IBRD
loan to the Industrial Development Bank of Turkey (TSKB). A copy of a
letter from TSKB summarizing the agreed guidelines, based on Mr. Walstedt's
paper and subsequent discussions, is also attached. Those guidelines
were recognized by both parties as tentative and subject to further study
and refinement.

    In connection with the need for such further consideration,
and before discussing the paper outside our Department or with operating
parts of the Bank Group (the Development Finance Companies Department
and IFC) it seems desirable to have other views within our Department
particularly since this overlaps with work in the Sector and Projects
Studies Division. I am therefore submitting the papers for your review,
with the idea of discussing them in an initial meeting.

    Some questions for consideration are:

    (a) Is the theoretical basis of Mr. Walstedt's paper sound? If
        not, in what respects should it be modified?

    (b) Are the operational guidelines indicated in the TSKB letter
        desirable? If not, what changes might be suggested?

    (c) What additional studies should be undertaken to facilitate

        (i)   the determination of certain major parameters in
              project appraisal like accounting rates for foreign
              exchange, capital, and labor, or

        (ii) the evaluation of "external economies", and how might
              they be undertaken?

    Mr. Walstedt is scheduled to leave early in April on a month's
mission to Mexico. If possible, it would be desirable to hold our meeting
before he leaves. I suggest Friday, March 28 at 11:30 A.M. in Room A-830.
Please let me know whether this is convenient for you.

Attachments

cc: Messrs. Kamarck, Stevenson, Walstedt

BWalstedt/GKalmanoff:vlb   GJK.

Mr. Warren C. Baum   January 29, 1969

R. Sadove

Project Data Reporting System

1.   I refer to your request of December 31, 1968 for our comments on
Mr. van der Tak's memorandum of December 24 and our nomination of a contact
man for this Department.

2.   I attach a memorandum by Mr. Jaycox, dated January 21, 1969 which
expresses our views. I wish to emphasize particularly the need to work out
more explicit proposals of what is wanted in the Data Reporting System. We
are standing in a welter of words from which it is not clear how far the
reporting would take us;

          1) in the monitoring of projects under execution,

          2) in the ex-post evaluation of projects, and beyond that,

          3) in the research possibilities with perhaps some general
              application of the results.

3.   The practical considerations are different from sector to sector
and even from project to project. I suggest, therefore, that when Mr. van
der Tak has given further thought to the more detailed definition of pur-
pose, he communicate with Mr. Jaycox (or in his absence, Mr. Hogg) who
would be the contact man for this Department.

AFGellot:bw

Mr. D. S. Ballantine   January 15, 1969

J. J. Stewart   ˅Nov 25

<u>Mr. van der Tak's memorandum on sector studies and project evaluation</u>

      The need for sector studies has long been recognized in our department and has been met with varying degrees of success by the Unesco PIM reports. The standard of these reports has been improving, and with the proposed increased emphasis upon longer range projections, the PIM reports should meet most, if not all, of our requirements. As you already have discussed, consultant firms might be used to provide additional sector studies, if required.

      Other departments, except perhaps the agriculture department, will not be able to obtain sector studies so readily. None of Mr. van der Tak's proposals for organizing sector work, however, impress me as being desirable. I would think that staff members concerned with operations work in each department would perform sector studies, as required. Contracting the sector studies to qualified consultant firms might also be considered as an alternative.

JJStewart/ms