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December 31, 1974
For further correspondence,
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OP-G.O.P. APPRAISAL
& PREPARATION OF
PROJECTS

Mr. R. K. Johanson

December 24, 1974

A. Stam

Contingencies (See minutes of board presentation on Ivory Coast Coco Project and Recent visit of E.Ds. to inter alia Thailand)

I suggest that the above topic be placed on the agenda for our division staff meeting. The following points may guide the discussion:

(1) World-wide inflation necessitates high contingency allowances. For recently appraised projects, the physical and price contingencies amount easily to 40-60% of the base cost.

(2) High contingencies don't please the eye (Mr. Armstrong's memo of November 1974), and give some executive directors the impression that a proposed loan or credit is based on a "guesstimate" of what total project costs may amount to. And indeed, the question arises whether an appraisal estimate with, for example, a contingency component of 50% of base cost, is an adequate base to determine (and in fact freeze) suitable loan or credit amount.

(3) Also, our borrowers at the time of negotiations have difficulties in digesting high contingencies, especially price contingencies. First, IBRD-financed projects need approval of the Borrowers' Parliaments, and presenting a project with a high price contingency component (for example 40% of the base cost) may lead their parliaments to conclude that their governments do not believe in the success of their own policy to fight inflation. Second, borrowers dislike paying full commitment charges on loans of which portions may be cancelled (Colombia, Education I and II).

(4) Another objection to the high contingencies is that they lead PIU staff as well as consulting architects easily astray. In the early stages of project implementation, these people tend to think that the proposed funding is rather generous and their first preliminary drawings often reflect such misunderstandings.

(5) In addition, even high contingency allowances are often inadequate as is demonstrated by the great number of (even recently appraised) projects with cost overruns. Governments are often unable to meet 100% cost overruns, which situation leads to slowed down implementation (and in times of inflation consequently to more cost overruns) and/or cutting down projects. In the case of education projects, for these reasons mid-way implementation often staffhouses, boarding and dining facilities, multi-purpose rooms, and libraries are reduced or eliminated; furniture and equipment curtailed. Projects, although well conceived at the time of preparation and appraisal often start operation as "amputees."

(6) With the above points I have wanted to indicate that the problem of high contingencies is not merely a cosmetic problem, but touches on the basis of the effectiveness of bank lending. The solution recently suggested by Mr. Armstrong to allocate price contingencies does not seem to address the real problem.

(7) I rather favor seeking the solution following the suggestion of Mr. Jansen, Executive Director of the Federal Republic of Germany. He suggested during the recent board presentation of the second coco project for the Ivory Coast to make loans and credits adjustable in one way or another to price fluctuation (inflation, currency adjustments, etc.).

(8) To illustrate how a more flexible lending system could be implemented, let us take a project with an estimated base cost of US\$9 million; physical contingencies US\$1 million; and price contingencies US\$4 million and an estimated implementation time of six years, for which bank financing is proposed for 50% of total cost. I would suggest that (i) an initial loan be made to cover 50% of the base cost and physical contingencies, amounting to US\$5.0 million; (ii) after three years (mid-way implementation) a complementary loan be made, based on updated cost estimates; (iii) another board presentation be required and adequate explanation should be provided if the second loan would substantially deviate (say more than 30%) from 50% of the originally estimated price contingencies; (iv) the commitment charges on this complementary loan be double those of the first loan to compensate for the reduced IBRD revenue from commitment charges that this system entails and to discourage Borrower's overspending for the second loan.

(9) The above suggested system could be refined, other safeguards built in to ensure careful and economical management and planning. For example, the disbursement percentage could be lowered for that part the total loan (first and second) exceeds the original estimate (US\$7 million).

(10) It would appear to me that the proposed system would overcome the afore-mentioned weaknesses of the present system. In addition, it would provide the Executive Directors an opportunity to become more informed and involved in project implementation.

AStam:er

OFFICE MEMORANDUM

*OP-G.C.P.-APPRAISAL
PREPARATION OF
PROJECTS*

TO: Files

DATE: November 12, 1974

FROM: John A. King *JAK*SUBJECT: Mr. Riley's Comments on the November 7 Draft on "Revolving Fund for Project Preparation"

1. Mr. Riley, who will not be able to attend Wednesday's meeting (November 13, 1974) on this draft, had the following comments:

a) Paragraph 2. In response to the Bank's request last summer, UNDP agreed to finance detailed engineering for water supply and sewage projects. This is a departure from its earlier practice and it is considering extending this exception to other sectors.

b) Paragraph 3(b). Under UNDP's current practice, there is no lower limit on amount, and requests, however small, can be considered for the Country Programme. The procedures, however, may still be cumbersome, though in principle the Resident Representative has authority to approve "projects" of under \$100,000.

2. Mr. Riley tells me that UNDP is concerned that its funds are not being utilized in the poorest countries; this concern covers both funds in the IPF and the special funds for the poorest countries administered by UNDP headquarters.

JAKing:lp

Messrs. Baldwin, Ballantine, Christoffersen, Riley,
Simmons, Strombom, Venkateswaran, Walton, Wiehen
John A. King

November 8, 1974

Revolving Fund for Project Preparation and Detailed Engineering

1. After a deplorable delay, I am circulating for discussion a draft proposal for such a fund. This draft results from our discussion of this subject last April (cf. my memo to you of April 3). I would like to discuss this draft early next week; my secretary will be in touch with you about times.

2. This draft is definitely a first attempt and undoubtedly needs considerable revision and refinement. Specifically, I would like to raise the following:

- a) Are the deficiencies in the existing system described too telegraphically? In particular does the relationship with UNDP need elaboration?
- b) Is the concept of the typical size (paragraph 4(a)) correct?
- c) Are the proposed characteristics of the Fund correct? What about the attitude on local currency costs, the financial terms, the procedures, the hiring of consultants, etc.
- d) What about the size and source of the Fund?
- e) What has been omitted?

3. I am circulating the draft to a few people who have not previously been involved, but as I see it the purpose of this review is to improve the draft so that it can be presented for review at the Operational Vice President level.

Attachment

cc: Mr. van der Tak
Messrs. Armstrong, Engelmann, Blaxall

JAKing:jlg

NOV. 7, 1974

D R A F T

JAKing:jlg
Nov. 7, 1974

A REVOLVING FUND FOR PREPARATION OF BANK-FINANCED PROJECTS

1. Introduction. Financing the preparation of projects to be considered for Bank^{1/} financing is carried out in a number of ways. Financing of technical assistance and engineering is discussed in considerable detail in OMS 4.00, but briefly the sources include:

Outside the Bank -

- Grants from bilateral aid, foundations and regional banks.
- UNDP.
- Assistance from specialized agencies (outside the Cooperative Programs).

By the Bank -

- Cooperative Programs with FAO, UNESCO, WHO and UNIDO.
- Retroactive Financing under project loans.
- Piggy-backing under project loans.
- Technical Assistance Grants.
- Technical Assistance and Engineering Loans.
- Preparation by Resident Missions (particularly those for Eastern and Western Africa).
- Preparation by Headquarters Staff.

In spite of this array; there is a feeling in the Regions and CPS that there are gaps in the system and that a revolving fund for project preparation, available under simple and flexible administrative procedures,

^{1/} Unless the text indicates otherwise, the term "Bank" includes IDA and "loan" includes development credit.

is needed. The purpose of this paper is to identify the gaps in the system and the needs and to propose means of meeting those needs.

2. Deficiencies in the Existing System. A major difficulty with the existing system is that many of the sources identified above do not ordinarily provide for engineering. This would be true in general for the sources outside the Bank described above and for Bank Technical Assistance Grants. This gap is significant, particularly where "detailed engineering" is required to bring the project to a stage where costs can be estimated with sufficient accuracy to present the project to the Board for approval.

3. Each of the sources described have their particular drawbacks. These are described briefly below:

a) In the case of grants from bilateral aid, foundations and regional banks the Bank does not have direct control over the scope and design of the work or over the selection of those performing the services. As a result, the work may not meet the Bank's requirements for project preparation.

b) In the case of UNDP, the UNDP Country Programme for the country in question may be too full to permit the timely financing of the work needed, or the amount required may be too small for UNDP to consider (normally amounts under \$200,000).

c) Assistance from the specialized agencies (outside the Cooperative Programs) suffers from the problems noted in (a) above.

d) The Cooperative Programs with FAO, Unesco, WHO and UNIDO of course perform an important part of project preparation in their respective sectors. But because of the way in which their work programs

are prepared, they lack flexibility and the capacity to deal with small but urgent tasks required ad hoc in the course of the preparation of particular projects.

e) Retroactive financing under the loan for the project in question is widely used for certain tasks of project preparation, particularly final design and preparation of specifications and invitations to bid. But it may not be suitable for other preparation tasks which arise earlier in the cycle. And in the case of poor countries, there may be an absolute lack of funds or foreign exchange to pay initially for work which may be later financed retroactively.

f) Piggy-backing is also widely used for such preparation work as feasibility studies and detailed engineering in sectors such as highways where the Bank finances a series of tranches in a development program. But it does not work so well in sectors where the Bank is not lending frequently or where, though the Bank is lending frequently for projects in the sector, the project to be prepared is not a logical extension of the project being financed. Furthermore, in the case of Bank loans, borrowers may be reluctant, under these circumstances, to pay commitment charges for preparation funds, while in the case of IDA credits, there is some evidence that funds committed for this purpose may not be spent promptly and effectively.

g) As already noted, Bank Technical Assistance Grants are not normally available for engineering. Furthermore, they are available only under "very exceptional circumstances".

h) Technical Assistance loans have been used in only a few countries where rather special circumstances prevail. They must meet the documentational and procedural requirements of Board presentation and

are not suitable to meet needs generally. Engineering loans also meet a rather specific case where a substantial amount of engineering, enough to justify the work connected with preparing the loan for presentation to the Board, is necessary for making the appraisal of a potential project. They too are not suitable for general use, even when only engineering is needed.

i) There are distinct limits as to what resident mission staff or headquarters staff can do in the way of project preparation. Resident missions have finite staff resources which cover only a limited number of sectors or subsectors and not all the skills which may be needed for project preparation even within sectors covered. And headquarters staff are constrained by other tasks and cannot usually devote continuous blocks of time to preparation work.

4. The Need. From this review, therefore, there emerges a need for a revolving fund to cover certain aspects of the overall task of the preparation of projects to be financed by the Bank. It appears to be -

- a) For small amounts of work, usually \$100,000 or under,
- b) Often but not necessarily in engineering,
- c) Needing direct Bank definition and control,
- d) In sectors or subsectors either in which the Bank is not particularly active in the country in question or in which projects do not flow logically from one to the other,
- e) In poorer countries,
- f) Available on short notice with a minimum amount of documentation and red tape.

5. The Revolving Fund. It is therefore proposed that a revolving fund to provide assistance in financing particular aspects of the preparation of projects to be financed by the Bank. It would have the following characteristics:

a) It would be available only as a last resort when other alternatives for financing project preparation were not available. This characteristic would tend to limit this assistance to the poorer countries.

b) Its use would not be limited to particular sectors but the expectation would be that the greatest use would be in the newer sectors.

c) It would be primarily for foreign exchange costs, but in cases where accomplishing the particular task would be delayed unreasonably because of the impossibility of providing local funds, it could be used to meet local currency costs as well.

d) Funds advanced for this purpose would be made available to governments at no interest (?) to be repaid to the Revolving Fund out of the loan for the project in question as soon as it became effective. If the project did not materialize, and the country was eligible for IDA funds, the advance would be forgiven, but if it were a Bank-only country (presumably an exceptional case), the advance would be repaid within a year after it had been agreed that the Bank would not finance the project in question.

e) Application for such assistance would be made by letter from the government in question identifying the particular preparation task for which financing was needed and indicating the estimated cost and why other financing was not suitable or available. Terms of

reference for the work and identification of how it would be carried out would then be negotiated between the prospective borrower and the Bank. Whether or not the proposal was suitable for the Revolving Fund would be determined by the Senior Vice President. The procedures would be based on the need for flexibility, rapid processing and prompt decision.

f) Consultants to carry out the work would be selected and hired, subject to consultation with the Bank (the Bank's approval?), by the prospective borrower. (Or should they be hired by the Bank, analogizing to the UNDP and Bank-grant practice?)

6. The Revolving Fund would be established initially with a capital of \$5 million (\$10,000,000?) out of the Bank's earnings (?). (Might the Bank be able to get UNDP financing for such a fund?) As it was depleted by advances forgiven in accordance with paragraph 5(d), it would be replenished from the same source. After an initial experience of, say, two years, the concept of such a fund and its usefulness would be reviewed and it could be modified, expanded or closed out as the circumstances indicated.

Mr. Alain Thys

October 14, 1974

W. Cosgrove

Logistics in Project Preparation, Construction and Operation

1. During my current series of supervision missions I have had the opportunity to observe and reflect on the importance of logistics in project preparation, construction and operation. The word "project" as used in this memo is intended to include the institution building which usually is associated with the physical works.
2. It is obvious to all that project disbursements are generally lagging behind appraisal estimates. Although all appraisal missions make a serious effort to be realistic in forecasting disbursements, and even to apply "bugger factors" to estimates of disbursement timing in order to make them more realistic than the Borrower is prepared to admit, these measures only serve to cover up the multitude and variety of constraints applying under the different circumstances of each project which not only delay the physical project but often more seriously affect the anticipated institution building associated with the project.
3. Our Division has for some time had a series of "long" and "short" questionnaires which we have submitted to prospective Borrowers at the stage of project identification or pre-appraisal in order that most of the required information can be gathered before the arrival of the appraisal mission. These questionnaires are also in general circulation and are being used on some occasions by WHO consultants doing project preparation. I propose that we add a section to this questionnaire at the end of the project description, costs and justification which would be entitled "Logistics."
4. Under this heading I would suggest a series of questions similar to and/or including those attached hereto as Annex I. A financial analyst might add to this Engineer's list of questions. It may be argued that most of these questions are already raised in various Bank documents such as the OPM's and Mr. Jennings' "Check list for Appraisal of Public Utilities Projects." This is true but unfortunately the recommendations of the appraisal team are received by the Borrower at the earliest during negotiations and often only after receipt of the Grey Cover Appraisal Report. Submission of these questions related to logistics as part of our questionnaire may result in their being considered by the Borrower as much as two years earlier than at present.
5. I have suggested that logistics be considered by the consultants and the Special Group preparing the Damascus Sewerage Project. Their immediate reaction was that if the project is scaled down to what it is logistically possible to carry out in a five-year period, they will be far from having achieved these objectives. Of course, the goal to be achieved in applying logistics is not to reduce the scope of the project but to identify bottlenecks which will prevent the anticipated results from being achieved even though the financing is readily available. Having identified these constraints, the Borrower can set about eliminating them so that the project goals can be reached as close to the desired

date as possible. When this was explained to the Damascus "Special Group" the representative of the municipality readily endorsed the idea. Citing 1974 as a typical year for housing and public works in Damascus he pointed out that there were credits available of 200,000,000 LS but that only 80,000,000 LS of work could be carried out because of the various constraints imposed on their program.

6. I realize that government administrative practices and policies will in general be the real source of nearly all of the obvious constraints and that individual administrators will not by themselves have much success in changing these. Furthermore, they will require expert assistance if they are to have any hope of doing so. Nevertheless, I believe that the Bank can contribute to the revision of these policies and practices which hinder development by insisting on the application of the science of logistics to the preparation, construction and operation of all Bank-financed projects. One method of introducing this concept into developing countries would be to put more emphasis on this type of problem in the EDI courses such as the one on water supply and sewerage. Introducing the requirements for consideration of logistics into our Division's water supply and sewerage questionnaires would also be a step in the right direction.

Attachment

 W Cosgrove:ja

LOGISTICS APPLIED TO PROJECT DESIGN, CONSTRUCTION AND OPERATION

Suggested Questions for Future Borrowers for Water
Supply and Sewerage Projects

- (a) Under the present applicable administrative procedures what period of time will be required for the selection of consultants for final design and the negotiation and effectiveness of the consultants' contract?
- (b) What counterpart staff are required to work with the consultant (including staff to supervise the consultant)? Are they available and how long will it take to mobilize them? How long will it take to collect and coordinate data to be furnished to the consultant by the Borrower?
- (c) What are the numbers and qualifications of the personnel required by the consultant (or the Borrower's staff, if consultants are not being used) to complete the tender documents? How long will it take to mobilize this staff and complete the project documents?
- (d) Under present applicable administrative procedures what period of time will be required for advertising of the tenders, bid preparation, bid analysis and approval by the appropriate authority?
- (e) What will be the quantities of materials and equipment required for the construction of the project? Are they available in the country? If not, should they be available in the country? Does the project warrant their local manufacture? If so, when should construction of the manufacturing installations begin? If materials and equipment are to be imported, what are their delivery delays on the international market? Under present administrative procedures, how much time is required to clear these materials and equipment through customs?
- (f) Estimate the manpower requirements for the construction of the project according to degree and type of skill ranging from project manager to common labor. What other projects will be competing for the same manpower? Are local contractors available with the personnel and equipment required? What is the present workload of these local contractors? Can it be expanded? If foreign contractors win the contracts will they be able to find sufficient skilled and ordinary labor on the local market?
- (g) Will the project construction be supervised by local personnel or consultants? If local personnel, how many men will be required in each specialty? How long will it take to mobilize them? If consultants are to be used, what local personnel will be required to supervise and coordinate the consultants efforts?

- (h) If consultants are to be used for design and supervision, does this reflect the need for more trained local personnel? What arrangements have been made to permit local personnel to learn from or be trained by the consultants?
- (i) Will the design, construction and operation of the project require a laboratory, machine shop, stores or other similar facilities? If these do not exist or are not adequate to meet the project needs, when must they be completed and staffed? Is the staff available? If staff training is required where will it be given and when must it begin?
- (j) What measures are required in addition to the project as defined in order to ensure that the product or benefits reach the intended recipient?
- (k) What personnel will be required for the operation and maintenance of the project and when? Are the skills available in the numbers required? If not when must recruiting and/or training begin in order to ensure they will be available when required?
- (l) Based on the above information, prepare a draft structure of the organization required for the design, construction, operation and maintenance of this project together with those other installations or projects for which the organization will be responsible on completion of the project. Are sufficient experienced managers available to administer this structure? Are sufficient skilled accountants available to carry out the billing, collecting and financial reporting? If there are shortages in either of these categories how will they be filled?

* *
*

Mr. Walter J. Armstrong, Supervision Adviser

August 13, 1974

Wilfried P. Thalwitz, Director, Western Africa Projects

Role of Bank Engineers in Connection with Engineering Designs and Cost Estimates

1. This is in reply to your memorandum of July 8, 1974, asking for comments on Mr. Knox's memorandum of July 8, 1971, on the abovementioned subject. Your main query was whether Mr. Knox's memorandum could be re-issued as a Bank-wide guideline.
2. There has been considerable discussion of this subject in WAP and it is evident that the variety of views reflect the different sector backgrounds and experience of those concerned, the perception of how engineers do or should function in the Bank and, not least, semantics. The following highlight the comments which appeared germane.
3. Not surprisingly, the highway engineer, agricultural technician, power expert and so forth, differ to some degree on the capacities of the engineer and, therefore, the responsibilities he can assume; the more complex the scope of the job, the less able is the individual engineer to fill the role of "expert." Everyone perceives this as a matter of degree; that Bank engineers should know their limits; when beyond them, should seek the advice of colleagues with appropriate expertise; and when necessary recommend the Bank seek advice from consultants.
4. On "cost estimating," needless to say no one makes any claims about the Bank engineer's ability in the present pricing climate to estimate equipment prices (or make expert "judgments") other than for staples such as vehicles and standard construction equipment. Nor does anyone claim that the Bank engineer can be expected to literally double-check the consultants' cost estimate of civil works. The distinction between a cost estimate and the "low" bid price is made; that regardless of how the former is made the latter will depend on the "market" for construction work. The following is an extract from Mr. Ireland's (Agriculture) memorandum:

Mr. Armstrong's para. 12 mentions "contractor's estimation procedures as opposed to unit price cost estimating" and at least implies refinements in civil works cost estimates at appraisal which do not make sense when in the next step, as a matter of judgment, 60% or more is added as a price contingency.

It seems to me that the experienced project planner would use a balanced risk approach to cost estimating whereby all inputs were examined and refined commensurate with their proportion of total project cost and their significance in project execution and in meeting project goals. Where civil works costs do not predominate

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in total project costs, as is the case in most agriculture projects, it does not make sense to over-refine civil works cost estimates simply because the techniques are well known and considerable sophistication in evaluation is possible.

Civil works cost estimates at the appraisal stage are normally based on quantities and unit prices. Regardless of the detail in the preparation estimate, it is not possible for Bank engineers at appraisal to check all items to any great extent. Regardless of how it is done, or who is held accountable, the low bid price is still heavily influenced by the amount of competition. Usually if 5 or 6 bids are received, the low bid will be fairly close to the estimate. If only two or three bids are received, the low bid will be higher than under the more competitive situation.

5. Another view as to acceptability of 'responsibility' by the Bank's technical expert is expressed by Mr. Hubert (Education):

... The Responsibilities are borne by the borrower's technical staff and consultants: (1) entirely, for design, and (2) within acceptable margins of error (more or less 15%), for cost estimates. Bank engineers could be responsible only for the review of Engineering designs and cost estimates.

6. In our view, the recently issued CPM 2.10(a) dated June 13, 1974, para. 27 states the matter quite adequately:

"Improving the Bank's Cost Estimate Review Capability

27. Although the ultimate responsibility for the accuracy of cost estimates rests with the borrower, the Bank accepts some share of the responsibility when during project preparation and appraisal the staff reviews, changes and accepts project estimates. The degree of implied responsibility is increased when Bank staff or Cooperative Program staff have a major role in preparing the project and the cost estimates... "

7. To this end the Bank's staff in accepting project cost estimates reviews available material, introduces changes on the basis of their own experience or with the assistance of other staff and consultants. No separate memorandum appears needed, but it would be useful to expand para. 27 of CPM 2.10(a), introducing a reference to the need for outside assistance in particularly difficult cases.

WPhalwitz/DKing:ev

cc: Messrs. Rowe, Pouliquen, King
Division Chiefs, WAP
Hubert, Ireland

D.P. G.O.P. Appraisal
& Preparatory
Projects

Mr. Vinod Dubey

August 6, 1974

Gavin E. Wyatt



Economic Analysis of Projects - Implementation
Program Fiscal Year 1975

Reference your memo of August 5, the information requested in paragraph 2 of Mr. Chenery's memo of August 1, is as follows:

Yugoslavia

1. Bosnia Power

- (a) Appraisal expected in September 1974.
- (b) Assistance is requested from CPS preferably in the person of Mr. Anderson.
- (c) Project Economist for the workshop - Mr. B. Russell.

2. Highways

- (a) Appraisal expected late October 1974.
- (b) Assistance is requested from CPS.
- (c) Project Economist for the workshop - Mr. V. Wouters.

Please note this project is expected to cover roads in five republics. It would not be practicable at this stage to apply the new methods to all five, but with assistance from CPS we would hope to do two or perhaps three.

3. Metohija Multipurpose

- (a) Appraisal expected in October 1975 but a preparation mission is scheduled for September 1974 and a pre-appraisal is scheduled for February 1975.
- (b) Assistance is required from CPS preferably in the person of Mr. Jeremy Warford.
- (c) Project Economist - we do not have one but suggest Mr. A. Hussain attend the workshop since he may become involved in later discussions. For the project we suggest Mr. Warford and FAO staff if possible.

Note: We assume Mr. Warford will be a participant in the workshop in any case, and with regard to FAO staff, you may wish to suggest that, depending on the volume of requests from other regions, the Bank hold a seminar in Rome at an early date for Agricultural Staff of FAO engaged in preparation of projects for Bank group financing.

Turkey

1. Istanbul Sewers

- (a) Appraisal expected March/April 1975
- (b) Assistance is required from CPS preferably in the person of Mr. Warford.

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(c) Project Economist - Mr. Victor ~~Wouters~~. **NWANERI**

Note: We have some doubts as to whether there is any rationale for applying the new methods to sewerage projects for which economic justifications have not been attempted in the past, however, it might be useful to attempt the exercise if only to prove its impracticability.

2. Rural Development

- (a) Appraisal is expected in September 1974.
- (b) Assistance is requested from DPS preferably in the person of Mr. Ahluwalia.
- (c) Project Economist for the workshop would be Mr. Donovan.

3. Agro Industries

The mission which has just returned from Turkey reports that this is primarily an Agricultural Credit and more like a DFC operation which does not seem to be a suitable subject for the purpose we have in mind.

cc: Messrs. Haynes
Pollan
Fish
de Man

GEM/agk

Mr. Robert S. McNamara
Warren C. Baum

August 2, 1974

Warren C. Baum and Hollis B. Chenery Signed Hollis B. Chenery

Economic Analysis of Projects

1. The attached set of papers prepared by Lyn Squire, Johannes Linn and Herman van der Tak represents the culmination of an extensive effort to revise and update the general guidelines to be followed by the Bank in its economic evaluation of projects. They raise some important issues and have met with considerable resistance at the staff level. However, we have reached agreement with the Regional Chief Economists along the lines indicated below. The major features of the proposed methodology, as compared with current practice, are discussed in the Introduction (attached).
2. Very briefly, the guidelines seek to:
 - (i) clarify current Bank practice with respect to the use of "shadow prices" that are intended to approximate more closely the opportunity cost of resources used, improve estimation procedures for such "efficiency" prices, and ensure more systematic and consistent application of these prices in project analysis.
 - (ii) Incorporate concerns with income distribution and fiscal and savings constraints in project evaluation procedures more systematically by attaching appropriate weights to benefits from the project accruing to different beneficiaries, private as well as public.
3. We have agreed with the Regions to introduce gradually the procedures with respect to efficiency prices and to apply them experimentally with respect to distribution weights. After one year we would evaluate the experience gained with implementing the new guidelines.
4. In view of the staff requirements for adopting the proposed guidelines, it is clear that they can be introduced only gradually. Staff will have to familiarize itself with the general framework of the analysis and the suggested approaches to the estimation of shadow prices. Project analysis in accordance with these guidelines can only start after country parameters for shadow prices have been estimated for the country concerned. Staff limitations make it necessary to stretch out over a number of years the initial process of building up national parameters for an increasing list of countries. It should be noted that some of the more time-consuming improvements relate to the calculation of "efficiency" prices (e.g. the shadow exchange rate), rather than to the introduction of income distribution concepts. However, this work should normally be done in connection with the preparation of a basic economic report.

5. We have agreed with the Chief Economists that during the Fiscal Year 1975 the Regions will estimate national parameters and shadow prices for at least the following countries:

Yugoslavia and Turkey (EMENA),
Ivory Coast and Ghana (West Africa),
Zambia, Tanzania and/or Ethiopia (East Africa),
Pakistan (South Asia),
Malaysia, and Philippines (East Asia), and
Colombia and Mexico (Latin America),

and apply the new methodology to a total of at least four projects in these countries. The use of distribution weights in project evaluation would be experimental at this stage. The program of implementation in the following years would be decided after review of the experience during Fiscal Year 1975. CPS and DPS will provide as much support as possible during this trial period.

6. We propose to establish a small CPS/DPS team to assist the Regions in implementing the new methodology and applying it in project evaluation. They would participate in country studies to estimate shadow prices and in project appraisals according to the new guidelines, as agreed with the Regions. They would coach Regional staff in the methodology by holding workshops for the staff concerned. They would also be responsible for monitoring the progress made and experience gained in the implementation of the new guidelines. These arrangements would facilitate the introduction of the guidelines and ease the Regions' legitimate concern with the additional burden being put on their staff.

7. Clearly, the introduction of the guidelines involves additional staff costs for the Bank, especially during the period of transition to general use of the new methodology. However, even during the initial stages, additional costs per country are, in Mr. van der Tak's judgment, unlikely to exceed ten man/weeks or, say 150 man/weeks during FY75. Costs per country would be much less in the later years of buildup of the system when staff becomes familiar with the approach and the work becomes an integral part of the regular country/sector work. The cost of "maintaining" the estimates after the original buildup would appear negligible. Additional costs of project analysis itself relate mainly to closer investigation of the distribution of benefits which we are increasingly examining anyway.

8. The benefits expected from application of the new methodology are, in our view, well worth the costs. First, it will result in more systematic and consistent use of the correct economic (shadow) pricing in our project work. Second, the guidelines translate our general concerns with income distribution, fiscal constraints, savings and growth in concrete project decision terms. We think these are moves in the right direction leading to better-informed project decisions. The practical impact on the design and choice of projects will, of course, be greater to the extent that we and the countries concerned apply this type of analysis at earlier stages of the project cycle. This would be highly desirable anyway and CPS is considering what steps the Bank can take to improve our project work in this regard.

August 2, 1974

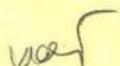
9. The Bank is the leading international practitioner of project lending, and adoption of these guidelines for the economic analysis of projects would establish its leadership in an important aspect of its operations. This step is likely to influence significantly the appraisal practice of developing countries and other development agencies.

Conclusions

10. We have agreed with the Regions that:

- (i) With respect to "efficiency prices," the Bank adopt the methodology outlined in the attached papers as its official guidelines, subject, of course, to revision from time to time in the light of evolving experience and understanding.
- (ii) With respect to "social prices," i.e. the use of distribution weights, the Bank further experiment with the proposed methodology and reconsider its introduction after one year.
- (iii) As the methodology is more fully applied, appraisal reports should show returns in terms of both efficiency prices and shadow prices reflecting distribution weights.
- (iv) Estimation of shadow prices in accordance with the new guidelines be implemented gradually, with an initial program as outlined in para. 5 above.
- (v) CPS/DPS establish a small team to assist the Regions with the initial implementation of the guidelines (para. 6).

Attachments

 Warren C. Baum

HGvanderTak/WC Baum/HBChenery:lfb

cc: Mr. Knapp
Messrs. Alter, Bell, Benjenk, Chauffournier, Husain and Weiner

Regional Chief Economists

August 1, 1974

Signed Hollis B. ~~CHENERY~~

Warren C. Baum

Hollis B. Chenery and Warren C. Baum

Economic Analysis of Projects - Implementation Program Fiscal Year 1975

1. During our meeting last Friday we agreed that during Fiscal Year 1975 the Regions would estimate shadow prices in accordance with the new guidelines for selected countries as follows:

EMENA:	Yugoslavia, Turkey
West Africa:	Ivory Coast, Ghana
East Africa:	Zambia, Tanzania, and/or Ethiopia
South Asia:	Pakistan
East Asia:	Malaysia, Philippines
Latin America:	Colombia, Mexico

Each Region would apply the new methodology to a total of at least four projects in these countries. Use of distribution weights would be on an experimental basis at this stage. At the end of Fiscal Year 1975 we would review the experience with the guidelines and draw up an implementation program for following years.

2. CPS/DPS would support the Regions in implementing the new methodology by participating in country studies and project evaluations, and by organizing workshops for Regional staff concerned. The CPS/DPS effort will be coordinated by Mr. Ahluwalia (DRC), Mrs. Hughes (DED) and Mr. Ray (VPSVP). To facilitate planning of CPS/DPS staff assignments for this purpose, it would be helpful if you could inform the coordinating team as soon as possible of:

- (i) the tentative Regional time schedules for estimating shadow prices in the agreed countries,
- (ii) the projects selected for application and the expected timing of their evaluation, and
- (iii) the kind of assistance you are looking for from CPS/DPS.

We would appreciate it if you could give them some preliminary indications on these points by c.o.b. August 9.

3. CPS/DPS will organize a workshop in September primarily for country economists participating in the implementation program. Details have still to be worked out, but we envisage a one-week series of daily sessions of, say, one and one-half hours each, probably in the second or third week of September. Later in the year we intend to arrange a similar workshop for project economists.

HGvanderTak:lfb

cc: Mr. J. Burke Knapp
Messrs. Alter, Bell, Benjenk, Chauffournier, Husain and Weiner
Regional Programs Directors
Regional Projects Directors
CPS Directors
DPS Directors

Mr. W.J. Armstrong, WPSVP

July 31, 1974

Jose A. Bronfman, LCPR

Role of Bank Engineers in Connection with Engineering Design and Cost Estimates

1. The comments below are furnished in response to your memorandum of July 8, 1974, with respect to Mr. Knox's memorandum of July 8, 1971.

2. Review of Cost Estimates (paragraph 12 of Mr. Knox's memorandum):
As an exception to the general practice of review of the work of the borrowers' staff and consultants, the Bank engineer should prepare the contingency allowances himself. In addition, it will normally be necessary for him to update the borrower's estimate based on rises in appropriate construction and other cost levels. Both the updating and the calculation of contingencies should be done in consultation with the borrower's engineers and consultants if they are available.

Cleared with and cc.: Messrs. Karman }
Vinekar } LCPR
Sabeti }

JHouman/mcm

Mr. Russell Cheetham

July 30, 1974

Irfan ul Haque *JH*

Implications of the Economic Analysis of Projects for Country Economic Work

1. At your request I have quickly gone through the above guidelines and have found that the following variables will need to be estimated by the country economist:

2. "d", defined as the marginal value of non-average consumption in terms of the marginal value of average consumption, which depends on "n", defined as the elasticity of marginal utility with respect to consumption; "B" or summary distribution parameter which depends on "n" and "O", the latter being defined as the Pareto cumulative distribution function that can be measured with the help of the Gini coefficient; "v", or the value of public income, which is a function of "q", "i", "r", and "s", which are respectively marginal product of capital, consumption rate of interest (itself a function of "n", growth of per capita consumption and the rate of pure time preference), the ratio of the value of a marginal increase in consumption at shadow prices to its value at market prices for the average consumer, and the public sector's propensity to reinvest out of "q"; a measure of critical consumption level or the level at which a unit of public income is considered as valuable as a unit of private sector consumption; accounting rate of interest (ARI) which can be derived from "q" and an adjustment factor for distributional impact of the project concerned that itself depends on "s", "q", "v" and "r"; value of private savings; shadow wage rate; and, finally, the whole set of shadow prices for tradable and non-tradable commodities together with the estimation of standard conversion factors.

3. I would have preferred to have spent some more time in determining the additional work required from the country economists, but this memorandum may nevertheless be useful for today's meeting with Mr. Hasan.

4. Of the above fifteen odd variables, about ten will have to be estimated directly by the country economists while the rest of the variables can be derived on the basis of these estimates. There are some variables, such as the growth rate of per capita consumption and saving propensities which the country economists are already estimating in the context of Country Program Paper, and some (e.g., commodity prices) which are readily available. However, as I am sure you are yourself aware, the estimation of most of these variables raises both conceptual and statistical problems. Conceptual problems arise partly from the difficulty of the concepts themselves and partly from the questionable assumptions on which these concepts are based. This is particularly the case with regard to "d", "n", "q" and "r". It is certainly not clear that the refinements under the new guidelines would yield results which are worth the additional effort.

5. The list of the variables to be estimated by the country economists does appear to be rather formidable, but if the Bank's methodology does not undergo frequent changes in the future (rather unlikely on the basis of the recent experience) some of these variables need be estimated only periodically, while others (for example, the shadow wage rate) will probably need to be estimated for each project separately. It is also my feeling that before the guidelines are put to practice it would be important that courses are held for the country economists not only to teach them the techniques of estimation but also to make them appreciate the logic and implications of the work.

cc: Messrs. P. Hasan, Sandburg

cc: Country Economist (EAP)

*A.P. G.O.P. Appraisal
of Economic
Projects*

Mr. Jean Baneth

July 29, 1974

Basil Kavalsky

Economic Analysis of Projects

1. I attended on your behalf a meeting in Mr. Chenery's office of Regional Chief Economists on the subject of the van der Tak proposal. There was a consensus that firstly work on improving the major efficiency prices for use in project appraisal would go ahead, staffed largely by the regions. It was proposed to begin in FY75 with two countries and four projects per region and each representative was asked to name the countries. I suggested that in our region given the small number of countries it was enough to have one country and that given the various work programs, Pakistan made the most sense. We will therefore have to develop better efficiency prices for use in two projects in Pakistan. I also pointed out however that we might want to do this sequentially concentrating first on those prices which seemed to us more interesting or critical, especially the valuation of family labor, and the exchange rate. These proposals were accepted.

2. The second point of agreement was that the work on the social rate of return would be regarded as strictly experimental and would be staffed by DPS and CPS with some support from regions. This would be done for the same countries and projects as the efficiency prices but it would not be "used" in the appraisal process or written up in the President's Report. In response to the question of whether any region objected to this, I said that we still had serious problems with the approach and even if it was someone else's time being wasted we would prefer it not to be wasted in our region. I hope that I got the message across sufficiently clearly that we can limit our contribution to making available information we would have collected in any case.

3. The above summary is only intended to bring out the operational implications but the meeting was really a very interesting one and I'll fill you in later on who said what.

cc: Messrs. Weiner
Diamond
van der Meer
Collier/Brown
Hansen

BKavalsky:at

OFFICE MEMORANDUM

*Folio proposed
Loan
10/31*

TO: All IC & DFC Division Operations Officers

DATE: July 25, 1974

FROM: Jacques Coudol

SUBJECT: Project Completion Reports (PCRs)

1. As I mentioned to you last week, we have now prepared guidelines for the PCRs. Obviously, they should be regarded more as guidelines than as frozen instructions. I am sending a copy to our Front Office as well as to Gustafson and Willoughby for comments and therefore more might be expected on this subject. In the meantime, since we have several PCRs underway, please try to follow the guidelines to the extent possible.

2. Our program for the next six months foresees the following schedule:

<u>Date Due</u>	<u>Project</u>	<u>Person Responsible</u>
July	Loan 582-Finland, IFF-3	Mr. Su
August	Loan 589-Turkey, TSKB-8	Mr. Su
August	Loan 660-Morocco, BNDE-4	Mr. MacNealy
November	Loan 539-Iran, IMDBI-4	Mr. Chaudhry
December	Loan 744-Ireland, ICC-1 ^{1/}	Mr. Su
December	Loan 665-Greece, NIBID-2	Mr. Griesshaber
December	Loan 791-Greece, NIBID-3 ^{1/}	Mr. Griesshaber

3. In reading the guidelines, you will note that our work with respect to PCRs is not a joke. It requires substantial work. In recent discussions with Mr. Willoughby, he indicated that in his view the required manpower on our side to complete a PCR amounts to about two man-weeks. This, at least over the first year of acquaintance with the exercise, may appear to be a rather optimistic statement. In any case, if he is right, this means 14 man-weeks over the next six months, for which we have no budget. I plan to discuss this aspect with Mr. Pollan on his return. In the meantime, there is little hope to foresee authorization for slippages on this exercise which is regarded as a very important one by our management. Please let me know if you have any comments on the guidelines themselves.

1/ Assuming disbursement is fully completed by then.

4. In addition to the guidelines, I attach a copy of the questionnaire which has been recently prepared by Henry Thomas to IMDBI. This might be useful for other projects.

Attachments

cc for comments: Messrs. Gustafson
Willoughby
Pollan

cc for information: Messrs. Wyatt
Sekse (o/r)
Powell
Renger
Hidalgo
Spall

JCoudol/ms

GUIDELINES FOR THE PREPARATION OF
PROJECT COMPLETION REPORTS ON DFCs

1. OPM 3.50 (paras. 45-49) establishes the obligation that Projects Divisions will prepare a Project Completion Report (PCR) on each loan within six months of completion of disbursements. This applies also to loans to DFCs. These PCRs are to provide the basis for the subsequent audit of the loan by the Operations Evaluation Department (OED) which then, together with the PCR, is distributed to the EDs.

Purpose

2. The PCR is expected to review:
- (a) the extent to which expectations and objectives 1/ at the time the loan was made have been, or show promise of being, achieved;
 - (b) the usefulness, soundness and impact of the Bank's decisions and emphases at the time, seen in retrospective; in particular, whether covenants or conditions (e.g. debt/equity ratio, labor intensive projects) imposed on a DFC in order to further certain objectives have been too restrictive or superfluous;
 - (c) the effectiveness in the utilization and the economic impact of the Bank's loan;
 - (d) the success or failure of the Bank's advisory efforts in institution building or the achievement of other set objectives;
 - (e) whether the Bank failed to identify or to take action on a particular issue.

1/ Certain objectives may not be spelled out in the appraisal report, e.g. resource mobilization, promotion of capital market. The attainment of such implicit objectives, routinely pursued in DFC operations, should also be assessed as a matter of course

3. In addition, the PCR should:
- (a) bring out any lessons to be learned from the implementation of the loan;
 - (b) highlight problems that remain unresolved;
 - (c) include recommendations regarding any action to be taken by the Bank in connection with the institution and/or the loan.

Coverage ^{2/}

4. At the outset, the PCR should identify the objectives the Bank intended to achieve by means of the loan with respect to both the institution, i.e. the DFC itself (e.g. strengthening its appraisal/supervision work, resource mobilization effort, prudence in lending operations, particular geographic distribution of loans, etc.), and the sub-projects financed from the loan in question (e.g. developmental impact as reflected in employment generation, foreign exchange savings or earnings, support of emerging entrepreneurs, etc.). These objectives, decisions in themselves, may have necessitated further, more specific decisions for their attainment (e.g. flotation of a specified amount of securities within a given time span, debt/equity ratio, etc.). The Appraisal Report, Loan Documents, Minutes of Negotiations, and other relevant documents produced during the appraisal of the DFC and up to the time the loan was approved should be perused to establish what those objectives and decisions were.

5. Once the Bank's objectives and decisions have been ascertained, an attempt should be made to evaluate their reasonableness, soundness and advisability in hindsight. Also, data and other pertinent information should be gathered to assess the progress made toward achieving such objectives.

^{2/} It may be advisable to extend the period of the review slightly beyond the date of disbursement of the loan, if this provides a better perspective for assessing the DFC's and subprojects' performance.

E.g. if strengthening of a DFC's appraisal work was the objective, was the Bank's emphasis on this matter justified? Did the DFC take the necessary steps toward this end by hiring, say, more engineers, or by improving its capabilities in market analysis through proper training programs? Is the improvement attained borne out in more recent appraisal reports? In this context, the PCR should indicate whether or not the Bank had proffered advice and whether or not it was heeded by the DFC's top management. Also, whether particular conditions on which the Bank insisted were inhibiting the DFC's operations and whether remedial action was taken to alleviate this situation.

6. To the extent possible, the PCR should communicate the DFC's own views and experiences (positive or negative) with the Bank's association and assistance, including advice on sub-projects. The PCR should also come up with a view as to whether there were identifiable, actual or potential, problem areas which warranted the Bank's action, but on which the Bank failed to act upon (e.g. onlending rates, protection, promotion, concentration of loans to a limited number of entrenched borrowers).

7. Concerning the effectiveness in the utilization of the loan, the projected resource gap at the time of the appraisal should be compared with the actual and any aberrations should be explained; the DFC's resource mobilization effort should be assessed and the resource contribution of the loan be ascertained. Similarly, projections of approvals, commitments and disbursements should be compared with actuals and the causes for major discrepancies be accounted for. Arrears, write-offs, guarantees, provisions for doubtful debts related to the loan should be reviewed. The PCR should also cover, whenever appropriate, major problems which have arisen (e.g. managerial, financial, etc.), the underlying causes, and the action taken to solve them or minimize their effects. Finally, the DFC's financial performance, growth

of operations and profitability should be discussed against the original projections. Procurement method(s) employed should also be mentioned.

8. An attempt should be made to assess the economic and social impact of the sub-projects assisted under the Bank's loan. To this end, and indicatively, the following information when relevant or available should be collected, and some relevant data should be routinely shown in annexes to the PCR:

1. Type of industry
2. Geographical location
3. New or expansion project (indicate separately projects promoted by the DFC)
4. Had the sponsor received financial assistance from the DFC before, whether for the same or a different project?
5. The DFC's financial contribution (amount and type)
6. Original estimate of total costs, broken down in major categories (e.g. buildings, machinery, erection costs, contingencies, working capital)
7. Actual costs in the same categories
8. Explanation of significant cost and time overruns
9. Year when full production was originally expected and when it was actually reached.
10. In the year when full production was originally expected:
 - a. Projected versus actual level of production
 - b. Projected versus actual profit
 - c. Projected versus actual total assets
11. Employment created
12. Fixed investment per job created
13. Actual or estimated exports as a percentage of total sales in year of full capacity operation

14. Effective rate of protection, economic rate of return, financial rate of return, domestic cost of foreign exchanged saved or earned, value added/total sales, etc. (whichever has been calculated by the DFC).
15. Total assets of the sub-borrower at the time the DFC approved the loan. In case of affiliation with an industrial group, indicate total assets of the group.

Format

9. There is no prescribed format and length for a PCR. This means that it could be incorporated in a supervision or appraisal report. Yet, in view of its focus and distribution (EDs, DFC, Government), a separate report may be preferable. The PCR should be about 5 pages long, preferably less, and in no case should exceed 10 pages.
10. The PCR should, as far as possible, keep with the following format:
 - I. INTRODUCTION (less than 1 page)
 - Details on loan under review
 - Organization of DFC (brief statement of ownership and control, board, management, staff, general policies).
 - II. LOAN OBJECTIVES (up to 2 pages)
 - Objectives (explicit and, possibly, implicit)
 - Other decisions made (or not taken)
 - Evaluation of such decisions and emphases (as per para. 2(b)).
 - III. RESOURCE CONTRIBUTION OF THE LOAN (less than 1 page)
 - (As per para. 7).
 - IV. ALLOCATION OF LOAN FUNDS (up to 3 pages)
 - Assessment of quality of the DFC's appraisal/supervision work.
 - Allocation pattern of the loan
 - sectoral, geographic and size distribution
 - public/private sector distribution
 - promoted/new/repeater projects
 - Subproject performance
 - DFC's contribution (financial, technical assistance, etc.)
 - Cost and time-overruns
 - Financial performance and rationale.

V. ECONOMIC IMPACT OF LOAN (up to 1 page)

- Support of particular types of industry, employment generation, export-orientation, capital intensity of sub-projects, income distribution effects, etc.

VI. FINANCIAL PERFORMANCE OF THE DFC (less than 1 page)

- Income performance
- Financial position

VII. CONCLUSION (1 page)

- Evaluation of performance against set objectives or special targets - Prospects
- General conclusions that may be possible to draw
- Unresolved problems and recommended action.

ANNEXES

- Mainly on sub-projects data

Timing-Preparation-Clearances

11. PCRs should be prepared in conjunction with a normal supervision or appraisal mission. DFCs should be increasingly "urged" during appraisal missions or negotiations to prepare their own PCRs. This may be possible on the second or third go-around. For the first time, though, the onus will be on us. We should, however, have the DFC supply us with the needed data and with comments on how the decisions we took affected it, by sending out a properly formulated Questionnaire. Questionnaires and Terms of Reference for missions which will prepare a PCR should be sent to the OED for comment. Drafts of PCRs should also be sent to the OED for review.

(Revised)
July 25, 1974

INDUSTRIAL AND MINING DEVELOPMENT BANK OF IRAN

Information for Project Completion Report
(Loan No. 539-IRN)

Introduction

The World Bank has recently instituted a program of "performance auditing" of all Bank-financed projects to determine the extent to which original expectations and objectives have been achieved and how useful to development the Bank's decisions and emphases at the time of appraisal seem in retrospect to have been in the opinion of all those concerned. These audits are carried out on each Bank loan once the loan is fully disbursed. Thus, each loan to a DFC is considered a separate project for this purpose, and requires a separate performance audit. The purpose of the audit is to respond to IBRD shareholders' concerns into how effective the Bank has been and how it can be more responsive to its borrowers' needs.

These audits are made by an independent unit within the Bank, relying on a "Project Completion Report" for basic data. This Report is prepared by the appropriate Projects Division. In the case of loans to DFCs, this Project Completion Report can be seen as covering two basic areas, the institution and the sub-projects financed from the loan being audited. With regard to the first, the Appraisal Report prepared by the Bank at the time the Loan was granted is reviewed in order to determine what aspects of the DFCs' operations were identified at that time as needing strengthening, improving, etc. The Project Completion Report attempts to indicate what has been done to strengthen or improve these aspects. With regard to the second area, the Project Completion Report essentially reviews how the Bank's money was used. On both aspects the key question is whether the decisions made by the IBRD and the advice it proffered were as good as they could have been. On this question the views of the borrower are quite important to us.

Loan No. 539-IRN was signed in June 1968 and was based on an Appraisal Report dated April 16, 1968. It would be convenient to assume that the institutional questions raised in the Appraisal Report referred to the status as of March 20, 1968.

Institutional Questions

1. The main weakness which the 1968 Appraisal Report identified related to appraisal and supervision work. The following two paragraphs, taken from that report, illustrate the concern felt at that time.

Appraisals. IMDBI's appraisals are thorough, but at times needing more appreciation of technological developments in the outside world. There is also a tendency, in a number of instances, to rely on government protection. The presentation of market forecasts or the actual market research in regard to new or more complex industrial products is mostly made by three overburdened IMDBI staff members rather than by the

clients themselves. Most of the projects, i.e. about 80%, are processed within five months.

Project Supervision. Although the Loans Supervision Department has been able to perform with some degree of effectiveness, it has for some time been seriously short of staff. This is an important weakness in view of the irregular habits of some clients in meeting their obligations to IMDBI, and because of the need to overcome the frequent reluctance of enterprises to furnish information requested by IMDBI. To help offset the Loan Supervision Department's staff shortage, IMDBI has recently recruited three additional employees. Even so, IMDBI's project supervision will need more time to become effective through a more intensive assessment of delinquent clients and a more intensive use of legal sanctions.

It would be appreciated if IMDBI would speak to each of the concerns expressed in these paragraphs, indicating in a few paragraphs what improvements or changes have taken place since 1968, whether the Bank's emphases on these aspects seem in retrospect to have been helpful, whether there was anything more IBRD might have done to help IMDBI on these matters, etc. It would also be helpful if IMDBI could prepare a table indicating the number of staff employed in each of the several departments (not just those dealing with appraisals and supervisions) at March 20, 1968 and at the end of each fiscal year thereafter up to the present, with an indication of the number of new staff recruited and the number of staff terminating each year.

2. The Appraisal Report noted with much approval IMDBI's growing promotional activities. However, it cautioned that "IMDBI would also have to be watchful in the future against a dilution of its energies by having its top management drawn overly into promotions and into managerial functions in client companies." It would be appreciated if IMDBI would indicate whether and how, in the years since 1968, its top management has been able to avoid too great an involvement in promotional work and in managerial functions in client companies. Some quantification should be possible; for example, how many top management individuals were closely involved in how many promoted projects in each year since 1968, how many staff members held how many directorships and attended how many Board meetings in each year since 1968, etc. An indication of the extent to which these functions have been taken up by middle management and the staff should be included.

3. At the time the Report was prepared, only three of the eleven promoted projects were in production (three sugar mills). The Appraisal Report noted that it was too soon to judge the success of these projects, although there was no evidence to question IMDBI's judgment. The Report did question, however, whether all the promoted projects would be viable without substantial protection from imports (e.g. the sugar mills) or whether others would operate, at least initially, with appropriate economies of scale. Attached is a statement (labelled A-10) describing these eleven projects. It would be appreciated if IMDBI would indicate the success or lack of success with each of the eleven, quantifying the

results as much as possible. References should be made to the level of protection currently enjoyed and to whether the level of production has proven to be economic.

4. The Report notes that IMDBI's loan portfolio appeared generally good. It does discuss the arrears situation, pointing out that there were 21 enterprises on June 21, 1968 with arrears of over three months totalling Rls. 123 million on outstanding loan amounts of Rls 299 million. Included were outstanding loans of Rls 133 million on which only interest was delinquent. This was about 10% of IMDBI's loan portfolio at that time. The Report goes on to say:

Roughly one-half of all the outstanding loans in arrears beyond three months were contracted by borrowers whom IMDBI considers as able to pay. The others are in various degrees of difficulties including two loans (Rls. 7 million) on which IMDBI has started litigation for recovery. It also has taken over the management of three enterprises (leather, sausage and fruit juice) accounting for loans of Rls 59 million; one of them with a loan of Rls 21 million may have problems in ever becoming viable, but IMDBI's position appears well secured.

It would be appreciated if IMDBI would review the performance since 1968 of these 21 enterprises. Did any of these arrears have to be written off? If so, was IMDBI's security sufficient to cover the bad debt?

5. The Report noted that IMDBI's equity portfolio of Rls. 345 million, representing investments in 16 companies (listed in table A-9 attached), were still unseasoned as practically none had been producing for any appreciable length of time. The Report also noted, however, that "one investment seems to be a white elephant (the warehouse) and another, doubtful (the Pak Dairy), together accounting for about 6% of IMDBI's equity portfolio". It would be appreciated if IMDBI could provide a short note on each of these 16 companies indicating how their operations have developed. The return on share capital, dividends paid, book value and market value (if listed) of the shares and other similar indicators for the most recent year available should be given.

6. The Loan Agreement for Loan No. 539-IRN increased the maximum allowed debt/equity ratio from 4 to 4.5 and slightly modified the definition of equity. This ratio was increased again when Loan No. 703-IRN was signed (October 7, 1970). Did IMDBI's actual debt/equity ratio, as defined in the Loan Agreement, ever exceed the 4.5 limitation during the time between the signing of Loan No. 539-IRN and the signing of Loan No. 703-IRN? Was this limit a constraint to IMDBI's business?

7. The Report noted that IMDBI had wanted to raise the limit on aggregate equity investment commitments from the then ceiling of Rls 930 million to Rls. 1.3 billion. The Rls 930 million corresponded to IMDBI's net worth (included loss provisions) on March 21, 1966 plus half of the Government Advance. The new limit suggested by IMDBI was about 30% higher than its net worth at the time. The Bank advised IMDBI that the limit should not

exceed IMDBI's net worth, but that it was prepared to review this question if and when IMDBI's operations approached the limit. Did IMDBI's aggregate equity investment commitments at any point since March 20, 1968 approach this limit. If so, what steps did IMDBI take? (The recent change in the Policy Statement is an example of such a step.) Was the retained limit an incentive to sales out of equity portfolio? Did the Bank's policy decision in this regard prove constraining to IMDBI, and if so what were the manifestations or results?

8. The Report noted that during the Third Plan Period, IMDBI provided some 12 to 14% of total private industrial investment. It was expected that during the Fourth Plan, IMDBI would continue to provide at least the same share of private industrial investment. The Fourth Plan target for total private industrial investment was Rls 120 billion. What was the actual total private industrial investment during the Fourth Plan, and how much of this total did IMDBI provide?

9. The Report noted IMDBI's persistent efforts to introduce more up-to-date concepts in Iran's industrial environment. It particularly noted IMDBI's role in getting the Tehran Stock Exchange organized and modern accounting standards adopted more widely. On this latter, it also noted that IMDBI, NIOC and several Iranian and foreign auditors were trying to set up an Association of Accountants in Iran which would have a "professional code and serve to spread modern accounting standards throughout Iranian industry". What became of the efforts to establish this Association of Accounts? Regarding the Stock Exchange, it would be appreciated if data could be provided on stocks and bonds listed and on trading and sales activity per year since establishment.

Questions Regarding Sub-projects

1. Attached is a list of the sub-projects authorized to be financed from Loan No. 539-IRN. For each sub-project, please provide the following information:

- (a) Type of industry
- (b) Geographical location
- (c) Promoted or regular project
- (d) New or expansion project
- (e) Had the sponsor received financial assistance from IMDBI before, whether for the same or a different project?
- (f) IMDBI's financial contribution (amount and type)
- (g) Original estimate of total cost, broken down in the usual major categories
- (h) Actual cost in the same categories
- (i) Explanation of significant cost and time overruns
- (j) Year when full production was originally expected and when it was reached
- (k) In the year when full production was originally expected:
 - (i) Projected versus actual production
 - (ii) Projected versus actual profit
 - (iii) Projected versus actual total assets
- (l) Employment created
- (m) Fixed investment per job created

- (n) Actual or estimated exports as a percentage of total sales in year of full capacity operation.
- (o) Total assets of the sub-borrower and, in case of affiliation with an industrial group, of the industrial group at the time IMDBI approved the loan for the project.

2. As you know, we review in Washington all appraisal reports for sub-projects above the free limit and pass on to you our comments and queries, if any. We would like your candid evaluation and opinion on the effect (positive or negative) our involvement with these projects has had on IMDBI's appraisal process and on the sub-projects financed from Loan 539-IRN.

Attachments

INDUSTRIAL AND MINING DEVELOPMENT BANK OF IRAN

Promoted Projects 1/
Approved through February 19, 1968

1. Neishabour Sugar Company: (Loan of Rls.170 million and IMDBI equity of Rls.50 million.) Construction was completed on schedule within the financial plan and trial operations have been completed successfully. The present season, October to March, has worked at 1,000 tons of sugar beet per day, the plant's installed capacity.
2. Qazvin Glass Company: (Loan of Rls.120 million and IMDBI equity of Rls.56 million.) There have been some difficulties during the early stages of construction, but these have now been successfully overcome and the project is expected to go into production in March 1968 though with a nine-month delay. Pan Alliance Corporation (U.S.A.) hold a 21 percent stake in the share capital.
3. Shahd Sugar Company: (Loan of Rls.100 million and IMDBI equity of Rls.28 million).
4. Naghse-Jahan Sugar Company: (Loan of Rls.100 million and IMDBI equity of Rls.35 million.) Both projects are under construction. The rated capacity of each equals 1,500 tons of sugar beet per day. No particular difficulty has been encountered to date and output should be achieved during the October 1968 - March 1969 season.
5. Kerman Cement Project: (Loan of Rls.200 million and IMDBI equity of Rls.24 million.) Construction has just commenced and the plant, according to plans, should begin producing during the fall of 1969. Capacity will be 300 tons per day expanding to 500.
6. Machine Ahwaz: (Loan of Rls.22 million and IMDBI equity of Rls.4 million.) A machine tool unit with Dutch collaboration has made satisfactory progress in construction. It is expected that production will start before the end of 1968.
7. Keshtirani Arya: (IMDBI equity of Rls.55 million.) A loan of Rls.300 million has been made to this company with Plan Organization funds available especially for this purpose, interest free and of 20 year duration with 10 years grace. This shipping company was established in the summer of 1966 to operate initially services in the Persian Gulf, but later also into Europe. The purchase of vessels are presently being negotiated.

1/ Including loan from Managed Funds in all cases.

8. Navahi Sanati Ghazvin: (Loan of Rls.30 million and IMDBI equity of Rls.15 million.) This is an industrial estate project 140 km. West of Tehran. The company has completed arrangements to provide the services such as water, electricity, sewerage, roads, etc. Plots will be sold to industries. The demand for plots appears to be strong.

9. Paper Project: (Loan of Rls.300 million and IMDBI equity of Rls.70 million.) IMDBI has completed negotiation and Pars Paper Company has concluded contracts with the Reed Paper Group (U.K.) for the provision of technical services and management. Preparatory work has been firmed up. The plant will be located near Ahwaz in Khuzistan with an initial capacity of 30,000 tons, expandable to 45,000 tons.

10. Navard Ahwaz: (Loan of Rls.300 million and IMDBI equity of Rls.70 million.) This is a rolling mill to produce, on a two-shift operation, 140,000 tons of skelp/strip and 40,000 tons of pipe. Construction has not yet started. British consultants have been chosen. Management arrangements have yet to be made. IMDBI is also seeking an IFC investment in this project.

11. Dorman Diesels: (Loan of Rls.300 million and IMDBI equity of Rls.70 million). Negotiations have been completed with W.H. Dorman & Company Ltd. of England and the English Electric Company for setting up a plant for the manufacture of stationary diesel engines. Capacity will be 3,500 engines annually. The plant is expected to start operations in 1970. IMDBI is also seeking an IFC investment in this project.

Source: IMDBI.

INVESTMENT AND MINING DEVELOPMENT BANK OF IRAN

Investments in Share Capital of Iranian Companies upto 31 Shordad 1346 (June 21, 1967)

(In Million Rials)

Company	Registered Capital	Type of Industry	Location	Committed	Taken Up	%	Type of Shares
1. Melli Shoe	260.00	Shoes	Tehran	15.00	15.00	9.00	Preferred Redeemable
2. Pak Dairy	46.80	Dairy Products	Tehran	6.15	6.15	-	Common
3. Public Warehouse	150.00	Bonded Warehouse	Tehran	30.00	15.00	-	Common
4. Kermanshah Sugar	340.00	Sugar	Kermanshah	70.00	70.00	-	Common
5. B.F. Goodrich Iran	252.00	Tires	Tehran	7.00	7.00	-	Common
6. General Tire & Rubber Co. of Iran	225.00	Tires	Tehran	45.00	45.00	7.20	Preferred Redeemable
7. Neishabour Sugar	225.00	Sugar	Neishabour	50.00	50.00	-	Common
8. Iranian Rolling Mill	396.00	Light Steel Sections	Ahwaz	58.50	48.00	-	Common
9. Qazvin Glass	120.00	Sheet Glass	Ghazvin	36.00	36.00	-	Common
10. Peerless Iran	100.00	Pumps	Tehran	5.00	5.00	-	Common
11. Aliaf	150.00	Artificial fibers	Tehran	22.50	7.65	-	Common
12. Iran Moeshot	50.00	Pharmaceuticals & P.V.A.	Tehran	15.00	15.00	-	Preferred Redeemable
13. Shahd Sugar	260.00	Sugar	Khoy	28.00	10.20	1.01	Common
14. Naghshe Jahan Sugar	240.00	Sugar	Esfahan	35.87	18.30	10.01	Common
15. Iranian Telecommunication Manufacturing	180.00	Telecommunication equipment	Shiraz	54.00	18.36	-	Preferred Redeemable
16. Qazvin Industrial Estate	40.00	Industrial Estate	Ghazvin	15.00	5.10	-	Ordinary
				493.02	372.26	27.22	

TABLE A-9

June 27, 1974

Loan No. 539-IRN - Subprojects

Signed: June 5, 1968
Effective: August 26, 1968

<u>No.</u>	<u>Date Submitted</u>	<u>Name</u>	<u>Date Authorized</u>	<u>Amount Authorized</u>	<u>Amount Disbursed</u>
1*	3/3/68	Navard va Luleh Ahwaz	9/17/68	3,400,000	3,400,000.00
2	10/2/68	Cashmere Dehairing Co.	10/10/68	800,000	800,000.00
3	11/6/68	Cablesazi IKO Iran	11/19/68	100,000	98,591.96
4*	8/6/68	Shahbaft Woollen Company	11/26/68	1,334,000	1,310,338.57
5*	11/6/68	Cashmir Woollen Company	11/26/68	1,334,000	1,334,000.00
6	12/15/68	S.S. Khavar Automobile Manuf. Co.	12/23/68	667,000	667,000.00
7	12/16/68	S.S. Chimico	12/31/68	134,000	134,000.00
8	12/23/68	S.S. Kontorsazi Iran	12/31/68	667,000	666,639.14
9	12/23/68	S.S. Pars Ceram	12/31/68	400,000	360,689.67
10	12/18/68	S.S. Ama	1/2/69	334,000	334,000.00
11*	10/28/68	S.S. Lamp Toshiba	2/3/69	2,267,000	2,267,000.00
12*	1/23/69	S.S. Iran Barak	2/10/69	3,000,000	2,999,130.19
13*	10/30/68	S.S. Abguineh	2/19/69	3,200,000 ^{1/}	3,220,809.09
14	3/5/69	S.S. Pars-Toshiba	3/17/69	934,000 ^{2/}	687,495.68
15	3/8/69	S.S. Karkhanejat Sanati Pars Lux	3/17/69	360,000 ^{3/}	46,140.26
16	4/12/69	S.S. Sanati Ab far	4/18/69	200,000	200,000.00
17	4/12/69	S.S. Karkhanejat Mokhaberati Iran	4/18/69	467,000	454,360.82
18*	4/13/69	S.S. Motor Diesel Iran	6/4/69	3,000,000	2,579,426.70
19*	5/4/69	S.S. Zoub Ghorazeh	6/19/69	2,000,000	2,000,000.00
20	6/24/69	S.S. Sanati Moghava Sazi Shargh	7/3/69	400,000	397,255.56
TOTALS ...				<u>24,998,000</u>	<u>23,956,897.64</u>

* Above the free limit of \$1 million.

^{1/} Due to increases in exchange rates, initial authorization was increased to \$3,237,451.57.

^{2/} Later reduced by \$220,000.

^{3/} Later reduced by \$268,793.

*D.P. G.O.P. Appraisal +
Preparation of
Projects*

Mr. M. Yudelman

July 23, 1974

C. W. Wolffelt

Project Appraisal - Estimation of Investment Cost

With the current inflation rates and the resulting price escalations affecting cost of equipment, turnkey jobs and other items procured under ICB, it is becoming increasingly difficult to estimate correctly for appraisal reports the investment cost of project components that involve complete assemblies like a cement plant, cashew nut processing factory, slaughter-house, tannery, tobacco drying plant, dairy, road construction etc.

It is easy to obtain up-to-date prices of single items like jeeps, trucks, weighbridges, wells, etc. but manufacturers are unwilling to venture information on prices for complete assemblies unless a formal tender is involved.

However, copies of tenders for equipment assemblies or turnkey plant constructions are received continuously in the Bank by the Regional Offices for their supervision of approved and on-going projects. If key information from those tenders were diffused to other Regions and C.P.S. it would assist the project professionals in staying abreast of current costs and prices. Although no two jobs are equal it would serve well the purpose of assuring the professional that his estimate is within a realistic range.

One way of implementing this service would be for C.P.S. to request copies of tenders from the Regions on a monthly basis, extract key information such as: country, product mix, capacity, cost broken down by civil works, equipment, etc. and communicate this in a monthly letter. The copies of the tenders would be kept on file for reference if required.

CWWolffelt/sm

Mr. Hollis B. Chenery

July 19, 1974

Parvez Hasan *PH*

Economic Evaluation of Projects

1. I refer to the draft memorandum on the above subject by you and Mr. Baum. The principal objections to the proposed guidelines which were highlighted at the staff review have been brought out quite clearly in the memorandum though they are not considered a persuasive ground for rejecting the proposed procedure. Even at the risk of some repetition I must state my feelings about the problems with the approach and the difficulties likely to be encountered in its implementation.

2. The approach assumes that the formal cost:benefit analysis has the center stage in the process of project selection. In actual practice the formal cost:benefit analysis has had relatively limited role in project selection in the past. The memorandum recognizes that the practical impact of the refined approach will be greater to the extent that we apply this type of analysis at earlier stages of the project cycle. However, no concrete recommendations are made as to how this is to be achieved. There is also a much more fundamental question of whether in applying the approach of a social rate of return we should be looking at the programs as a whole rather than individual projects. The present approach could easily lead to rejections of projects having a high rate of economic return but benefiting mainly higher than average income groups in a country. The desirability of appraising integrated programs rather than individual project exists even on the economic rate of return criteria. The need for looking at whole programs becomes paramount if social considerations are to be taken into account.

3. Regarding determination of efficiency prices, the draft memorandum quite clearly brings out that the burden of estimating national parameters will fall largely on the country economists. A systematic application of the efficiency prices is much to be desired but it should be understood that very little of the country economists' time at present is spent on these matters. I am not sure that even basic economic reports have given a great deal of attention to this. Considering that the present involvement of the country economists in estimating efficiency prices is minimal, sufficient time should be allowed for this stage of the work. The application to projects should await a consideration of the shadow prices derived and discussed in the country context preferably through the CPP cycle.

4. To sum up it seems desirable to limit the improved economic analysis of projects to a systematic application of efficiency prices. Even this will involve very substantially additional work of the nature with which country economists are not very familiar. The calculations

July 19, 1974

of comprehensive social rate of return on projects will not only be technically complex but could be misleading. The income distribution weights and government revenue considerations should best be taken into account in the context of our total lending program to a country. The CPP review should explicitly focus both on relevant efficiency prices and social implications of projects because it is really at this stage that the design and the selection of projects can be influenced. Unless the discussion has proceeded along these lines, the application of even efficiency prices to individual projects should be for internal purposes only.

cc. Messrs. Bell
Baum
van der Tak
Votaw
Kirmani
Howell
Vergin
Bussink
Cheetham
Balassa
Regional Chief Economists

PHasan/gbr

Mr. Hollis B. Chenery

July 17, 1974

Jean Baneth

Economic Evaluation of Projects

1. I refer to the draft memorandum on the above subject by you and Mr. Baum. Over the past two years I have frequently expressed the point of view that the methodology proposed by Mr. van der Tak is unduly complex, unavoidably relies on arbitrary assumptions and is unlikely to assist us in a significant manner in the process of project selection, preparation and evaluation. Consequently, it provides low returns for the substantial costs it involves in terms of manpower and of supervisory attention. This view seems to be held by the majority of regional program and projects staff, and was not refuted in the course of the many discussions on the subject.
2. The process of project selection, preparation and appraisal by the Bank must necessarily rely on many factors and pieces of information which cannot properly be taken into account in formal cost-benefit analysis. These include the institutional impact of our lending, our impact on general policy measures in the country, the need to transfer resources with greater or lesser speed. Nevertheless, a certain number of prices have to be determined, both for project preparation and evaluation purposes and from the point of view of our sectoral and macroeconomic analysis. In many cases, notably foreign exchange, interest rates (price of capital), and the wages of family labor, there is in general no single and unambiguous market price; even if there were one it is not necessarily the one that has to be used in various analyses. It is therefore unavoidable that we should either arbitrarily assume or calculate substitute prices.
3. One could call these "shadow prices", though I prefer the expression "efficiency prices" because of the linear programming, lagrangean multiplier connotations of the term "shadow prices". We need to estimate such efficiency prices at least for the major factors of production for all our countries, if possible in a reasonably systematic and consistent manner. I have little doubt that these calculations will involve a number of iterative approaches, which, though they will never give us a theoretically perfect set of prices, will allow us progressively to improve our estimates. Provided we entertain no illusion that such a set of prices will solve all or even most of the problems of project selection and evaluation, this is a useful and worthwhile approach.
4. I have frequently proposed to initiate such a gradual approach, but was told by CPS that I should rather await the completion of their draft O.M. I now propose that for the South Asia Region we should proceed and calculate without further unnecessary delay such efficiency prices as an integral part of our country economic work, and that we should apply them in a systematic manner to project evaluation, sectoral discussions

July 17, 1974

and related matters. In most cases we should probably start out by making very rough estimates, and then improve them progressively by a combination of deeper work on individual prices (such as estimates of effective protection rates, etc.) and of iterative interaction. The processes of estimation will no doubt give rise to specific problems, both on the theoretical and on the practical levels. These we should identify and strive to solve as and when they concretely emerge.

5. As for the much more complex and much less useful considerations relative to income distribution, preferences for government revenues, etc., I propose that we should not attempt to incorporate them directly into shadow price calculations, for doing so necessarily involves highly arbitrary choices and assumptions, whose nature is disguised to the final reader. It is preferable to indicate explicitly to what extent our distributional or social preferences have influenced the final choice of a project.

6. I believe my approach is fully consistent with that being proposed by Bela Balassa.

cc: Messrs. Weiner
van der Tak
Balassa
Diamond
van der Meer
Kavalsky
Pilvin
Chief Economists

 JBaneth/ylc

D.P. G.O.P. Appraisal & Preparation of Projects

draft

ARay/mm

July 15, 1974

PRICING AND COST RECOVERY POLICIES

FOR PUBLIC SECTOR PROJECTS

Anandarup Ray
Projects Advisory Staff
July 1974

PRICING AND COST RECOVERY POLICIES

FOR PUBLIC SECTOR PROJECTS

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PRICING AND COST RECOVERY POLICIES
FOR PUBLIC SECTOR PROJECTS

I. INTRODUCTION

1.1 A major consideration in project analysis concerns the project's impact on the financial resources available to the government to carry out its development program, and on the finances of the project entity. This consideration has a general bearing on nearly all aspects of a project. It bears on its choice, on its scope, size and timing, on its design and service standards, and, in particular on the determination of the prices, charges and taxes that the project beneficiaries should pay. This paper focuses on this last aspect, which concerns the level and means of recovery of the costs of a project from its beneficiaries. This aspect is not, of course, a clearly separable one in the overall analysis of a project. The limited focus of this paper is warranted not only because of the complexity of the subject matter but also because the paper on the "Economic Analysis of Projects," recently prepared,^{1/} covers in detail the various interdependent decisions involved in project analysis.

1.2 This paper does not aim to establish specific sectoral guidelines and policies for cost recovery, but rather to elucidate the

^{1/} See van der Tak and Squire (23).

general principles relevant to the development of such guidelines -- it refers to specific sectors and types of projects only by way of illustrative examples. Each sector and indeed each type of project has its own special characteristics which need to be reviewed in depth before more specific guidelines can be provided. But the diversity of issues that arise in this context, ranging from the determination of financial rates of return for revenue earning public enterprises to the analysis of government budgets in projects such as in education and family planning, points to the need for a statement of the general principles involved. This is the aim of this paper, although its scope is further limited in that it refers only to public sector projects, not private sector ones.

1.3 Cost recovery issues are important not only because of the scarcity of resources for development purposes that most governments face but also because prices and taxes bear directly, and sometimes very heavily, on the benefits of a project to the country. Clearly it is of great importance to get the prices "right," as these influence the amount of use that people make of the products and services provided, and their decisions in this matter determine the project's value to the country. As long as the country does not want to waste its resources and opportunities it will want the people to make the right decisions on the amount of use they make of the facilities and services being provided, so that on balance the benefits, net of

2/ For example, see Duane (11) for guidelines on cost recovery for irrigation projects.

costs, derived from a project are as large as possible. In a sense this is a prior concern, because it will remain relevant even in the unlikely situation where a government has plenty of resources at its command and is, consequently, not particularly concerned whether a project produces a deficit or a surplus.

1.4 It is of some importance therefore to be clear about how the right product prices can be determined even if no revenue scarcity existed, or "efficiency" prices as these are referred to in this paper. When prices are higher than these efficiency prices, project benefits are sacrificed in order to realize more revenue, and this is a factor that needs to be taken into account in decisions on product prices. The next section, Section II, is devoted entirely to the various aspects that enter into the determination of these important efficiency prices.

1.5 Section III considers cost recovery policies, and to that end pulls together the discussion of efficiency prices with considerations related to revenue scarcity, economic inequality and equity. It stresses the point of view of the public sector, rather than that of project entities within it, although the relations of a particular entity with the rest of the public sector are also discussed. It reviews some cost recovery norms, such as the principle that "beneficiaries should pay total costs," although it refrains from recommending the norms that may be suitable in specific sectors.

1.6 Finally, this paper is not intended to provide guidance on the analysis of general fiscal, monetary or trade policies of the government. It is oriented towards individual projects, and this project orientation is maintained throughout, although some of its observations may have more general applicability. "Macro-economics" is linked with the discussion in this paper through the general judgments, not specific to any one individual project, on the scarcity of developmental resources at the disposal of the public sector, which are of critical importance to cost recovery matters.

II. PRICING AND EFFICIENCY

2.1 The benefits and costs of a project depend on the levels of outputs and services that are actually provided, and these levels depend on the prices charged. The prices at which the outputs and services are sold will, therefore, materially affect the net benefits from a project. The best prices are those that will maximize the net benefits from the investment.^{1/}

2.2 The determination of these output prices is intimately linked with the precise way in which the benefits and costs are defined. This Section is concerned only with pricing in relation to economic benefits and costs in the conventional sense, setting aside considerations related to income distribution. This discussion of product pricing with the sole objective of maximizing net economic benefits, or "efficiency" pricing for short, also leaves aside the revenue generation aspects and the considerations related to inadequacy of total savings in the economy. These aspects will be discussed in the next Section. This separation of issues facilitates the exposition and the analysis of trade-offs; it also has some pragmatic relevance as it may not always be desirable or feasible to orient output pricing towards revenue and savings generation and income distribution.

^{1/} This project orientation, i.e., the use of the project net benefit maximization objective, for discussing pricing policy has considerable expositional advantage in the context of this paper. It also has been frequently used in the literature, see, e.g., Acharya (1), Feldstein (12), and especially Turvey (20).

2.3 This discussion of pricing policy is purposely put in the context of the analysis of project investments so as to relate it easily to the cost recovery issues. Given this context, it may be noted that the objective of ensuring maximum project benefits is not special to the design of a pricing policy, but bears equally on the interrelated issues such as the determination of the size, design and timing of the project, as well as various other considerations relevant to efficient project operations. The familiar practice of making sure that the accepted project has a least cost design is an example of the application of this objective, which simply reflects the idea of not wasting resources, or in other words, getting as much out of an investment as possible.^{2/}

2.4 The principal considerations in the determination of efficiency prices are taken up sequentially, beginning with the traditional or basic rule. The outline of this section is as follows:

- (i) the basic rule,
- (ii) complexity and variability of efficiency prices, and the costs of implementing and administering such prices,
- (iii) the relationship with investment policy,

^{2/} It may be useful to note that a sufficiently high internal economic return for a project merely assures that the project is expected to produce at least as much economic benefits as it costs. It is, by itself, no proof that even higher net benefits cannot be earned by following say, a different pricing policy.

- (iv) the effect of prices on future demand, and on consumer expectations,
- (v) the implications of possible differences between economic and financial costs, and between privately and socially perceived benefits,
- (vi) the implications for meeting foreign demand,
- (vii) inflation.

Finally there is a brief summary.

(i) The Basic Rule

2.5 The traditional rule for product pricing so as to realize the highest net economic benefits can be stated as follows: the product price should be equal to the current economic cost of producing the last unit of the product sold. If, however, demand is not fully satisfied at such a price, the price should be raised so as to clear the market.^{5/}

2.6 This rule implies that current production should be expanded as long as the cost of an additional unit is less than the benefits generated by that unit, i.e., as long as the net benefits can be increased by increasing production. If there is a strict production

^{5/} The rule is that during each period (product price) = (current production cost of the last unit sold) + (mark-up to clear the current market when necessary). Note that period-wise independence of costs and benefits are being assumed, so that maximizing net benefits in each period will lead to the maximization of benefits over the relevant future period. The implications of relaxing this assumption will be considered subsequently.

constraint so that an extra unit cannot be currently supplied then the price should be raised so as to ration demand. Increasing the price in that case will distribute the consumption of a fixed supply between consumers in such a way that those who are prepared to pay more get more.

2.7 This type of pricing is intended to provide inducement to purchasers to make correct decisions regarding the extent of their use of the product, and leads them to make appropriate choices in terms of the impact of their decision on the economy as a whole. When the cost of producing additional output is very low, as in the presence of excess capacity, the price will be correspondingly low, thus inducing greater use of the product by the customers. When the product is in short supply, the price will be high to allocate the product to its most productive uses, or to those customers who have the least access to product substitutes. A few simplified examples are needed to illustrate what this pricing rule will mean if applied in practice.

2.8 In a project supplying potable water to an urban area, the price of water per thousand gallon charged to a consumer will equal the cost of supplying him with the additional water. When the system capacity is not fully utilized, this cost will simply be the cost of treating and distributing the additional water. If the distribution costs differ by consumer groups, the prices charged will accordingly differ. Charging less than this will encourage

the consumer to put the water in uses where the benefits are less than the costs, and "waste" water in this sense. Not charging anything at all will, of course, encourage him to let the water run to waste literally. Charging more than the additional cost will mean that he will not put the water to some uses where benefits are greater than costs. This will also be wasteful, in the sense that some opportunities for increasing benefits to the public will be needlessly foregone.

2.9 Similarly, the price to be charged for connecting and metering a consumer will equal the cost of providing the additional cost of so doing, viz mainly the cost of the additional equipment and labor. The actual use of water by the consumer after connection will, of course, not be affected by the connection charge, although this charge will determine the number of consumers who will seek metered connections.

2.10 The price of water should, of course, be high when the system capacity becomes a bottleneck, as it will when the demand growth catches up with the capacity provided, or during periods of "peak" demand, such as summer months. Different prices for "peak" and "off peak" periods should be charged, as in the case of electric power. Prices will be low when electricity can be produced cheaply, as in the presence of excess system capacity, and high when demand would otherwise violate the security constraints.^{4/}

^{4/} See Anderson and Turvey (2), (3), for more detailed discussions of electricity pricing, and Turvey and Warford (21) for urban water pricing.

2.11 Similar considerations apply in most other cases. The actual use of inter-urban and rural roads is very cheap -- the cost of an additional vehicle trip is simply the wear and tear of the road caused by that trip. The price charged for using such roads should thus reflect only the wear and tear cost, differentiated by vehicle types as different vehicle types cause different amounts of wear and tear. Use of congested urban road space, however, is very expensive -- the additional congestion cost imposed on others by a vehicle trip, and the cost of additional pollution and noise. Use of vehicles in "heavy" traffic zones should be deterred by high prices.^{5/}

2.12 The use of irrigation water will similarly be very cheap in periods of excess system capacity, and expensive in "heavy" demand periods. Farmers thus will be charged for the actual use of water, and at rates which differ by periods. This will provide incentives to farmers to economize on water, and allocate it to the acres where it is most productively used. The prices for seeds, farm equipment fertilizers, etc., will reflect the additional cost to the economy of producing or importing them.

2.13 As these examples suggest, one would expect to find a "structure" of prices, corresponding to the "structure" of additional economic costs of meeting the demand of different consumer groups and regions, and in different periods of time. The uniformity in pricing that is often found in practice is generally contrary to the

^{5/} See Churchill (7) and Walters (25) for detailed discussions of road user charges.

efficiency pricing rule. The mere existence of the structure of prices that will follow the application of the rule does not, however, necessarily indicate cross-subsidization between consumer groups and regions. Indeed, uniform tariffs often result in cross-subsidization. If a low-cost consumer and a high cost consumer pay the same rate, then the low-cost consumer will be subsidizing the high-cost consumer.

2.14 These examples also bring out that the efficiency pricing rule is designed to induce the right level of current use of a product. Past costs are completely irrelevant for calculating the additional economic costs of current production. The level of current use of a facility will tend to affect the costs of future use, however, through wear and tear. Use-related maintenance costs are, therefore, part of the cost computation for efficiency pricing. Similarly, stock depletion needs to be taken into account, e.g., liberal use of irrigation water during the off-peak season may lower the reservoir water availability during the dry season.

2.15 If the efficiency pricing policy is not followed, then the magnitude of the loss of economic benefits will depend on the difference between the actual price and the efficiency price, and on the responsiveness of demand to the price difference. There will be no loss involved only in the case where demand does not change at all in response to price. The product supply conditions, and the repercussions on other markets may also, of course, be relevant.

The following highly simplified example is designed to illustrate quantitatively some of the considerations involved.

2.16 Suppose, for example, a municipality runs a bus transit system, providing 1 million rides a year at 15 cents a ride.^{6/} If in order to raise more revenue it raises the fare to 20 cents, i.e., by 33%, ridership falls by 10% to 900,000 rides. The persons who continue to use the system now will pay \$45,000 extra (5 cents x 900,000). However, 10% of the ridership has been diverted to other alternatives, which the riders consider inferior to the bus system at 15 cents a ride and preferable at 20 cents. The persons affected are worse off by amounts ranging from 0 to 5 cents per ride, or on average by 2.5 cents. The total loss of benefits on account of diverted rides is thus \$2,500 (2.5 cents x 100,000). The total loss of benefits suffered by the customers is consequently \$47,500.

2.17 As against this loss, the municipality makes an extra \$30,000 (20 cents x 900,000 - 15 cents x 1,000,000) from fare collection. If its operating costs remain unchanged, the net loss will be \$47,500 - \$30,000, or \$17,500. This is the loss which is not compensated by extra revenue, and is thus a dead loss to the economy. That is, for every \$1.00 of extra revenue, the economy loses \$1.58 (47,500/30,000). The "deadweight" loss is 58 cents per every dollar.^{7/}

2.18 The operating cost will, however, fall in all likelihood. If the initial 15 cent fare represented only operating costs which

^{7/} This example is taken from Vickrey (24).

are now avoided, and if the unit operating costs are constant, the municipality's profit will further increase by \$15,000 (15 cents x 100,000), and the deadweight loss will now become 6 cents per every dollar of extra profit.^{8/} The saving in operating costs will be less than \$15,000 if the unit operating costs fall, and/or if the initial fare partly represented capital charges and fixed maintenance costs which remain unchanged. Thus, the deadweight loss will vary between 6 cents and 58 cents for every dollar depending on how unit operating costs behave, and how the initial fare was set. If, for example, the cost saving is \$7,500, the deadweight loss will be about 26 cents to the dollar.

2.19 It can easily be seen in terms of the above example that the deadweight loss will be greater, the greater the demand responsiveness. Thus, if ridership fell by 20% in response to the 33% fare increase, the extra revenue will be only \$10,000 (20 cents x 800,000 - 15 cents x 1,000,000), assuming no change in operating costs, but the loss suffered by customers will now be \$45,000. The deadweight loss will now be \$3.50 for every dollar of extra revenue.^{9/} If operating costs fall by as much as \$30,000 (15 cents x 200,000), the deadweight loss will be 12 cents. The loss will thus vary between 12 cents to \$3.50 for every dollar, depending on cost saving assumptions.^{10/}

^{8/} As $0.06 = (47,500/45,000) - 1$.

^{9/} As $3.50 = (45,000/10,000) - 1$.

^{10/} As to the repercussions on other markets, if the traffic is diverted to private autos then there may be an additional loss due to increased traffic congestion. For a more extended analysis of consumer and producer surpluses, including the necessary qualifications, see Currie et al (8), and van der Tak and Ray (22).

2.20 Even a loss of 6 cents to the dollar is not negligible, and this was obtained by assuming a fairly low demand responsiveness and that the initial fare reflected only variable operating costs. A 10% reduction in demand due to a 33% increase in price implies an elasticity of demand of only about -0.3. Thus, in general, one would expect the gains from correct pricing to be quite significant, and this also makes the analysis of trade-offs between the generation of greater revenue and the generation of greater economic benefits more meaningful.

(ii) Administration and Transaction Costs

2.21 The efficiency pricing rule tend to suggest that prices should be finely differentiated to reflect the differences in the costs of meeting the demand of different consumer groups, and at different time periods. Indeed the pricing rule may be interpreted to mean that each bus driver, in terms of the previous example, be given the option of choosing the routes himself, and be continually appraised of the costs of taking each route option, and be allowed to clear the market at each stop by negotiating the fare, i.e., operate in a manner not unlike unregulated taxi cabs. This would, of course, be absurd because the service provided by the bus system is scheduled service, apart from other reasons such as administration costs.

2.22 More generally, the administration of a price system is not costless, and the more differentiated the price system, and the

more its variability over time, the greater the administration costs. Similarly, it is costly for the customers to receive and respond correctly to a large number of price signals. In any complex system, it takes time to compute the optimum response, and optimum transactions will either not take place, or will take place after considerable delay. Simplicity in the price structure, as well as its stability, are often economical policies.

2.23 Thus in the case of electric power, for instance, one would differentiate prices only to reflect major cost differences, such as between peak and off-peak periods, and by regions; one would not want the price to respond continually to random fluctuations in demand; temporary excess supplies and demands are thus inevitable. As it may not be desirable to make very frequent price changes price setting will have to be somewhat "forward looking" in nature. Similar considerations apply to other sectors.

2.24 A related aspect is the cost of the mere act of charging for the amount used. For example, product pricing in water supply requires metering devices as well as meter reading and bill processing. In some circumstances, it may not be desirable to incur the expenditures for metering, as the benefits therefrom may be less than the costs. Public standpipes, for example, are hard to meter. In such cases resort to flow limitation devices may be preferable.

2.25 The problem is even more typical of road transport. In the absence of toll gates, which are usually neither desirable nor

feasible, there is presently no way of monitoring the use of individual road segments and charging for their actual use. Indirect means, such as registration fees, gasoline taxes, parking fees, etc., need to be used, which at best only broadly distinguish between "heavy" and "light" traffic zones and different vehicle types.^{11/}

(iii) Relationship with Investment Policy

2.26 As noted previously the pricing rule implies that prices should be raised to clear the market in periods when current production from existing capacity cannot be expanded to meet demand, i.e., there should be no quantity rationing. In such periods, however, the government or the public enterprise concerned may consider installing new capacity to meet demand, if the high demand is expected to continue. More specifically, there will be an upper limit to the price beyond which it will be desirable to install new capacity. This is sometimes considered to be an advantage of the pricing rule over quantity rationing, as the market clearing price will provide a "signal" for new capacity creation -- an equally simple signal is not provided by the length of the queues, or the magnitude of waiting time, or the magnitude of bakshish that quantity rationing tends to involve.

2.27 The calculation of this upper limit is first illustrated with a simple example, before considering some difficulties related to its use. Suppose that in a particular case capacity can be

^{11/} See Churchill (7) and Walters (25).

expanded by acquiring some machines, and the problem is to find the price per hourly service from the existing machines at which it becomes desirable to acquire an extra machine. As in conventional cost benefit analysis, it will be desirable to acquire an extra machine if the benefits therefrom exceed its costs. If the machine is expected to provide say, 5,000 hours of service each year of its life, then the present value of the costs of providing that service can be calculated and added to the purchase price of the machine to compute the total cost of investing and running the machine. Dividing this cost by the total hours of service to be provided (5,000 times the number of years of service) will give the cost per unit of service, and clearly if the expected demand is such that the machine's services can be sold at a price exceeding this unit cost, it will be preferable to acquire the extra machine, as the present value of gross revenues will then exceed the present value of the cost of investment and operating the machine. The upper limit to the market clearing price of the hourly services provided by the existing machines will thus be the unit cost of expanding the service by acquiring an extra machine so calculated. This limit price is sometimes referred to as "long run marginal cost" price or "incremental" cost price.^{12/}

^{12/} More strictly, this is one version of the concepts. It should be noted that a marginal capacity increment is involved in the example: for large increments the averaging device will be wrong. For a more rigorous version in terms of the dual (shadow price) to the capacity constraint see Anderson and Turvey (4), Chapter 8.

2.28 There are two difficulties. First, in the above example the acquisition of a new machine is supposed to take no time at all. This may be so in some cases, but generally capacity expansions in public enterprises take a number of years. Consequently, public enterprises should not wait till the price actually shoots up to the upper limit, but anticipate it to make timely investments. In fact, in situations where demand growth is very fast, and a public enterprise frequently has to add to capacity to meet it, it might just as well set the "peak period" price equal to the unit cost of capacity increments without incurring significant losses in terms of economic benefits.^{13/}

2.29 The key difficulty with this limit price calculation is that it relates to small additions to capacity. This sort of calculation is meaningfully made for electric power or urban water and telecommunications only when relatively small increments to system capacity are involved so that the incremental capacity can be expected to be fully utilized during peak periods shortly after installation. Since Bank projects often involve large additions in relation to the expected growth in demand this difficulty needs to be specially noted.

^{13/} The merit of this policy may in fact be a bit stronger than this. In such cases the risk of running short on supply may be too great, calling for a relatively high price for some "safety." For example, in electric power, "black-outs" and "load shedding" are very costly in terms of industrial disruption, etc.

2.30 In the case of large additions to capacity, such as a new road, a new irrigation dam, provision of water supply or electric power to new towns, etc., the incremental revenue earned is a very poor measure of incremental benefits generated. The product price only reflects the marginal benefit from the last unit sold, and thus the incremental revenue generated will not reflect fully the total benefits from the intra-marginal units. This point is best seen by taking the extreme example of a zero price (no revenue) due, say, to the infeasibility of product pricing. The benefit will, of course, not be zero simply because revenue is zero.

2.31 The larger the output increment provided the greater will tend to be the divergence between incremental benefits generated and incremental revenue, although even for relatively small changes this divergence may be important. The limit price calculation in the manner illustrated in para. 2.27 loses its value as a guide to good investment policy whenever the incremental revenue earned is likely to seriously underestimate the incremental benefits generated. This is inevitably the case whenever capacity can only be provided in large "chunks," i.e., whenever significant indivisibilities are present.

2.32 In any case, it should be noted that what is at issue here is not the operation of a pricing rule as such, but how it can be (and whether it can be) combined with a suitably specified investment rule. Except in the case of small capacity increments the

appropriate investment rule may not impinge on the pricing rule, and even when it does the investment rule merely defines an upper limit to the price that should optimally be charged. The upshot of all this is to confirm the validity of the efficiency pricing rule even in the "dynamic" context when investments are being considered.^{114/} The "dynamic" elements on the demand side are considered next.

(iv) Consumer Adaptation

2.33 A frequently important consideration is the effect of prices on the future development of demand. In many cases, it is necessary to charge very low prices initially, or not to charge at all, to create a market. The need for promotional pricing is seen most clearly in the case of projects geared to new unsophisticated markets. There may be no or very little demand for safe potable water in a small town or village with adequate access to other sources, albeit contaminated sources, unless the consumers can learn to associate health benefits to the direct consumption of water. This type of cases arises routinely in general agriculture projects which aim to introduce new methods and techniques of farming. One would not, however, expect such promotional pricing to continue indefinitely. That promotional elements are sometimes relevant in other cases as well, such as for example tourism related airport

^{114/} For an interesting discussion of pricing policy in a dynamic optimization context, see Turvey (20), Chapter 7 on "Optimal Pricing Through Time," esp. p. 74 for a summary statement confirming the textual statement. See also Walters (25) for an extensive discussion of the optimal investment rule in the case of highway investments.

pricing, need no elaboration. As is usual one needs to form a judgment about the extent of promotion or advertisement desired, its length of time, and least cost ways of so doing, including other non-price alternatives.

2.34 A more difficult issue arises regarding the impact on consumer expectations, as formed by the prices they have experienced in the past and the current price. Industries make investments in equipment of varying durability, select products, and choose locations on the basis of their long term expectations of the prices at which they expect to get electric power, coal, steel, and other intermediate products, many of which may be provided by the public sector. Similarly, consumers also choose residential locations, equipment of varying durability such as refrigerators and autos, and generally adapt their behaviour and mode of living to expected prices. If the industrial and consumer expectations prove to be quite wrong, there will undoubtedly be a substantial waste of resources involved.

2.35 This is one reason why stable prices may be desirable (para. 2.22). This consideration may also imply that prices be set higher than they otherwise should be, if the optimal time path of prices is an increasing one. However, one needs to review such conclusions carefully. One can easily imagine that a proper analysis of this aspect of pricing will involve complex dynamic optimization models. Such models will clearly require a theory of how specific expectations are formed, how they affect private investment behaviour, and

also of the various means, other than price, that can be used to influence expectations.

(v) Economic and Financial Costs/Benefits

2.36 The discussion has thus far run in terms of economic costs and benefits, but project entities generally observe only financial data, not necessarily economic data. Thus, one may distinguish between: (a) efficiency prices based on "shadow" prices, with due allowance for "distortions" in related markets,^{15/} and (b) efficiency prices that can be fairly easily estimated by project entities on the basis of data they directly observe. The latter may differ from the former for various reasons.

2.37 From the pragmatic point of view, it should suffice to identify only the major reasons for the discrepancy, if significant to begin with, between the two sets of prices (a) and (b) above. Reasons which are minor, or very transitory, or highly speculative in nature should be ignored. The extent to which one would be concerned with such discrepancies may also depend on the role of the relevant project entity within the government's decision making framework. A few examples are given below to illustrate these observations.

2.38 First, it should generally be possible to measure production costs by using shadow prices, at least for major cost items. One would first identify the major cost items which affect the derivation

^{15/} See van der Tak and Squire (23) for a full exposition of "shadow" prices.

of efficiency prices significantly (labor in some cases, imported inputs in others, etc.) and revalue them using shadow prices.^{16/}

It should be noted that in estimating efficiency prices, one would normally subtract taxes paid, or add subsidies received, on purchases of inputs from other public sector enterprises.^{17/}

2.39 Secondly, there may be taxes or subsidies on goods which are related to the use of the product, either in production or in consumption. A tax on gas will call for a higher price of electric power, as gas is a substitute for power. Similarly, a tax on refrigerators will call for a subsidy on power sold to residential users as they are complements. The use of such "corrections" to the efficiency prices are, however, more complex than this suggests. The actual "correction" will be a weighted average of the effects on other goods, some complementary and some substitutes. Moreover, it is not easy to decide which indirect taxes and subsidies are to be regarded as distortionary.^{18/}

2.40 With respect to these complications, there is a commonly held view that no individual project entity should be given the responsibility, or assumed to have the capability, for taking actions designed to correct distortions elsewhere in the economy, e.g., it should not be the responsibility of a railway department to subsidize the transport of cotton in order to nullify the effects a

^{16/} See van der Tak and Squire (23) for shadow price evaluation methodology.

^{17/} See Little/Mirrless (13) for a fuller discussion.

^{18/} See Little/Mirrless (13), pp. 223-227, and also Turvey (21), Chapter 2, for a discussion of second best pricing.

"wrong" tax on cotton imposed by the Finance Ministry. Similarly, no port authority should be concerned with whether the government imposes the optimal trade taxes or not. There is clearly a great deal of merit in this view. The extent to which the project entity should gear its pricing policy to corrective actions will have to be a matter of judgment in specific cases, depending on the type and severity of policy constraints faced by particular governments, and the permanency of the distortions in the related markets.

2.41 Thirdly, there are other types of effects which may be pertinent to consider. Increases in pollution due to increased production of the product, or due to its use by other industries, is one example. However, better antipollution measures may be available. On the consumption side, one may consider the case of potable water supply. Increased consumption of potable water supply may produce increased health benefits, which consumers underestimate because they act as private individuals, and because they themselves may not be aware of the benefits. Health benefits, of course, will not increase after the minimum requirements are satisfied, and thus after that point be irrelevant for efficiency pricing. The important point here is that not all external effects are relevant for product pricing, but only those which directly vary with the amount of output at the margin.

2.42 To summarize, whereas in principle all "externalities" related to the volume of output at the margin should be taken into

account, in practice one has to be very selective and sure about charging prices which are different from a more straightforward calculation of the efficiency prices.

(vi) Foreign Demand

2.43 The efficiency pricing rule discussed so far does not apply with respect to foreign sales, whether exports of goods abroad or sales to foreign tourists. In such cases the country should exploit whatever monopoly power it may have, with due consideration to "good will" and promotional value of pricing, and long-term demand implications. Price discriminations vis-a-vis foreign and domestic tourists will be warranted.

2.44 One special point with respect to airport pricing is important to note. Even if an airport authority has considerable monopoly power in setting airport charges on foreigners and foreign aircraft (due to say, lack of competition from other airports) it should not exercise this power if in so doing it would reduce the total volume of tourist expenditures in the country. The reason is that tourism is an industry in which a large number of activities participate, and the objective is to maximize net profits in social terms from all these activities considered jointly.

(vii) Inflation

2.45 Finally, the discussion so far has assumed implicitly that costs and benefits are measured in real terms. In theory, inflation is defined as a uniform rate of increase in all prices in the economy;

in practice, however, inflation not only is accompanied by, but also gives rise to, relative price changes, i.e., differential rates of changes in prices. A project entity seeking to implement efficiency prices need not, however, be directly concerned with attempts to distinguish between relative and absolute price changes. On the cost side, the entity need only be concerned with the cost increases as it sees or expects them, whether stemming from inflationary changes or not. Similarly, on the demand side the entity need only be concerned with the demand growth it experiences, or expects. Indexing its price to the general inflation rate may be far better than the extreme "stickiness" often observed in practice, but it will not be a good policy if the changes in the efficiency prices for its products differ markedly from the growth of the general price index. The best policy in an unstable environment may be one of flexibility, or fairly short lags in price changes, as otherwise its price will tend to be unrealistically high after a period of rapid inflation has subsided, or too low after a period of stable prices is followed by rapid inflation.

(viii) Summary

2.46 This Section has discussed the pricing policy that would be appropriate if income redistributinal, revenue and savings generation considerations are set aside. Such a pricing policy, here called the "efficiency" pricing policy, is derived from the objective of maximizing the net economic benefits, in present value terms,

under the assumptions mentioned. This discussion was necessary in order to highlight the efficiency considerations without which no meaningful judgments on cost recovery issues can be made in most cases. It is not implied that such a pricing policy will necessarily continue to be appropriate when the other important considerations are discussed in the following Section. It should be noted that the efficiency pricing rule is a rule for product pricing, and as such it does not apply in cases where product pricing itself is not feasible, e.g., flood control or flood irrigation schemes.

2.47 Efficiency pricing involves a large number of aspects, and should not be summed up simply in terms of a rule. But if a rule is needed as a starting point it should be as stated in para. 2.5. Each public sector undertaking has its own particular conditions relevant to the derivation of efficiency prices, and consequently it will take too much space to indicate the specific characters that efficiency pricing policies may take in practice beyond what has been done.^{19/} It needs to be stressed, however, that significant departures from efficiency prices for revenue or other purposes should only be made after due consideration of the losses that may accrue to the economy as a consequence.

^{19/} There is a considerable volume of Bank literature on the subject which may be consulted for more detailed guidance. See Bibliography for the principal sources.

III. COST RECOVERY

3.1 This Section discusses the various aspects of cost recovery policies, focussing on issues and considerations which are of general relevance, irrespective of the sector or project entity involved. The discussion starts with some general observations on efficiency prices as they bear on revenue generation. Cost recovery issues are then considered from the point of view of the public sector, introducing the taxation of the beneficiaries of a project as a second policy instrument for revenue generation in the project context. Finally, some broad implications of cost recovery policies for project entities are considered. The outline of this Section is:

- (i) Revenue Implications of Efficiency Pricing;
- (ii) Cost Recovery and the Public Sector; and
- (iii) Cost Recovery and the Project Entity.

(i) Revenue Implications of Efficiency Pricing

3.2 The preceding Section discussed the various aspects of product pricing from the point of view of maximizing the present value of the net economic benefits from a project without any reference to the adequacy or inadequacy of the revenues generated. As efficiency pricing is not concerned with the adequacy of revenue generation, the revenue generated from such pricing may be quite inadequate to cover total costs. Indeed the possible

conflict between efficiency pricing and revenue generation has traditionally been the center of the discussion on public sector enterprises' pricing policies, especially in connection with the railways and electric power. This conflict is usually discussed in terms of "decreasing costs" and "economies of scale," and the main points may be illustrated in terms of such a stylization.

3.3 First, one may envisage a large indivisible investment, which provides a lot of excess capacity initially, before demand "catches up." The fixed cost of the basic initial installations or equivalent annual capital charges, will be spread over more and more output as demand grows. If the operating costs are a small fraction of total costs, or if the operating costs do not increase fast enough with increase in output, the total unit costs may decrease over a wide range of output, even near full capacity utilization. Total costs will not be covered then until production can no longer be expanded, and then only after the demand grows sufficiently to raise the market clearing price to the level of total unit costs. And additional investment in basic capacity may possibly become desirable well before that happens.

3.4 A highway investment fits into this category. Even if a toll gate is provided so that a price can be charged per trip on the highway created, all annual costs, i.e., fixed maintenance costs, use-related maintenance costs, toll operating costs and

capital charges, will not be covered on the basis of charging for use-related road maintenance costs and toll gate operating costs. Until significant traffic congestion starts so that a congestion surcharge becomes justified, total cost recovery is not likely to occur. A widening of the highway, or an alternate highway investment, may become desirable prior to that actually happens. In this case, even the conventional operation and maintenance costs will not be covered as the maintenance costs which are independent of actual use will not be charged for.

3.5 Secondly, even if such infrastructural indivisibilities are relatively small, the capacity installation costs per unit capacity provided may decrease with plant size, or as increments to capacity are made. Greater size, for example, may involve technologically more efficient options. Superior technology, both its progress and its adaptation, may be biased towards large size.^{1/} These descriptions are, of course, stylizations. In many cases "capacity" is a multi-dimensional concept, and a large investment is usually associated with a multitude of sub-activities, each with its own "capacity," and involving many types of products and services.

3.6 While these problems may arise, in many cases the cost structure is such that the efficiency prices recover all costs of project investments. However, a distinction need to be made between

^{1/} See Westphal (27) for illustrations of economies of scale.

historic or sunk costs, and presently avoidable costs, as these processes take place over time. For example, efficiency pricing of electric power may well cover the incremental capacity costs relevant at a point in time, without doing much for historic costs which were incurred years ago when the system was set up but which may still be important in financial accounting. When indivisibilities are relatively unimportant, and/or operating costs are a significant portion of total costs and rise rapidly with output, and/or demand growth is very rapid, the revenue generated from efficiency pricing should cover at least all new investment costs. To the extent that efficiency prices are lower than they otherwise would be because of special factors (e.g., promotional pricing, para. 2.33), the revenue generation implications become, of course, worse, and conversely if such prices are "corrected" upwards (e.g., if an important input is very important in production costs and foreign exchange is scarce).

3.7 One should not prejudge the implications of efficiency prices from the revenue generation point of view. Efficiency pricing may generate large surpluses, as well as deficits. Paradoxically, the serious problems in practice often tend to arise not because efficiency prices are being charged, but because the prices set are below their efficiency levels. The tendency to underprice is quite common in utilities, and is, of course, chronic in the case of urban private automobile use, among other areas.

(ii) Cost Recovery and the Public Sector

3.8 This subsection discusses cost recovery issues from the point of view of the public sector defined comprehensively to include its project entities. A measure of the fiscal impact of a project is first introduced, followed by discussions of revenue generation policies in the project context and of cost recovery norms.

(a) Fiscal Impact

3.9 The impact of a project on the financial resources available to the public sector is a natural concern given that in many countries the size of the public sector investment program is constrained by the government's inability to raise sufficient revenue. This concern appears in project analysis directly when the project entity is a government department, e.g., an irrigation or a highway department, which does not collect revenues itself but relies on transfers from the government to finance its expenditures. Analysis of the project's impact on the government's budget is a routine part of rural development projects, for example. This concern also arises indirectly in the case of specific financial accounts, such as that of a state-owned power company. One of the purposes of financial autonomy is to safeguard drains on the Treasury by encouraging or requiring self-financing for revenue generating entities, when feasible. Similarly, the prescription that at least the annual operating and maintenance costs be covered is intended to minimize the

adverse effects of the project on the public sector budget on a recurrent basis.

3.10 When public funds are scarce and less than socially desirable the fiscal impact of the project becomes a material consideration in both project choice and financing decisions. In such cases there will be a scarcity "premium" on a dollar of revenue at the disposal of the public sector, and this premium may be used to evaluate the deficits or surpluses generated by the project.^{2/} Decisions on the pricing of products and on beneficiary taxation will be affected by judgments on this premium.

3.11 From the point of view of the public sector, the relevant measure of a project's budgetary impact is the present discounted value of the annual deficits and surpluses due to the project, the discount rate being the relevant shadow interest rate.^{3/} The annual deficits or surpluses are measured as follows (in real terms):

- (a) the total incremental public sector expenditures due to the project,
- (b) minus the total incremental revenues that accrue to the public sector due to the project.

^{2/} If a project yields a deficit of \$1.00 in a particular year, and the public sector has to reduce some other expenditure to finance it, the "shadow price" of the dollar will be the present discounted social value of the use sacrificed, and the excess of this price over unity is the premium. See Marglin (16) for a full discussion.

^{3/} For a discussion of shadow interest rates see van der Tak and Squire (23).

A corresponding fiscal cost recovery rate may be defined as the present discounted value of (b) divided by the present discounted value of (a).

3.12 This measure relates to the account of the public sector, and involves all public sector cash flows directly or indirectly related to the project. Private sector expenditures and receipts in connection with the project are excluded, although the changes in public revenue and income that these induce are counted. For example, the private investments made by farmers in an agricultural project will not be a part of this measure, except for the revenues that the public sector receives from the taxes on inputs that the farmers purchase from elsewhere. Similarly, the income that the farmers receive from selling their outputs is not included, although any changes in the proceeds of taxes on these outputs will be included, as will any change in the profits that the public sector might make if it undertakes marketing and processing of the outputs. The public sector revenue or income changes from the additional consumption expenditures of the farmers will also be included in the measure. Indeed, all changes induced in public income in or outside of the project boundaries are relevant.

3.13 It is clear that the fiscal cost recovery rate as defined above is very difficult to measure, since it requires an estimate of all net incremental revenues accruing to the public sector as a result of the project. Some of the major revenue items that are

relatively easy to measure are (i) revenues from sales of the products and services provided by the public sector component of the project, (ii) revenues from taxes, tariffs and subsidies on private sector inputs and outputs of the project, and (iii) revenues from direct taxes on beneficiaries because of the income or capital gains they receive.

3.14 To see this more clearly, it is convenient to categorize the major components of the cash inflows (item (b) para. 3.11) separately. The following breakdown of the fiscal effects is an illustration only, as the appropriate decomposition will depend on project type and pragmatic convenience.^{4/} Noting that the fiscal impact is to be measured in terms of present discounted values, and in real terms, the measure is:

- (a) incremental public sector expenditures on the project at market prices;
- (b) minus the tax/tariff/subsidy components in (a) above; these payments are merely transfers within the public sector;
- (c) minus the tax/tariff/subsidy component in incremental private project expenditures, i.e., other than the public expenditures (a) above;

^{4/} The classification here is least convenient for credit operations. For such operations, item (a) below will simply be the public sector outflow on credit disbursements and administrative costs etc. The item (d) below will then consist of the repayment stream, the "product price" being the real interest rate.

- (d) minus the incremental revenues earned, gross of sales taxes and net of sales subsidies, from the sales of the products and services provided by the public sector. These revenues stem from the prices charged for these products and services. In some cases, these products and services are also considered to be the project's output, e.g., public utilities projects.
- (e) minus the incremental revenues earned from taxes on outputs and services of the private sector resulting from the project (in the case of a subsidy, it is to be regarded as cost). In some projects, as in agriculture, these products and services provided by the private sector are considered to be the project's outputs. In an irrigation project, e.g., the incremental revenues from sales taxes on the agricultural commodities produced will be included in this category.
- (f) minus the incremental revenues earned from direct taxes on users and beneficiaries. Typical examples are land taxes, betterment levies, income and property taxes. This may be further divided into:
- (1) direct taxes which are general,
 - (2) direct taxes which are specially designed to bear on users and beneficiaries only,

i.e., "discriminatory" direct taxes, e.g., a differential property tax on a neighborhood benefitting from a project, a betterment levy paid only by benefitting farmers, etc.

- (g) minus the incremental net revenues earned from all other effects not counted above. This is the residual "catch-all" term, which is very difficult to measure and which can be either negative or positive.

3.15 It should be noted that the various terms in the measure of the fiscal impact of the project (para. 3.14) are not necessarily mutually independent. For example, the prices set for the public sector products will affect the costs (item (a), para. 3.14) by changing the amounts purchased, and the other inflows as well.

3.16 Discriminatory taxes and charges on project beneficiaries deserve special emphasis for two reasons. First the possibility of raising additional revenue from such taxes is obviously relevant from the point of view of equity and income distribution. Secondly, even apart from equity and income inequality aspects, raising additional revenue from such taxes, related as they are to the incremental project benefits, may be one of the easiest options available to the public sector, whose ability to raise additional revenue through other means may be quite limited. Consequently, this option,

along with the pricing of products provided by the public sector, should be considered a basic revenue generating policy parameter in the context of a project.

(b) Revenue Policy

3.17 The revenue generating policy in the context of a project consists of the decisions on pricing of the products and services provided by the public sector, and on the discriminatory benefit taxes to be levied on project beneficiaries. The objective in raising a given amount of revenue through these two instruments will be to do so at least sacrifice of net economic benefits. And the higher the scarcity premium of public funds, the greater the sacrifice that can be tolerated, i.e., the greater the additional revenue that should be raised. The method of raising additional revenue and the amount of revenue to be raised may both, of course, be conditioned by the income levels of the beneficiaries in the context of existing economic inequalities and by equity.

3.18 It may be helpful to consider these issues in terms of two steps:

- (a) the determination of the efficiency prices for the products and services provided by the public sector (discussed in Section II), so as to obtain the maximum net benefits from the project, and any discriminatory benefit taxes that might be levied with negligible adverse effects on the total net benefits of the project,

- (b) the determination of the desired level of revenue generation from the project in excess of the revenues that will be generated from step (a).

3.19 If the first step (a) involves a deficit, then the second step (b) raises the issue of the best way of financing it. Any additional revenue generated from the project will reduce its total net economic benefits, and this sacrifice needs to be compared with the net benefits which would otherwise be sacrificed elsewhere in financing the deficit, either from reductions in other expenditures or from raising additional revenue through other means. If the first step involves a surplus, then the second step raises the issue of whether a larger surplus would be desirable. That is, is it worth sacrificing some of the project benefits in order to avoid having to raise additional revenue by other means to finance other expenditures?

3.20 In both cases, the issue is essentially the same one, i.e., what is the social opportunity cost, or the social value, of public funds, given that it is scarce and less than socially desirable, and how does it compare with the cost of raising additional revenue from the project. The two instruments, product pricing and benefit taxation, are discussed separately below from this point of view.

Pricing Policy

3.21 To start with, the amounts of products and services to be provided by the public sector, and the corresponding efficiency prices, may be estimated, assuming that all taxes, tariffs, and subsidies are given and that no discriminatory benefit taxes are feasible. At issue then is whether departures from efficiency prices are justified, given the scarcity premium on public revenue. The fiscal impact, corresponding to these efficiency prices may be a deficit or a surplus -- in either case the premium is applicable.

3.22 The usual approach to this issue is as exemplified in Section II (para. 2.16). If a dollar of public revenue obtained from the private sector is worth, in social terms, one dollar and fifty cents, then a mark-up on the efficiency price can be tolerated as long as the resultant loss in economic benefits ("deadweight" loss) is less than fifty cents. The more inelastic the demand for the products with respect to price changes, the higher the mark-up that can be tolerated for any given premium on public funds. Since the valuation of the losses in economic benefits will depend on the income level of the persons suffering the losses, the mark-ups will be lower, possibly zero or even negative, the poorer the consumers of the products.^{5/} When price discrimination is possible the mark-ups will be higher for those consumers whose demand is relatively inelastic, or those who are affluent. These are familiar conclusions. Two qualifications need to be noted, however.

^{5/} The premium will then have to be defined relative to a norm level of consumption or income.

3.23 First, this approach assumes that not only all other taxes, tariffs and subsidies are given, but also all other prices. The losses of economic benefits sacrificed cannot be fully measured by this approach if other prices also change as a result of the mark-up. A mark-up or a tax on, say, the fertilizer price will also be partly passed on to consumers of the agricultural products through higher prices. When all such repercussions are taken into account it turns out that in many cases the ideal policy for the government would be to tax only final consumption goods for raising revenue and either not to tax production at all, or to tax it in a manner so as not to impinge on production decisions. In particular, in pricing the products of public sector undertakings it would be preferable to avoid "mark-up"s or "mark-downs" on efficiency prices of the products which enter into other production processes (as is often the case with Bank financed projects). The reason is that if the prices of such intermediate goods do not reflect social costs, the production methods adopted by industries and farmers will not be minimum social cost methods for given levels of output. If, for example, prices of coal, transport, etc., do not reflect social costs the resultant industrial location patterns may not be least (social) cost. Similarly, mark-ups on fertilizers will also mean that whatever the volume of agriculture production may be, it will not be produced at least cost socially, as the socially correct combination of fertilizers with other inputs will not be used. Such "ideal"

policies are of course not followed in practice, and hence the possible need to adjust efficiency pricing to reflect the "distortions" due to prevailing taxes, tariffs, etc., as discussed in 2.36-2.42. These adjustments, however, will be efficiency oriented, not revenue oriented, possibly exacerbating the revenue generation problem rather than ameliorating it. Thus unless the demand elasticities are very low, one needs to be cautious in recommending mark-ups on efficiency prices for revenue generation, especially for intermediate goods, as the losses of economic benefits may easily be underestimated.^{6/}

3.24 Secondly, judgments on demand elasticities are very difficult in practice. This is an additional reason for minimizing mark-ups on efficiency prices. The premise that demand is very inelastic, as commonly used in practice, is highly plausible for some commodities in the short-term but long-term effects should not be ignored. It is not generally plausible that long-term elasticities are also very low.

3.25 Similar considerations apply also to the issue of product subsidies. Just as a mark-up on the efficiency price can be justified only if it is the best way of raising revenues, a product

^{6/} Little and Mirrless (13) strongly recommend that the efficiency pricing policy should be followed for all intermediate goods. See Dasgupta and Stiglitz (9), however, for a taxonomy of cases where this advice will not be strictly correct. For a discussion of the classical "elasticity" and "proportionality" rules, see Baumol and Bradford (5), and Dixit (10).

subsidy, or mark-down on the efficiency price, can be justified only if this is the best way of transferring income. The more conventional reason that individual users and purchasers may underestimate the social value of their consumption has already been incorporated in the definition of efficiency prices (Section II). Purely from the point of view of transferring income, a product subsidy is just one of many alternative instruments that may be available and its merit should be assessed in that context. In practice product subsidies often tend to be somewhat haphazard in nature, and this may be quite costly if the revenues lost thereby could have been better used through well planned poverty redressal programs. Given that the resources available for poverty redressal are limited, the issue is the most effective form in which subsidies can be given.^{7/}

3.26 Subsidy costs are usually minimized by appropriate choices of products and service standards for the poor. Some quantity rationing may also be necessary to "reserve" the products for the poor, as is the case with urban sites and services, for example. In allocating such products the prime consideration may be to reach a target income group through controlled selection, the price playing an allocative role only within the target group, even so perhaps a limited one. In such cases the issues is how poor the chosen target group can be, consistent with minimum service standards, and the scarcity of public funds.

^{7/} For a discussion of alternative forms of consumption subsidies from the efficiency point of view, see Pauly (17).

3.27 Finally, the product pricing option may not always exist. It may not be feasible in some cases (e.g., flood control), while in others it may not be desirable if the cost of implementation and administration of a pricing system outweigh the benefits (Section II (ii)). However, the option of instituting product pricing should not be dismissed without serious consideration, both for efficiency and revenue reasons (e.g., irrigation water).

Benefit Taxes

3.28 There are various types of discriminatory taxes, charges and levies that may be imposed on project beneficiaries to capture a part of the benefits generated. When feasible, this option should be examined first, prior to any decisions on departures from efficiency prices. However, since most devices tend to impinge on production or consumption decisions, at least to some extent, benefit taxes generally also have efficiency effects and cannot be neatly divorced from the pricing considerations discussed above. Any distinction between product pricing and benefit taxes has to be a matter of practical convenience, based on differences in degree rather than on matters of principle.

3.29 For example, the fee for a private connection to a water supply system is usually regarded as a "price," the "product" being private access to the system. As such, it will have an efficiency level which will optimize the number of private connections to the system. But if the responsiveness of demand for private connections

to mark-ups on the efficient connection fee is low, the mark-up may also be regarded as a fairly good discriminatory benefit charge. Similarly, a tax on each household with access to a community water tap may be a good benefit charge, although it may make some households worse off. A betterment levy on project farmers after an irrigation project may be a good tax, although again it may make some farmers worse off. On the other hand, a sales tax on the crops produced by the project farmers will not only hurt all other farmers producing the crops, but may also involve significant efficiency losses. Thus, such a sales tax is not likely to be a good discriminatory benefit tax.

3.30 Generally, the scope for suitable benefit taxes will depend on whether or not it is possible to restrict the incidence of such taxes to the project beneficiaries with very little efficiency losses, and relate them to the net benefits received by the different beneficiaries so that the tax burden imposed on a beneficiary does not exceed the net benefits he receives. In practice differential land and property taxes may be the best of the available options. However, in many cases the scope for suitable discriminatory benefit taxes may be very limited, e.g., in most transportation and industrial projects, and in poverty redressal programs and projects such taxes may defeat the purpose.

3.31 The limit to benefit taxes is set by the incremental project benefits received by a beneficiary, net of (i) the incremental

payments he makes on his purchases from the public sector, (ii) incremental production expenditures that he incurs, if any, to realize the benefits, and (iii) his incremental payments of direct general taxes, if any, due to the benefits he receives. Within this limit, the level of new discriminatory tax payments imposed on a beneficiary should depend on the valuation of his personal income, as it would be after the project, in relation to those of others in the country. The lower is his relative post-project income, the lower should be the level of the additional taxes imposed on him. The efficiency losses due to such taxes (sometimes referred to as incentive effects in this context), if any, will also tend to be less the lower the new taxes. On the other hand, the lower the new taxes the less revenues the government will have for financing other expenditures, including expenditures for more deserving persons. The resolution of these opposing factors determines the level of incremental tax payments from new or higher taxes that should be imposed on each project beneficiary and thus on the beneficiaries as a group.

3.32 It may be noted that the systematic incorporation of the objective of income redistribution requires a redefinition of the concepts of economic benefits and costs, and correspondingly requires some basic modifications in the conventional project analysis. The conventional analysis implicitly assumes that the social value of a dollar's increment in consumption is the same regardless of the income of the person it accrues to. The necessary modifications

stem from the replacement of this implicit "regressivity" with suitably progressive schemes for the relative valuation of benefits accruing to, or cost incurred by, different income groups.^{8/} If such a progressive scheme is specified, then the income distributional considerations can be consistently brought to bear in pricing and taxation decisions in all projects in the country concerned.

3.33 In addition to these considerations of efficiency, scarcity of public funds and economic inequality, the notion of "fairness" (or "equity" as it is sometimes construed) may be noted. It has two interpretations in this context. First, it is sometimes used in the sense that project beneficiaries should receive equal treatment. That is, each should pay benefit taxes or charges in proportion to the benefits he receives. As such this notion conflicts with both efficiency and the concern with economic equality. As discussed earlier uniform prices often result in cross-subsidization from low-cost consumers to high-cost consumers (para. 2.13). And charging benefit taxes in proportion to benefits received (as also equal taxes per beneficiary regardless of the distribution of benefits) ignores the initial economic inequality between the beneficiaries. Two beneficiaries with very different income levels receiving the same benefits would then be required to pay the same taxes. From the point of view of redressing economic inequality, it is

^{8/} See van der Tak and Squire (23) for methodological details, and Chenery (6) for a discussion on income redistributional policy options and analysis thereof.

preferable to relate benefit taxes to the with-project distribution of income, i.e., to the initial distribution of income as modified by the distribution of benefits from the project.

3.34 The second interpretation of "fairness" would be as follows:

(i) equal-cost consumers of equal income should face the same product price. That is, prices will differ between consumers only to reflect differences in the cost of supplying different consumers and/or to reflect differences in income (or more appropriately "welfare") levels between the consumers. Price discrimination between consumers of different income levels is not, however, always possible, and even if it is possible, it should only be practiced when mark-ups on efficiency prices are unavoidable for raising additional revenues; (ii) beneficiaries with equal with-project income (or "welfare") should be charged the same benefit taxes.

3.35 "Fairness" in this sense is entirely consistent with, and indeed, should result from, the systematic application of the efficiency and economic inequality considerations. The concept of "fairness" is a separate consideration only in the first sense (para. 3.33). Two difficulties in the application of the "fairness" notion or of the concern with economic inequality to pricing and discriminatory benefit taxes need to be noted. First, with respect to both price discrimination and benefit taxation, the appropriate concept is "welfare." Annual with-project personal monetary income will be a poor index when family sizes differ, cost-of-living differs,

expected lifetime incomes differ etc., and moreover, "income" may sometimes be in non-monetary form, especially in rural areas. For this reason it might be preferable to apply the economic inequality considerations to pricing and taxation only when large differences exist. Secondly, it is rarely possible to treat all beneficiaries equally, because there are different types of beneficiaries, not all of them the direct purchasers of the products and services being provided. For example, the consumers of the crops produced by an irrigation project may gain substantially from the project, but yet it will not normally be feasible to levy discriminatory benefit taxes on them. This is a limitation of the "fairness" notion.

(c) Cost Recovery Norms

3.36 The fiscal benefit or surplus associated with a project, as defined in para. 3.11, is important in project evaluation as the social value of each dollar of public revenue will be greater than unity when the funds available to the public sector are scarce and less than socially desirable. It is important to note, however, that unless the project deficit or surplus is large in comparison with the total resources available to the public sector, one's judgment on the scarcity of public funds (i.e., the scarcity premium) should not be altered by the project. Consequently, from the point of view of pricing and taxation decisions, the actual size of the deficit or surplus will be immaterial as long as the initial judgment on the scarcity of public funds is unaffected by

the project. If benefit taxes and mark-ups on efficiency prices are considered desirable because a deficit would otherwise result, these should be equally desirable if efficiency prices would have generated a surplus. In the unlikely event, however, that the deficit or surplus is so large as to affect the basic judgment on the scarcity of public funds, it becomes important to measure the actual size of the deficit or surplus comprehensively.

3.37 There is, however, no natural reference value for the fiscal cost recovery rate defined in para. 3.11. Even if public sector outputs are distributed free of charge and there are no benefit taxes, the fiscal cost recovery rate need not be zero, while it can easily exceed 100%, even if only efficient product prices are charged. However, if the pricing and taxation decisions made with reference to the considerations discussed earlier are judged to be optimal, the fiscal ratio will have a corresponding optimal value.

3.38 The fiscal cost recovery rate may be partitioned in order to focus on the two revenue generating policy instruments, viz product pricing and benefit taxes. It may be rewritten, using the breakdown given in para. 3.14, as follows (noting that all terms should be in discounted present value terms, and in real terms):

The fiscal cost recovery ratio = $R = R_1 + R_2$, where

R_1 is the ratio of the term (d) (i.e. incremental revenues earned from product sales, gross of sales taxes and net of sales subsidies) plus the

term $f(2)$ (i.e., incremental revenue from discriminatory benefit taxes), to the term (a) (i.e., the total public sector project expenditures). In other words, R_1 reflects the policy variables determining the fiscal cost recovery rate; and

R_2 reflects the other "passive" fiscal effects of the project.^{9/}

3.39 The partitioned cost recovery ratio, R_1 , also does not have a natural quantitative reference value of general validity. Its minimum value is uniquely defined to be zero, while, like the complete cost recovery rate, it can easily exceed 100% on the basis of efficiency prices for the products, if the undertaking is a profitable one at such prices. In general its optimum value will tend to be higher, ceteris paribus, the higher the scarcity of public funds; in this sense it is country specific. It will also tend to be higher, ceteris paribus, the higher the level of efficiency prices and/or the higher the relative income class of the project beneficiaries; in this sense it is sector and project specific.

3.40 The optimum value of R_1 may be zero in some cases. For example, it may be zero for some programs and projects geared to extreme poverty groups. It may also be zero for family planning projects

^{9/} In the notation of para. 3.14,

$$R_1 = \frac{d + f(2)}{a} \quad \text{and}$$

$$R_2 = \frac{b + c + e + f(1) + g}{a}$$

as the efficiency price for such services may be zero because of the benefits external to the individual beneficiaries and because discriminatory benefit taxes are also unlikely to be desirable in such cases. In general, it will be zero regardless of the income level of the beneficiaries whenever suitable discriminatory taxes and product pricing are either not feasible or not desirable.

3.41 The optimum value of the partitioned cost recovery rate, R_1 , or of the complete fiscal cost recovery rate, will be 100% only by chance. In this sense there is no intrinsic merit in full cost recovery, i.e., in the principle that "beneficiaries should pay total costs," from this point of view.

3.42 If the principle that "beneficiaries should pay total costs," is regarded as a value judgment independent of the judgments on the scarcity of public funds, economic inequality and efficiency, then all incremental payments made by the beneficiaries to the public sector in order to become beneficiaries should preferably be counted, regardless of the means or mechanisms of payment employed. In particular the payments on direct general taxes which the beneficiaries could have avoided by not choosing to earn additional income by using the services provided by the project should be counted. It should, in fact, be preferable to use a measure similar to the complete fiscal cost recovery measure (except for the "residual" term (g) in para. 3.14) from this point of view, making allowance for project-induced incremental payments to the public sector made by non-beneficiaries, if any.

3.43 Unless such a value judgment is made, quantitative reference norms can be devised only in the context of specific sectors or types of projects. For example, in circumstances in which there is a chronic tendency to underprice products and services, or reluctance to levy desired discriminatory benefit taxes, a suitably high quantitative norm may be very useful in counteracting such biases. A general quantitative standard is not feasible. At any rate it should be clear that the general considerations underlying pricing and taxation decisions are the same, regardless of the specific sectoral norms that may be devised, viz

- (a) the losses of the project's net benefits likely to be incurred by departing from the efficiency prices for the products and services of the public sector (when product pricing is relevant),
- (b) the losses of project's net economic benefits likely to be incurred from the imposition of discriminatory benefit taxes (when such taxes are relevant),
- (c) the scarcity of resources available to the public sector. If the project's deficit or surplus is a material consideration in this judgment, then the comprehensive fiscal measure, in para. 3.11, should be used; all incremental revenue inflows to the public sector are

relevant, whether from new or existing taxes on income and wealth, or from new or existing taxes on the various project inputs and outputs, or from other sources,

- (d) the post-project income and wealth of the individual beneficiaries as compared to those of others in the society, and the relative social valuation of their income and wealth.

3.44 Pricing and taxation policies may also be geared towards increasing the total amount of private savings and re-investment, e.g., by discriminating in favor of those consumers who save more, i.e., with higher marginal savings rates, and in favor of those industries which plough back a greater share of their profits. This is of little more than academic interest in most cases as the information requirements are very high. The incorporation of this element will make the pricing and taxation policies more regressive than otherwise, as the savings rate tends to increase with income. However, the impact on private savings might be considered when meaningful judgments are possible, and in such cases this consideration should be added to the list above.

(iii) Cost Recovery and the Public Sector Project Entity

3.45 The discussion in the preceding sub-section (ii) covers well the project entities which may be regarded as simply project implementation agencies of the government, with no discretionary powers

on pricing and taxation decisions, e.g., the various governmental departments. Numerous problems may of course arise in practice, related to such issues as decentralization of decision making, allocation of funds between the different levels of the government and between sectors and projects, but the broad perspective of the country's economic and social objectives can in principle be directly brought to bear on pricing and taxation decisions, and the relevant revenue generation objectives are those of the government itself, not of the entities.

3.46 Cost recovery issues mainly arise at the level of the project entity when the entities concerned earn revenues directly from the public and are required to maintain satisfactory and viable financial positions. The typical examples of such project entities are the public sector enterprises in the public utilities, railways, air and sea ports, major industrial branches, etc. The cost recovery rate relevant for the public sector, discussed earlier, will differ from the cost recovery rates relevant to such public enterprises as the public sector's cash flows and the public enterprises' cash flows are generally quite different. Since public sector enterprises normally do not have the option of levying discriminatory benefit taxes, the cost recovery instrument available to such enterprises is usually only the pricing of its products and services.

3.47 The key consideration in treating a public enterprise from the cost recovery point of view concerns the valuation of the

financial resources at its disposal relative to the valuation of the financial resources at the disposal of the government. With this in mind one may distinguish between two types of cases:

(a) "independent" enterprises. An enterprise should be classified in this category if its financial resources should be valued differently from the resources at the disposal of the government, and

(b) "semi-independent" enterprises. An enterprise should be classified in this category if the value of its financial resources should be regarded as equal to the value of the financial resources of the government.

These two categories are briefly discussed below. Matters such as administrative, managerial and general operating efficiency, various sector and project specific financial issues, etc., are not considered.

(a) "Independent" Public Enterprises

3.48 This category is likely to be relevant for the fully autonomous public enterprises, with independent financial objectives, which are generally required to follow the commercial rules and practices of the private sector. They may also in some cases borrow directly, or accept equity participation, from the private sector. Such enterprises are usually required to do without special

privileges from the government which are not also available to the private sector, e.g., subsidized interest rates, exemptions from dividend payments, lower taxes, etc.

3.49 The desired cost recovery rate for such a public enterprise depends on its financial objectives and targets. It will seek to be profitable, and earn enough to cover all its financial costs and obligations, based on market prices, including a reasonable return on its invested capital. Complementary to this is the need for prudent financial planning in a dynamic context, which may require it to generate internally surplus cash for future investment purposes. Its desired cost recovery rate may be expressed by suitable financial indices, such as a minimum required rate of return on its net fixed assets on an annual basis.^{10/}

3.50 The pricing policy of its products and services, as also its investment policy, will be geared to profitability considerations. Although the dominant objective for such an enterprise is to attain its internal financial targets, it may be able to charge efficiency prices when such prices are consistent with its financial requirements. When it has to charge more than efficiency prices it may be able to take into consideration economic inequality between its customers. The financial stringency faced by such an enterprise may be much more or much less severe than the financial stringency faced by the government, and accordingly the mark-ups on efficiency prices that such enterprises will charge may be much more or much

^{10/} The project's internal financial rate of return may be analytically preferable, but it cannot be conveniently covenanted. See Solomon (18) for a discussion of some of the different rates of return concepts and their interrelationships.

less than the mark-ups that would be desirable from the point of view of the general government.

(b) "Semi-independent" Public Enterprises

3.51 As revenue earning financial institutions the public enterprises in this category will also have their financial targets and objectives, like the enterprises in the previous category. As such a "semi-independent" public enterprise will also have its own cost recovery rate, as discussed in para. 3.49.

3.52 However, in this case the public enterprises are to be treated as integral parts of the public sector, and their pricing and investment policies must coincide with those that would be appropriate from the broader perspective of the public sector. The pricing policy appropriate to such an enterprise may thus be derived directly from the considerations discussed in the previous subsection (ii) and in Section II.

3.53 In each case it is possible to estimate both (i) net revenue requirements necessary to satisfy the individual public enterprise's own desired financial cost recovery rate, and (ii) the net revenue generation that would result if the pricing policy is determined from the point of view of the public sector, with reference to the fiscal cost recovery rate. It should be noted that the accounts of the enterprises in this category should be regarded as a part of the public sector account in estimating the fiscal impact of the projects concerned. The products and services provided by the

the enterprise are to be regarded as public sector products and services, and the total incremental sales revenue therefrom are to be regarded as accruing to the public sector, although this revenue may be shared between the government and the entity if there is a sales tax.

3.54 In the event that the comparison of the estimates (i) and (ii) in the previous paragraph reveals material differences, the preferable procedure would be to adjust the financial targets of the public enterprise. If this is undesirable in a particular case, then alternative (but essentially equivalent) means may be employed, such as reimbursing the public enterprise for providing services at prices which are not adequate to cover the financial costs of the services. For example, a municipality may reimburse a water supply enterprise for providing water to a neighborhood free of charge through public standpipes, by levying additional taxes on the households in the neighborhood.

3.55 Such problems tend to arise whenever the optimum product prices are too low to permit satisfactory financial performance, i.e., whenever project entities are charged with the mixed responsibility for managing both financially viable and non-viable operations. But optimum product prices may also be higher than those derived by an entity from its financial targets. As a general rule, therefore, it is preferable to compare the fiscal cost recovery considerations with the entity's own cost recovery considerations, and

if these two different perspectives produce material differences to the pricing and investment decisions, these should be reconciled through appropriate re-arrangements of the financial relationship between the entity and the government. Such re-arrangements would have the desired effect of equating the scarcity "premium" on the resources at the disposal of a public enterprise with the scarcity "premium" on the resources at the disposal of the government.

IV. SUMMARY

4.1 This paper has discussed the general principles relevant to the decisions on recovery of the costs of a project from its beneficiaries. From this point of view, the discussion has centered on the two revenue generating instruments specific to a project, viz. the pricing of its products and services, and discriminatory taxation of its beneficiaries. When both these options are available, greater reliance should be placed on taxation than on pricing. The prices of the products and services provided by the public sector should be set at their efficiency levels (discussed in Section II), unless the sacrifice of the net project benefits involved in charging more than such prices is fully compensated by the value in alternative uses of the additional revenue raised. The risk of underestimating the sacrifice of the net project benefits is particularly high when the products and services concerned enter into other production processes.

4.2 More generally, the principal considerations that should determine the optimum pricing and beneficiary taxation decisions are the following:

- (a) The losses of the project's net benefits that are likely to be incurred by departing from the efficiency prices for the products and services of the public sector (when product pricing is relevant).

- (b) The losses of the project's net economic benefits that are likely to result from the imposition of discriminatory benefit taxes (when such taxes are relevant).
- (c) The scarcity of resources available to the public sector when this aspect is relevant, the project's deficit or surplus should be determined by a comprehensive fiscal measure, defined in para 3.11, which includes all incremental revenue inflows to the public sector, whether from new or existing taxes on income and wealth, or from new or existing taxes on the various project inputs and outputs, or from other sources.
- (d) The post-project income and wealth of the individual beneficiaries as compared to those of others in the society, and the relative valuation of their income and wealth.

4.3 If these considerations are applied to determine the optimum pricing and taxation policies, then a corresponding optimum fiscal deficit or surplus will be defined, yielding an optimum fiscal cost recovery ratio. A corresponding optimum partitioned cost recovery ratio may also be defined with only the policy variables, viz. product pricing and discriminatory

taxes in the numerator, as in the ratio R_1 defined in para. 3.38. It should be noted that the generation of additional private savings may also be a relevant additional consideration in some cases.

4.4 There is, however, no a priori reason why the optimum value of such a ratio should be at any particular level. The optimum value can be zero or over 100%. It will be 100% only by chance, and consequently the conventional full cost recovery rule has no intrinsic validity. Furthermore it is usually defined in partial terms. If a value judgment is made that the "beneficiaries should pay total costs" then all incremental payments made by the beneficiaries to the public sector in order to realize their benefits should preferably count, regardless of the particular mode of payment. Meaningful quantitative cost recovery norms can only be derived for specific sectors and types of projects, and then only if the general considerations listed in para 4.2 bear with sufficient uniformity.

4.5 These considerations remain material when revenue earning project entities are considered, as long as the financial resources at the disposal of such entities are not valued differently from the resources at the disposal of the general government. In the event that correct pricing decisions are not consistent with the financial targets of an individual project entity, the

preferred procedure will be to adjust the financial targets, or alternatively the entity should be reimbursed directly in exchange for a commitment to charge lower prices than its financial targets require. Situations in which neither adjustments to the financial targets nor compensating payments are desirable, are situations in which it is considered appropriate to evaluate the financial resources of the entity and of the government differently. In such cases the mark-ups on efficiency prices will be determined entirely by the independent financial objectives of the entity, and the third factor (c) listed in para 4.2 above will need to be changed accordingly.

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Mr. W.J. Armstrong

July 9, 1974

Harold R. Shipman *HS*

Role of Bank Engineers in connection with Engineering Designs and Cost Estimates

You enquire as to our reaction to a proposal for issuing to all engineers a statement along the lines of your attached draft and which outlines the extent to which engineers are responsible for cost estimates and engineering design of Bank Group financed projects. You also request any suggestions for material changes in the text of the attached statement. My comments are as follows:

NOT ATTACHED

1. I believe there is merit in the issuance of a statement along the lines proposed.
2. The attached statement should be revised to a limited extent to reflect more broadly the differences in types of projects with which engineers in the Bank deal. A few of the possible changes might be as follows:
 - (a) In paragraph 6, the second sentence might read as follows, "To the extent needed and justified, the Bank engineer will specify what additional investigations are to be made before project appraisal, and before preparation of final design and tender documents", and
 - (b) In paragraph 11, the suggested wording might be as follows, "The engineer is expected to review the detailed calculations supporting the engineering design to the extent necessary to establish the soundness of the design chosen. The Bank engineer should raise questions and explore the rationale for project design but should not attempt to take over the direct responsibility for design and engineering of the project".
3. It seems to me that paragraph 8 of the statement is covered in our normal procurement procedures and that this paragraph could very well be deleted.
4. Paragraph 9 should either be deleted or reworded along the following lines, "In cases where project appraisal is based upon preliminary design and cost estimates, the engineer will be expected to review the detailed design and specifications prior to the time when bids are invited".
5. An additional paragraph heading might be included entitled, "Facilities for Local Fabrication". On projects where there is a possibility that some of the supplies and equipment may be manufactured locally, the engineer is expected to investigate both the capacity of the local fabrication facilities and the means by which quality control standards are to be ensured in the event that the local facility is selected in the

bidding process. Costs which may accrue to the borrower as the result of third party inspection should be estimated and included within the project costs. This would usually show in appraisal reports under the "Engineering Services" item.

6. It is believed that paragraph 13 relating to the review of tender documents might be modified somewhat along the following lines, "In regions where procurement engineers are responsible for the review of tender documents, the project engineer will be expected to carry responsibility in alerting the procurement engineer to any documents which will be critical to the project, and the project engineer should review these documents to the extent necessary to ensure this objective.

HRShipman:cfa

Log 695
July 8/74

OFFICE MEMORANDUM

TO: See Distribution Below

DATE: July 8, 1974

FROM: W. J. Armstrong *[Signature]*

SUBJECT: Role of Bank Engineers in Connection with Engineering Designs and Cost Estimates

Consideration is being given to issuing to all engineers a statement, along the lines of the attached, of the extent to which engineers are responsible for cost estimates and engineering designs of Bank Group financed projects.

I would appreciate:

- (1) Your reactions to this proposal; and
- (2) Any suggestions you may have for material changes in the text of the attached statement.

Please let me have your comments by c.o.b. August 2, 1974.

Attachment

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cc: Mr. van der Tak
Mr. Lithgow
Mr. Finne

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

INTERNATIONAL DEVELOPMENT ASSOCIATION

OFFICE MEMORANDUM

TO: Professional Staff
Transportation Projects Department

DATE: July 8, 1971

FROM: A. D. Knox

SUBJECT: Role of Bank Engineers in Connection with Engineering Designs
and Cost Estimates

Introduction

1. From time to time the question arises as to the extent to which the engineers in this Department can and should be responsible for the engineering design and cost estimates of Bank Group financed projects. This memorandum states what is expected of them in this respect. It does not deal with other responsibilities of engineers.
2. Project appraisal reports include a statement such as "the engineering of the project is sound, and the cost estimates are reasonable." The responsibility for this judgment rests on the Bank engineer directly involved in the project. This is all the more so since, in general, appraisal reports contain less material to permit others to judge the engineering than the economic or financial aspects.
3. This, however, does raise a very difficult question of how far the Bank's engineer should go in reviewing designs and cost estimates. Clearly he cannot be expected to redo the work of the borrower's engineers and consultants who have done the detailed work. The magnitude of the work would be beyond one man since not every Bank engineer will have the same knowledge in depth in all engineering subjects. For example, civil engineering includes soil mechanics and foundation techniques, structures in steel or concrete, hydraulics, etc., and special expertise in each of these fields is usually available to the borrower's staff and consultants. Nevertheless the Bank engineer has the duty of putting questions and spot-checking to a sufficient degree to enable him to judge whether the designs and cost estimates are sound. If his inquiries lead to doubts on any significant aspect he should request that additional work be done. If he concludes that there are important areas on which his training and experience make him hesitant to pass judgment he should seek the advice of colleagues specialized in these areas and, if necessary, recommend that the Bank retain consultants to advise it. This general principle should be kept in mind in the more detailed discussion of particular points which follows.

July 8, 1971

Competence of Engineers Responsible for Preparation of the Project

4. Even if the reputation of the borrower's technical staff and consultants is known to be good, it should not be taken for granted that the individuals responsible for the preparation of design and cost estimates of the particular project under review are as competent as those who established the good reputation. During project preparation and appraisal the Bank engineer has an opportunity to form a judgment on the competence, experience and sense of responsibility of those handling the project. Assessment of these qualifications, and reporting on these, is one of the most important tasks of the Bank engineer.

Review of Design

5. At the time of project preparation or appraisal, the Bank engineer should discuss with a borrower's technical staff and consultants: the master plan, if any, of which the project forms part; the basic layout and concept of design of the facility and its components; the choice and application of geometrical and engineering design standards (particularly for roads); the design chosen for the various structures and the broad specifications therefor; construction methods; etc.

6. During this procedure he will inquire what investigations have been made, and the degree of detail thereof, upon which the design is based, such as topographic maps and surveys, location and site drawings, soil investigations including borings and laboratory tests, location of sources of materials, hydrological and hydraulic surveys and laboratory studies; etc. To the extent needed and justified, the Bank engineer will specify what additional investigations are to be made before tender documents of a project, or a part of it, are completed and what additional investigations may be made at a later date or during execution of the contract.

7. He will also inquire what alternative design studies have been made, and in what depth and detail. He should satisfy himself that no worthwhile alternatives have been overlooked and that the alternative chosen in his judgment is the optimum from a technical and economic point of view. In cases where difference in estimated cost of alternatives is small, and can be accurately determined only on the basis of actual bids, he will discuss the desirability of asking, or allowing, contractors to submit bids for alternative designs.

8. In cases where detailed designs and cost estimates of the project or its components are completed at the time of appraisal, the engineer will impress upon the prospective borrower and its technical staff and consultants that any substantial changes proposed subsequently in layout, design and specifications, and resulting changes in cost estimates should be brought to the attention of the Bank and that specific approval should be obtained for them.

July 8, 1971

9. In cases where detailed designs and cost estimates of the project or its components are not completed at the time of appraisal, the engineer should make adequate arrangements which will allow him to review the detailed design, specifications and cost estimates at a later date, before bids are called for such projects or their components.

10. Where all or part of the engineering is done by consultants in their own offices, outside the country of the borrower, the engineer should, as a rule, do part of his appraisal in the consultant's office.

11. The engineer is normally not expected to review the detailed calculations supporting the engineering designs, unless he has reason to doubt the soundness of the designs chosen. In such a case he should carry out spot-checks to enable him to identify possible errors or weaknesses in the calculations or reasoning and ask for further studies or explanations. The Bank engineer should not, however, attempt to take over the direct responsibility for design and engineering of Bank Group projects.

Review of Cost Estimates

12. With respect to cost estimates, the engineer should inquire how these are arrived at, and upon what assumptions they are based. Where estimates are based upon unit prices, supported by recent contracts for similar work, he should satisfy himself that the type of work and conditions (e.g., with respect to availability of labor, climate, political stability within the country, etc.) are indeed comparable. Where he has reason for doubt or where complex works are involved, he should discuss the desirability or need for applying detailed contractor's estimation procedures, as opposed to unit price cost estimating. He should satisfy himself that the estimating procedure followed is sound, and the resulting cost estimates appear to be reasonable.

Review of Tender Documents

13. Part of the task of the engineer is the review of tender documents. During such review he will satisfy himself that design and specifications as shown in these documents are in accordance with those discussed and agreed upon at the time of loan negotiations, taking account of possible changes agreed upon subsequently. To this end he will normally review only those drawings showing layout and major dimensions. He is not expected to review for approval every drawing attached to the tender documents, but should make some spot checks.

HJvanHelden/ADKnox:pg/mkc

cc: Messrs. Chadenet
Baum
Lithgow

OFFICE MEMORANDUM

TO: Distribution List

FROM: H. G. van der Tak *HT*SUBJECT: Economic Analysis of Projects

DATE: July 3, 1973

Mr. Knapp
OP-60P - Approval
+ Preparation of
Projects

In January of this year we circulated a draft paper on Economic Analysis of Projects, followed in April by a draft Annex on Derivation of Shadow Prices. Since then these papers have been widely discussed, formally and informally, and Mr. Squire and I are grateful for the many comments that we have received. I now attach a revised version of these papers which, we hope, clarifies some general issues and corrects some errors and inconsistencies in the earlier treatment.

The revised structure of the papers is intended to make them useful and accessible to a wider range of readers. The main paper provides a general non-quantitative account of economic analysis of projects. The Annex discusses the basic quantitative relationships underlying the derivation of a consistent set of shadow prices which reflect income distribution objectives. Further technical details on this derivation are given in Appendix I. A second Appendix discusses problems of estimation and value judgments, and illustrates the approach to estimation with an actual numerical example. We hope this Appendix provides useful guidance for the further case studies that are now being undertaken in the Regions in order to test the feasibility of deriving shadow prices along the lines set forth in the Annex.

I should be grateful for further comments and suggestions from you or your staff. Please address them, at your convenience, to Mr. Pellegrini, Room D-735, Extension 4600.

Attachments

HGvanderTak:lfb

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cc: Messrs. Baum and Chenery
Messrs. Pellegrini and Squire

ECONOMIC ANALYSIS OF PROJECTS

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ECONOMIC ANALYSIS OF PROJECTS

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Economic Analysis of Projects

Introduction

1. This memorandum is concerned with the basic approach followed by the Bank for assessing the economic merit of a project. It discusses how to measure the likely costs and benefits of a project to the country where it is undertaken. The perspective is economic, not financial or technical. The memorandum presents the general rationale for Bank appraisal methods as they have evolved over time, reflecting rapid advances in analytical techniques during the last decade. While it provides guidelines for some particular problems, it is not an exhaustive treatment of the subject. In particular, it does not deal with sector-specific issues.
2. Part I of the memorandum discusses in broad terms the basic ideas behind cost-benefit analysis and introduces some of the concepts which will be developed in later sections. Part II identifies the types of costs and benefits of projects which are relevant to their economic appraisal, whilst Part III discusses in general qualitative terms how such costs and benefits should be valued and in what circumstances shadow prices will be appropriate. Specific quantitative guidelines for the derivation of shadow prices are given in an Annex, with two Appendices. Appendix I provides further technical details. Appendix II discusses how the underlying parameters may be estimated and illustrates the approach with a case study. Part IV shows how costs and benefits may be compared so that a meaningful decision can be made about the value of the project to the country. Finally, Part V examines how to take account of the considerable risk elements and uncertainties that are commonly involved in undertaking a project.

Part I - General Context of Project Analysis

3. All countries, but particularly the developing countries, are faced with the basic economic problem of allocating limited resources, such as labor at all levels of skill, management and administrative capacity, capital, land and other natural resources, and foreign exchange, to many different uses, such as consumer goods, public services or investment in infrastructure, industry, agriculture or education. These different uses of resources, however, are not the final aim of the allocative process: rather they are the means by which an economy can marshall its resources in the pursuit of more fundamental objectives such as the removal of poverty, the promotion of growth and the reduction of income inequalities. Using limited resources in one direction (e.g. industry) reduces the resources available for use in another direction (agriculture). Pursuit of one objective, say, better income distribution, may involve a sacrifice in terms of other objectives, say, rapid growth. Thus there are clearly trade offs: the country can have more of somethings, and less of others, but not more of everything. A choice has therefore to be made among competing uses of resources, in terms of the extent to which they help the country achieve its fundamental objectives. If the country consistently chooses allocations of resources which achieve most in terms of these objectives, it ensures that its limited resources are put to their best possible use.

4. Project analysis is a method of presenting this choice between competing uses of resources in a convenient and comprehensible fashion. In essence, project analysis assesses the benefits and costs of a project and reduces them to a common denominator. If benefits exceed costs (both expressed in terms of the common denominator) the project is acceptable: if not, the project should be rejected. As such, project analysis may appear divorced from both the fundamental objectives of the economy and the possible alternative

uses of resources in other projects. The definition of benefits and costs, however, is such that these factors play an integral part in the acceptance/rejection decision. Benefits are defined in terms of their effect on the fundamental objectives: costs are defined in terms of their opportunity cost which is the benefit foregone by not using these resources in the best of the available alternative investments. The foregone benefits are in turn defined in terms of their effect on the fundamental objectives. By defining costs and benefits in this fashion we try to ensure that acceptance of a project implies that there is no alternative use for the resources "consumed" by this project which would secure a better result in terms of the country's objectives.

5. Economic analysis of projects is similar in form to financial analysis in that they both assess the "profit" of an investment. The concept of financial profit, however, is not the same as the social profit of economic analysis. Financial analysis identifies the money profit from a project accruing to the project-operating entity, whereas social profit measures the effect of the project on the fundamental objectives of the whole economy. These different concepts of profit are reflected in the different items considered to be costs and benefits and in their valuation.^{1/} Thus, a money payment made by the project-operating entity for, say, wages is by definition a financial cost. But it will only be an economic cost to the extent that the use of labor in this project implies some sacrifice with respect to the country's objectives. Conversely, an economic cost of the project may not cause a money

^{1/} It should be noted that "financial analysis" as used here is only one of several concepts of financial analysis, all of which have their specific purposes. See OM ____, Financial Analysis of Projects.

outflow from the project entity in which case it is not a financial cost. The two types of cost need not coincide. Similar comments apply to economic and financial benefits. Economic costs and benefits are measured by "shadow prices" which may well differ from the market prices in which financial costs and benefits are assessed.

6. Shadow prices are determined by the interaction of the fundamental policy objectives and the basic resource-availabilities. If a particular resource is very scarce (i.e. there are many alternative uses competing for that resource), then its opportunity cost (i.e. the foregone benefit in the best available alternative) will tend to be high. If the supply of this resource were greater, however, the demand arising from the next best uses could be satisfied in decreasing order of importance and its opportunity cost (or shadow price) would fall. Frequently, market prices will correctly reflect this scarcity but there is good reason to believe that in less developed countries markets are so imperfect that there is a considerable divergence between market and shadow prices. Three important resources (labor, capital and foreign exchange) are generally considered to fall in this category and Part III will be largely concerned with the appropriate shadow-pricing of these resources.

7. Resource availabilities, however, need not be the only constraints operating in the economy. Political and social constraints may be equally binding. These non-economic constraints can limit the alternatives open to the government in pursuing its development objectives to a narrower range than that implied by the basic resource availabilities. If the tools of general economic policy (i.e. fiscal and monetary policy) cannot successfully break

these constraints, project analysis should take account of them by means of appropriate adjustments in shadow prices. For example, if the government is unable to secure a desired redistribution of income through taxation, then the allocation of investment resources can be used as an alternative method of redistributing income. By attaching higher values to increases in income accruing to the poorer sections of society in project appraisal, investment will be biased in their favor. This merely reflects the fact that all available policy tools should jointly be working towards the same goals. If one particular instrument is inoperative or blunted, other instruments may be used to achieve the same end.

8. Project analysis permits decentralized decision-making on the appropriate choices between competing uses of resources, costs and benefits being defined and valued, in principle, so as to measure their impact on the development objectives of the country. In many cases, however, a more direct link is necessary with the sector and economy as a whole: in case of economies of scale, ^{for example,} the merits of a project cannot be judged without making an estimate of the demand for its output, and this in turn requires placing the project in its sector and country context.

9. Furthermore, in practice, many shadow prices, for land, natural resources, site values, are hard to determine independently of the project appraisal process. In other words, the appropriate choice of resources can only be determined by considering alternatives. This is the basic reason why a systematic scrutiny of plausible alternatives is at the heart of the appraisal process: it is not sufficient in practice to select "acceptable" projects whose benefits appear to exceed costs; it is necessary to search for alternatives with a larger surplus of benefits over identified costs.

If such projects are found, it means that the opportunity cost of using, say, land in the project / ^{originally considered acceptable} is underestimated, or wholly neglected.

10. Consideration of alternatives is the single most important feature of proper project analysis throughout the project cycle, from the sector development plan through identification and preparation to appraisal. Many of the more important choices are made at early stages when decisions are taken concerning the alternatives which are to be rejected or retained for further more detailed study. For economic analysis to make a maximum contribution to trying to ensure that scarce resources are used to best advantage to the country, it should start at the earliest phases of this process of successive sifting and narrowing down of options that are open to the country. Use of shadow prices reflecting basic policy objectives and resource constraints tends to be mainly "cosmetics" if only resorted to in the final stage of appraisal when most of the essential choices with respect to types of project and project design have already been made. To be an effective aid in decision-making, shadow prices should also be used in framing sector strategies, in identifying promising project possibilities, and in designing their major features.

Part II - Identifying Relevant Costs and Benefits

11. The implementation of a project will reduce the supply of inputs ("consumed" by the project) and increase the supply of outputs (produced by the project). Without the project, the supply of these inputs and outputs to the rest of the economy would have been different. Examining this difference between the availabilities of inputs and outputs with and without the project is the basic method of identifying its costs and benefits. In many cases the "without" situation is not simply a continuation of the status quo ante, but rather the situation that is expected to exist if the project

is not undertaken, some increases in output, and costs, are often expected to occur anyway. Furthermore, some projects (e.g. modernization projects and land-conservation projects) have as their primary aim the prevention of future cost increases or benefit decreases. The without situation must then include these cost increases or benefit decreases in order to fully reflect the improvement engendered by the project. An accurate description of the situation "with," as also that "without," the project may involve difficult judgments.

12. Frequently, the projected financial statement of the project entity will be a good starting place for identifying economic costs and benefits. In general, two types of adjustment must be made to the financial calculation in order that it should reflect economic concepts: firstly, it may be necessary to include (exclude) some costs and benefits which have been excluded from (included in) the financial analysis; and secondly, some inputs and outputs may have to be revalued if their shadow and market prices differ. Only the former adjustment is considered here, the latter being the subject matter of Part III.

Transfer Payments

13. Some payments which appear in the cost streams of the financial analysis do not represent direct claims on the country's resources but merely reflect a transfer of the control over resource allocation from one member or section of society to another. For example, the payment of interest by the project entity on a/^{domestic} loan merely transfers purchasing power from the project entity to the lender. The purchasing power of the interest payment does reflect control over resources but its transfer does not use up real resources and is, to that extent, not an economic cost. Similarly, the loan itself and its

repayment are financial transfers. However, the investment or other expenditure which the loan finances, involves real economic costs. The financial cost of the loan occurs when the loan is repaid; but the economic cost occurs when the loan is spent. The economic analysis does not, in general, need to concern itself with the financing of the investment, i.e. the sources of funds and how they are repaid.^{1/} Again, depreciation allowances may not correspond to actual use of resources, and should therefore be excluded from the cost stream. The economic cost of using an asset is fully reflected in the initial investment cost less its discounted terminal value. Finally, taxes are also transfer payments and as such do not constitute a resource cost.

14. However, although transfer payments such as taxes and interest etc. are not a resource cost, this does not mean that they should be excluded from the economic analysis of the project. These transfers affect the distribution of income and savings. As will be discussed further in Part III, in general, this should be taken into account in determining the costs and benefits of a project, and be reflected in the shadow prices of factor inputs and incomes.

Contingencies

15. Contingency allowances are determined by engineering and financial considerations which are beyond the scope of this memorandum, but it is important to examine the treatment of contingency allowances in the economic

^{1/} These points also apply to foreign loans, unless the loan is "tied" to the project in which case its economic cost is the stream of associated repayments. Bank loans are not considered tied. Note, however, that a country should not borrow beyond the point where the real cost of the debt service exceeds the return on the marginal project.

appraisal. To the extent that the physical contingency allowance is a part of the expected value^{1/} of the project's costs, it should be included in the economic analysis. Any allowance beyond this should be excluded from the basic data but should be examined in the sensitivity or risk analysis. The project evaluator will require the assistance of the engineer in determining the nature of physical contingency allowances. With regard to the price contingency, to the extent that it covers expected increases in relative prices of project items, it should be included in the economic analysis. Any price contingency for domestic and foreign inflation of the general price level should be excluded, provided that differential rates of inflation in supplier countries are offset by currency realignments. If not, the part of the price contingency covering "excess" inflation beyond that in the numéraire currency, should be included.

Sunk Costs

16. Sunk costs are defined as all those costs incurred on the project prior to appraisal and which therefore can no longer be avoided even if they were considered utterly wasteful. They should be excluded from the cost of the project for the purpose of reaching a decision as to whether to proceed further with the project; only costs which can still be avoided matter in this regard; bygones are bygones. For example, the economics of a project designed to complete a project started earlier and left unfinished, does not

^{1/} The concept of "expected value" is discussed further in paras. 63 - 64 which deal with risk.

depend on the costs already incurred but only on the costs of completion. (Similarly, the benefits from the new project are only those arising over and above those that may flow from the old, uncompleted works.) This treatment of sunk costs may result in a high return on the investment in completing the project, but this is then as it should be. In addition to this calculation of the return on the incremental investment, it is usually of interest to show the return on the total project, including sunk costs, to throw light on the question whether, in hindsight, the original decision to proceed with the project was well-founded.

Externalities and Linkages

17. There are some effects of the project which do not impose a cost or confer a benefit within the confines of the project itself. If these effects (known as externalities) affect the achievement of the country's objectives (either positively or negatively) they should be included in the economic analysis. Unfortunately, externalities are sometimes difficult to identify and nearly always difficult to measure. On the benefit side, demonstration and training effects are often cited as externalities, but these are not amenable to quantification at present. Various forms of pollution and congestion, use of water affecting yields of wells elsewhere, side effects from irrigation schemes on health, or fisheries, are some of the standard examples of external costs and, if they are significant and measurable, should be counted as economic costs. Whether or not externalities can be quantified, they should at least be discussed in qualitative terms.

18. Price effects caused by the project are also often included in the definition of externalities. The project may lead to higher prices for the inputs which it requires and lower prices for the outputs which it produces. The project may also result in lower demand and prices for competing

products or services, or higher demand and prices for complementary ones. So-called forward linkage effects may thus occur in industries which use or process a project's output, and backward linkages in industries which supply its inputs, in that such industries are encouraged or stimulated by increased demand and higher prices for their output or lower prices for their inputs. Conversely, other producers may lose because they now face increased competition, and other users of inputs used by the project may have to pay higher prices. The project may have wide-ranging repercussions on demands of inputs and outputs and cause gains and losses for producers and consumers other than those involved in the project itself.

19. Such external costs and benefits may or may not have to be added to the more direct costs and benefits of the project. The direct social profit is a comprehensive measure of all social gains and losses of the project provided that two conditions are met.^{1/} First, the government should be indifferent as to who gains and who loses as a result of the project. If it attaches different weights to gains and losses depending on the person or region affected, the direct social profit on the output from the project is not a full measure of all its positive and negative effects on the country's social/economic objectives. There is then no remedy but to trace as best one can the repercussions on the rest of the economy. Whether this is a serious qualification, in practice, depends on the extent to which the project results in price changes. If induced price changes are minor, or income distribution weights of affected groups are approximately the same, it may be a reasonable approximation to exclude such external price effects from the economic analysis of the project.

^{1/} The terms "social gains and losses" and "economic benefits and costs" are used synonymously. But see paras. 26 and 27 for more rigorous definitions in terms of "shadow" and "efficiency" prices.

20. Second, and perhaps more serious, the direct costs and benefits of the project, in terms of its own output, do not provide a complete measure of its social profit in cases where other producers whose output is affected by the project, do not sell in perfect markets where price equals social marginal costs. In such cases - which are of course normal - there will be gains and losses not measured by the social profit on direct output from the project. For example, if an improved road diverts traffic from a railway which charges rates below marginal cost, this diversion entails a social gain on reduced rail traffic (because the previous social loss on this traffic is no longer incurred) in addition to the social profit on road traffic as usually measured (in terms of changes in the area between its demand and supply curve). In practice, it is not feasible to trace all externalities arising from such market imperfections: the analyst can only hope to capture the grosser distortions on more immediately affected changes in output.

21. Externalities of various kinds are thus clearly troublesome, and there is no altogether satisfactory way to deal with them. However, this is no reason simply to ignore them: an attempt should always be made to identify them, and if they appear significant, to measure them. In some cases it is helpful to "internalize" externalities by considering a "package" of closely related activities as one project. This procedure is also convenient in cases where strictly speaking externalities play no role, but where it is difficult, if not impossible, to estimate demand and the social value of the output from the project without closely linking it to related activities. A standard example is the analysis of irrigation projects which measures benefits in terms of agricultural output rather than water.

Multiplier Effects

22. In an economy suffering from general excess capacity, project investment may cause a further increase in income as the additional rounds of spending following the investment reduce the excess capacity. General excess capacity however is not the situation in which LDC's typically find themselves. If it were otherwise, development would be a far easier task and could be furthered simply by spending more. This does not deny the existence of secondary expenditure effects. As will be discussed in Part III these effects may be important when measuring the social cost of consumption expenditure induced by the project. Different patterns of second round expenditure out of incomes generated by the project may impose different social costs. As a variant of this, differences in regional impact may need to be taken into account even if income distribution considerations are ignored.

International Effects

23. Some external effects of the project may extend beyond the borders of the country concerned. For example, a project's output may increase exports or substitute for imports, and thus tend to reduce world prices, thereby benefitting other importing countries but harming other exporting countries. Or the increase in demand, and possibly prices, for inputs into the project may affect other countries, favorably or adversely. Or the project may influence the environment of a neighboring country, for example, if it diverts water upstream, or pollutes it, in rivers flowing through more than one country. All such external effects on other countries are similar in nature to the externalities discussed above (paras. 17 - 21), and raise similar problems: The crucial issue in this case is whether one should take

account of benefits accruing to or costs imposed on other countries - which may be developed countries or other developing countries, may be poorer or better off than the country concerned and may be politically close or otherwise. This clearly depends on value judgments. The Bank's policy is to take account of physical externalities, as in international rivers, and expect agreement between the countries concerned on the sharing of water and appropriate compensation for any untoward effects (see OM). Thus far, however, it has not taken into account external price effects of the projects it finances on other countries,^{1/} and normally evaluates investment projects from the point of view of the country where the project is to be undertaken. This means that costs borne by foreign countries, or foreign participants in the project, and benefits accruing to them, are excluded from the economic analysis of the project. Some implications of this are discussed further in Part III below.

Double Counting

24. While all relevant costs and benefits should be included when evaluating a project, it is necessary to ensure that benefits and costs are not recorded twice. Double counting may arise on two scores. First, as noted above, external benefits and costs may be included (erroneously) even though they are already fully accounted for in the social profit measure of the project. For example, increases in agricultural output may mistakenly be claimed as additional benefits of, say, a road project when such benefits are already reflected in the usual measure of the social surplus gained on the transport services to be provided. Second, benefits may be claimed for

^{1/} But the Bank has recently accepted a recommendation that appraisals of primary commodity projects should take account of their effect on export prices of other developing countries; problems of implementation are still being considered.

employment, or foreign exchange earnings, in addition to the estimated social profit of the project. Provided that labor inputs into the project, and its foreign exchange costs and savings, have been evaluated in terms of shadow prices which are a comprehensive measure of their value to the economy, any such employment or foreign exchange effects are already taken into account, and should not be added as separate benefits. The contributions of increased employment and foreign exchange earnings to the social/economic objectives of the government have then been given their full and proper weight in deriving the measure of the social surplus of the project. This does not mean that employment and foreign exchange effects should not be discussed in the report; but it does mean that any discussion must be **consistent** with the assumptions underlying the economic evaluation of the project.

Part III - Valuation and Shadow Prices

25. Every project uses up resources (inputs) and produces outputs. Part II above discussed which inputs (costs) and which outputs (benefits) are to be included in the economic analysis of the project. This Part considers what are the values of the costs and benefits thus identified to the economy. These values depend on the value judgments of the government, as well as on technical and behavioural parameters, and on resource and policy constraints. Value judgments of the government determine the weight to be given to future consumption relative to present consumption, i.e. to growth (depending on savings and investments) versus consumption; to benefits for different classes of income recipients (or regions); to future employment relative to present employment; and to other possible objectives such as national independence, or modernization. Policy constraints of an institutional/administrative or political nature may limit the choice of path that the economy

can follow in pursuing its development objectives to a narrower range than that imposed by the technical and behavioural parameters and resource availabilities in the economy.

26. Shadow prices are defined in the generally accepted theory of resource allocation as the values of inputs and outputs associated with the optimal development program, given the weights attached to the basic social/economic objectives (objective function) and given all the various constraints which limit the extent to which these objectives can be achieved. The costs and benefits of the project to the economy should thus be valued in terms of shadow prices reflecting, as best one can, these objectives and constraints. Any changes in objectives or constraints affect the optimal development program that is feasible, and hence the shadow prices and the costs and benefits of any given project.

27. Three points should be noted about this definition of shadow prices. Firstly, these prices relate to an economic environment in which distortions are likely to persist: they are not the equilibrium prices which would prevail in a distortion-free economy. However, this should not be interpreted as a passive acceptance of the existing distortions; in fact, the estimation of (second-best) shadow prices supplies important information which can be used as a basis for designing policies to remove the distortions. Secondly, the Bank should try to arrive at some common understanding with the government concerning the social/economic goals pursued in the country's development policy. If views differ, for example, with respect to the desirable distribution of the gains from development, the Bank could treat the government's views as an additional constraint which has to be satisfied in the selection of projects:

there is likely to be a sizable sub-set of projects which are compatible with both the government's and the Bank's value judgment. In extreme cases of discord, the Bank might prefer to cease operations in the country.

1. The Shadow Rate of Interest

28. In the absence of policy constraints arising from political feasibility, administrative costs and repercussions on incentives, the government could ensure through its fiscal policy that, at the margin, additional savings (and future consumption) are in its view as valuable as additional present consumption.^{1/} In that case project analysis does not need to concern itself with the impact of a project on consumption or savings, but could concentrate on the impact on income, irrespective of its use for consumption or savings, since both are worth the same. The opportunity cost of capital, which measures the rate at which additional savings (investment) in the current period are transformed into output in the next period, does then equal the "consumption rate of interest" which measures the discount attached to having additional consumption in the next period rather than now. There is in that case no need to distinguish between savings and consumption when assessing costs and benefits.

29. However, in some cases the government might prefer more rapid growth, and higher savings and investments, at the expense of current consumption, but it judges the administrative and political obstacles to the necessary fiscal measures to bring this about insurmountable. Savings are then at a premium (or equivalently, consumption at a discount), and the

^{1/} The inclusion of the interpersonal aspect of the distribution of consumption requires that consumption (and the consumption rate of interest) be defined in terms of an homogeneous unit of account (e.g. the marginal utility of consumption at a particular level of consumption) because the value of an additional unit of consumption now depends on the individual's existing level of consumption. Provided the definitional changes are made consistently, the arguments presented above concerning consumption's intertemporal distribution are largely unaffected. See Annex.

opportunity cost of capital exceeds the consumption rate of interest. The correct choice of discount rate then depends on the chosen numéraire (the common yardstick used for expressing savings and consumption), because the discount rate is defined as the rate at which the value of the numéraire falls over time. For example, if consumption is chosen as numéraire, then savings should be valued at their higher consumption equivalent, and benefits and costs in different time periods should be discounted by the "consumption rate of interest." The choice of numéraire, however, does not affect project analysis because the selection of projects depends only on relative prices, whereas the numéraire only determines the absolute price level. It is recommended that the Bank use as numéraire public income (revenue) expressed in terms of foreign exchange. This is considered convenient because most Bank loans are to the public sector and involve large amounts of foreign exchange. Accordingly, the Bank discount rate, described as the "accounting rate of interest," should be defined as the rate of fall over time of the value of public income expressed in foreign exchange. This discount rate will equal both the consumption rate of interest and the opportunity cost of capital if the level of investment is considered optimal.^{1/}

30. In current Bank practice, the discount rate is interpreted as the opportunity cost of capital, i.e. the marginal productivity of additional investment in the best alternative uses. It should be realized that this treatment implies a judgment that there is no significant imbalance between the value attached to current consumption and future growth (current savings).

^{1/} For this statement to hold when one includes the interpersonal distribution of consumption, that, too, must be considered optimal. See Annex.

Appraisal reports, in fact, seldom differentiate between consumption and savings in assessing the costs and benefits of a project, and implicitly treat both as of equal value. This approach may not always be appropriate, as noted above. In cases where growth rates are considered too low, because of insufficient savings rather than inefficient use of resources, and greater fiscal efforts are ruled out by overriding constraints, project appraisals should take account of the greater value which then attaches to savings than to consumption. Project appraisal reports should make clear in such cases that in estimating the discount rate (in terms of public income) due allowance has been made for the higher value of savings relative to consumption. Guidelines for estimating the accounting rate of interest are given in the Annex.

2. The Shadow Wage Rate

31. Similar considerations apply to the concept of the shadow wage rate. The appropriate values, and the interpretation of what the shadow wage rate represents, will differ depending on the value judgments and policy constraints that are considered applicable. The value judgments should be consistent with those underlying the estimates of other shadow prices. If, for example, savings and growth are considered at a premium, this would be reflected in both the shadow rate of interest, as argued above, and the shadow wage rate. Shadow prices are interdependent: changes in assumptions determining one, also affect others.

32. In the simplest case, the shadow wage rate does not aim at measuring anything more than the opportunity cost of labor, i.e. the marginal output of labor foregone elsewhere because of its use in the project. In case of severe unemployment which is expected to persist even

when the development program is implemented, the shadow wage would then be zero, and not whatever market wage is actually being paid. However, such factors as seasonal fluctuations in demand for labor and varying degrees of labor mobility should caution against any hasty conclusion, even in that case, that the opportunity cost of labor and the shadow wage rate are zero. Furthermore, the creation of one additional urban-sector job may induce several rural-sector workers to migrate to the town so that the foregone output is then some multiple of one worker's marginal product. It is also likely that there is not one shadow wage rate in a country but rather a whole set of rates, for different skills and different times and locations.

33. The shadow wage rates thus measured may not be the total cost to society of using labor on the project. Labor incomes will tend to be higher than they otherwise would be, because of market wages being paid instead of subsistence, or because of more productive self-employment. This is likely to give rise to higher consumption at the expense of savings. If, consumption is considered, at the margin, less valuable than savings, this should be reflected in the shadow wage rate. An increase in consumption out of labor income is, in that case, to some extent a cost that should be added to the shadow wage. The effect of this upward adjustment in the shadow wage rate will be to sacrifice some current employment and output in order to obtain faster growth, in line with the relevant value judgment.^{1/}

34. There are other complications. If the project provides additional employment to the unemployed or to subsistence farmers, it is likely to give

^{1/} Similar arguments could be made in favor of differentiating further between categories of "investment" and categories of "consumption" and attaching different weights to them depending on whether they are considered valuable (e.g. government expenditure on health?) or not (monuments?).

higher incomes to some of the poorest groups in society. If poverty redressal is considered important - and, of course, this is based again on a value judgment that the income distribution is not what it is desired to be, and a policy judgment that it cannot be corrected effectively through fiscal means - this should be reflected by adjusting the shadow wage rate downward. Thus the growth objective, may require an upward adjustment, as argued in the previous paragraph, while the income distribution objective may require a downward adjustment in whatever level of the shadow wage rate would otherwise have been appropriate. This is not a contradiction, but a straightforward reflection of the trade-off between current output (and employment), growth and income distribution objectives.

35. Even in cases where growth (savings) and income distribution considerations play no role, a shadow wage rate based on the marginal productivity of labor in alternative uses may be considered overly simply. People may prefer being unemployed to arduous work at low pay. This depends on their income situation while unemployed, the value of "leisure" and leisure time activities such as fishing or fixing the roof, and the unpleasantness of the job. There is some "reservation" wage below which they would prefer being unemployed rather than take the job. Should the government simply ignore this preference in its economic planning and decision making? If not, the shadow wage rate may need to be higher than indicated by a more narrow interpretation of opportunity cost of labor. Consequently, there will tend to be more (voluntary) unemployment than if society did not attach any value to leisure and to the possible disutility of at least certain kinds of work.

36. Current Bank practice in shadow pricing labor focuses on the output of labor foregone in alternative uses. This approach implies a judgment that there is no significant reason for attaching a greater value, at the margin, to savings (growth) than to consumption; that the value attached to income distribution (or possibly to expanding employment per se) does not require a reduction in the shadow wage rate below the marginal productivity of labor; and that preference for work and leisure can reasonably be ignored. (It might also reflect a judgment that any adjustments on these scores roughly cancel out.) In such cases the Bank considers it good practice to make these judgments explicit. In many cases, however, it may be more appropriate to allow for these other factors in the determination of the shadow wage rate, and adjustments should be made, upward or downward, as discussed earlier, in the rate established in terms solely of the marginal output of labor in alternative uses.^{1/} The basis for the adjustments and the judgments underlying them should always be indicated in the economic analysis of projects. Guidelines for estimating the shadow wage rates on various assumptions as to the value of key parameters are given in the Annex.

3. Foreign and Domestic Values/Traded and Non-traded Goods

37. Some inputs of the project are directly imported or, though bought locally, lead to additional imports since any domestic production of this input has reached capacity constraints. The cost of such goods to the economy is the c.i.f. import price prevailing at the time the input is required. Similarly, the value to the economy of any output from the project which substitutes for imports is measured by the c.i.f. import price. Conversely, output that is directly exported or, though physically sold in the home market,

^{1/} The accounting rate of interest should then be adjusted to reflect the same judgments.

leads to additional exports because domestic demand is fully met from existing supplies, has a value to the economy measured by the f.o.b. export price. And similarly again for any input used in the project that would otherwise have been exported. In all such cases the c.i.f. or f.o.b. (border) prices should, of course, be adjusted for internal transport or other costs in order to arrive at the value of the commodities ex-factory or farm gate. This account assumes that the supply of imports or demand for exports is perfectly elastic, so that the project does not affect the import or export prices. The border prices should then not be adjusted for any import duties or export taxes that may be levied: the import supply and export demand prices measure the value to the economy. However, if import prices rise or export prices fall on account of the project, the value to the economy of additional imports or exports is approximated by the marginal foreign trade revenue paid or earned (see Annex).

38. Any output or input of which the value to the economy cannot be measured this way in terms of f.o.b. or c.i.f. border prices should, as a first approximation, be assessed in terms of its price in the home market. This applies to obviously "non-traded" commodities such as electricity or transport, as well as to all commodities, usually those with high transport costs, of which the domestic supply price, at the given level of local demand, is below the c.i.f. price of imports, but above the f.o.b. price of exports. It also applies in cases where government policy isolates commodities from foreign markets through import (export) prohibitions or quotas. This price in the home market depends on local supply/demand conditions, including market imperfections: monopolistic pricing affects, say, power rates; so does an

import quota on fuel imports; and, more indirectly, general trade policies affect it through their impact on factor prices such as wages.

39. As a result of market imperfections, or indirect taxes, the marginal value (demand price) of non-traded inputs or outputs may differ from their marginal cost (supply price). The shadow prices of such goods may be the demand price, the supply price or somewhere in between depending on whether project inputs or outputs affect the supply to other users, the supply from other producers, or both. If an input used in the project reduces the supply to other users, its shadow price should be based on the demand price; if the input is supplied from new production, its shadow price should be based on the supply price. If the input is supplied from both sources, affecting other uses as well as calling forth new output, the shadow price is a weighted average of the demand price and supply price, depending on the elasticities of supply and demand (see Annex). The shadow price of output is determined similarly in terms of its demand or supply price, to the extent that additional output increases supply, reduces output from other producers, or both. If at the margin supply is perfectly elastic or demand perfectly inelastic, the supply price is the shadow price. If at the margin supply is perfectly inelastic or demand perfectly elastic, the demand price should be used.^{1/}

40. In some cases indirect taxes (or subsidies) are designed to compensate for external costs (or benefits). If the tax (subsidy) corresponds exactly to the external cost (benefit) of an input, the shadow price of the input should include the tax (subsidy). Conversely, the shadow price of an output should in that case exclude the tax (subsidy). In other words, the cost of an input

^{1/} This corresponds to the border price discussion for traded goods in para. 37.

should be increased, and the value of an output reduced, by the amount of the external cost (tax). Similarly, subsidies which reflect external benefits should reduce the cost of inputs and increase the value of outputs. However, the taxes or subsidies may provide only partial compensation or create other distortions. It may often be preferable therefore to treat such compensating taxes or subsidies as market distortions and allow separately for any externalities.

Conversion Factor and Shadow Exchange Rate

41. Thus, with the qualifications noted above, the value to the economy of traded goods is measured by border prices, in foreign currency; that of non-traded goods is measured by domestic prices, in local currency. The final step is to convert border prices into domestic prices or vice versa. The choice of foreign or local currency as a yardstick is immaterial; the problem is to determine the proper method of conversion. What is the rationale for this conversion? Consider, for example, that a project increases demand for a non-traded commodity which is made in part by expanding its output and in part by a shift in consumption away from other uses. With respect to the former, the cost of expanding output in terms of foreign currency may be determined by breaking it down into its component inputs, consisting in part of traded and in part of non-traded goods. Traded input components can then be valued directly at border prices, in foreign currency. This process can be repeated, in principle, until all inputs consist of directly and indirectly traded goods, and of basic domestic inputs, i.e. mainly labor (and possibly some other primary resources such as land). As noted earlier, the foreign exchange cost of labor (or other primary factors) is, in general, made up of output foregone and of additional consumption. Consumption costs are

the sole cost item if demand for a non-tradable is met by withdrawing it from other uses. The foreign exchange cost of such consumption will differ from its value to the consumer if the price he pays includes tariffs or subsidies. In general, the foreign currency equivalent of domestic expenditure on a non-traded good would incorporate both the cost of an increase in output and the cost of increased consumption. It should be clear that the conversion factor for translating domestic prices of non-traded goods into border price equivalents will vary between different non-traded goods depending on the relative weights of traded goods used in their output and in the induced consumption. In principle, there is not one conversion factor but a large set of such factors.

42. Use of such a set of conversion factors is not feasible in practice. We need a shortcut which provides a reasonable approximation. One shortcut is to decompose the (incremental) cost of major non-tradables for one or two rounds and apply a general conversion factor to the residual. The same general factor is then used also to convert minor non-tradable items. Similarly, differences in consumption pattern may be taken into account at least for some major income groups. These approaches imply some differentiation in conversion factors applied to various non-tradables. A more traditional approach ignores the need for differential conversion factors and simply applies one conversion factor (i.e. the shadow exchange rate) to all non-tradables.

43. The method for arriving at the standard conversion factor, or shadow exchange rate, is already suggested by the foregoing discussion. It should measure the value to the economy, at the margin, of having additional foreign exchange which can be used for increasing consumption or investment. This value depends on the trade policies being pursued by the government. For

example, in case of wide-ranging import restrictions, the official exchange rate understates the value to the economy of additional exchange earnings. In other words, the shadow exchange rate of local currency per unit of foreign currency is then higher than the official rate. Note that this is not a question of "equilibrium": the official exchange rate is an equilibrium rate given the trade restrictions, but the shadow rate is higher. Export restrictions have similar effects; widespread export subsidies tend to give an official exchange rate higher than the proper shadow exchange rate. If trade policies are anticipated to change over time, this should be reflected in corresponding changes in the previous shadow exchange rates. In case of general trade liberalization, the shadow and official exchange rates would tend to merge - not at the existing official level, but at a new equilibrium level.

44. Estimates of the shadow exchange rate, or standard conversion factor, are based on weighted averages of (import and export) tariffs, the weights being given by the relative importance of tradables in non-traded output, or in consumption. As an approximation, weights may be based on the shares of tradables in imports and exports. Current Bank practice normally uses the general shadow exchange rate approach. Use of specific conversion factors is encouraged in cases where greater accuracy of conversion is required. Guidelines for estimating the appropriate shadow exchange rate or conversion factors in the light of current and anticipated trade policies and other considerations, are given in the Annex.

4. Miscellaneous Valuation Problems

Excess Capacity

45. In some cases the increase in demand for inputs in the project can be met by expanding output from plant working below capacity. The

valuation of such inputs raises no new problems. They are valued as non-traded commodities since their supply is not met by increasing imports or reducing exports. The cost of the inputs is determined by current operating costs, with each of its elements, say fuel and labor, appropriately shadow priced; or, in other words, the relevant cost of the inputs is their short-run marginal social cost. There are no capital costs: The investment in the plant may be considered a sunk cost (cf. para. 16 above) as long as the excess capacity continues. When capacity constraints begin to impose themselves or new investments become necessary to expand output, incremental operating costs alone are no longer an appropriate measure of the value of the inputs to the economy. One should then include as costs the scarcity value or rents earned on the inputs or the cost of additional investment.

Rents

46. Factors in fixed supply, such as land, mineral resources, or sites, may earn rents which should reflect the value of such inputs in alternative uses which are best for the country. Increases in demand for them cannot be met by increasing output. Their asset value is derived from current and future demand which determines the opportunity cost of using them in the project. An estimate of the opportunity cost to the country, which may or may not be reflected in the market value, is the starting point for shadow pricing primary factors other than labor. Similar considerations apply to other assets, such as a road or a power plant, that are temporarily in fixed supply: costs are sunk, but strong demand may give the assets a high rent value. The shadow prices of their output, say road services or power,

cannot then be assessed in terms of the shadow price of their operating costs only, but should include the scarcity value of the assets.

Profits and Other Capital Incomes

47. The shadow wage rate, it will be recalled (see paras. 31 to 36 above), does not depend solely on direct opportunity cost in terms of output foregone, but also on other factors such as impact on savings and income distribution. The shadow value of rents, interest and profits may similarly have to be adjusted. This depends on who are the recipients of such payments, the extent to which they save their incomes, whether such savings are considered more valuable than their consumption, and the value attached to income accruing to them as compared to income accruing to others. Current Bank practice does not systematically incorporate these factors in its economic analysis of projects, except, to some extent, with respect to income accruing to foreigners. The implication of this approach, and the underlying judgments on which it is based, should always be made clear. Where income distribution and savings effects are considered relevant, they should be explicitly taken into account in the economic analysis. Shadow rates for rents, interest and profit payments are further discussed in the Annex.

Consumer Surplus

48. The project may lower price to consumers. The shadow price corresponding to the new level of output is in that case not a complete measure of the benefits to the economy: it neglects the effect of the reduction in prices. Consumers would have been willing to pay more for the quantity of the product they now buy. Consumer surplus is a measure of the difference between what a consumer is prepared to pay for a product and what he actually pays. If

the project lowers the price to consumers, they gain an increase in consumer surplus. This increase should be included as part of the benefits of the project.

49. Consumer surplus, however, is a private measure of the benefit derived from a reduction in price, which does not necessarily correspond to its social value. If the government accords the same value to benefits regardless of the recipient of those benefits then the social and private measures will coincide, but, as we have seen in connection with the discussion on wages (paras. 34 and 35) and capital incomes (para. 47), the government may wish to assign a higher value to benefits accruing to poor people than those accruing to rich, or a higher value to benefits which will be translated into savings than to those which will be consumed. Three important points should be stressed here. First, the revaluation of consumer surplus should be consistent with the assumptions relating to income distribution and growth which were incorporated in the estimate of shadow wage rates and capital incomes. Second, care should be taken to identify the real beneficiaries of the "consumer surplus" on intermediate goods: a gain in "consumer surplus" by road users, for example, may in fact be an increase in their profits, or the profits of middlemen or shippers, or an increase in surplus for consumers of the transported goods, etc. Finally, gains in consumer surplus, like other increases in income, lead to shifts in consumption expenditures. In principle, one should take account of the costs (benefits) of increases (decreases) in consumption of other goods valued at their social costs.^{1/} In practice, correction by a standard conversion factor may be sufficient.

^{1/} In extreme cases, the social value of the consumer surplus could be more than offset by an increased cost of consumption.

Inflation

50. It follows from the foregoing discussion on shadow prices that the economic analysis of projects should not be based simply on present prices, but on the prices pertaining to each period. Thus the analyst must project changes in shadow prices, taking into account the various considerations discussed previously. This should not be misunderstood: general changes in the price level which leave relative prices unchanged, should not be taken into account. General inflation is not relevant for economic analysis of projects. However, projected changes in relative (shadow) prices reflecting changes in the relationship between supply and demand, whether or not associated with inflation, should enter into the economic analysis. They indicate real shifts in the value of inputs and outputs to the economy. One apparent exception should be noted: any divergence between domestic and foreign inflation gives rise to a change in relative prices of traded goods (in foreign currency) and non-traded goods (in domestic currency). But this is not a real change in relative prices, requiring a shift in allocation of resources. It requires nothing more than an adjustment in the exchange rate to maintain relative prices, expressed in foreign or domestic currency, unchanged.

Part IV - Comparing Costs and Benefits: Investment Criteria

51. The foregoing Parts of this paper have discussed what costs and what benefits should be included in the economic analysis of projects and how they should be valued (shadow priced). This leaves us with time streams of costs and benefits, appropriately shadow priced to reflect their value to the economy, given the government's basic objectives and the resources

it has at its disposal. The remaining questions are how these costs and benefits streams are to be compared and what criteria are to be used in deciding whether a project represents a good use of resources.

52. The basic technique is to discount costs and benefits occurring in different periods and express them all in a common value at any one point of time. The relevant discount rate for this purpose has been discussed above (paras. 28 to 30). If the net present value (NPV) of the project is negative, i.e., if the discounted value of the benefits is less than the discounted value of the costs, the project should be rejected. But projects with a non-negative NPV should not necessarily be accepted, in practice, for two reasons.

53. Strictly speaking, if it had been possible to include all inputs at their shadow value including rents, the NPV of all acceptable projects would be zero and that of all others negative. In principle, no project would then have a positive NPV, and all projects with a zero NPV should be undertaken, without qualification. In practice the shadow prices of inputs including rent elements, e.g., land or site values, or mineral resources, will be virtually impossible to estimate independently of the project appraisal process itself. Consequently, the value of such inputs is not included as a cost but forms part of the, now possibly positive, NPV of the project. Furthermore, there are many projects which, by their nature, are mutually exclusive: if one is chosen, the other cannot be undertaken. This applies to different designs or sizes or timings of what is essentially the same project. It also applies, perhaps less obviously, to such cases as plants in alternative locations serving the same limited market, surface irrigation development ruling out tubewell irrigation, river development upstream instead

of downstream, etc. In all such cases of mutually exclusive projects it is not sufficient to choose a project with a positive NPV but one should select the project with the highest NPV amongst the mutually exclusive alternatives. The analyst should not assume too easily that such mutually exclusive alternatives do not exist.

54. This discussion bears on the issue of ranking of projects in order of priority. This is a rather ambiguous notion. For a given investment budget, and associated shadow prices including the shadow rate of interest, projects are either acceptable in accordance with the foregoing criteria and should be included in the investment program, or they are not and should be excluded. This applies to mutually exclusive projects where only the project with the greatest NPV qualifies as well as to any other projects which only require a non-negative NPV. The only "ranking" is here between the "ins" and the "outs". A more interesting ranking question appears to be which project should successively be excluded (included) if the investment budget were reduced (expanded). However, a change in the size of the available investment budget implies a change in the shadow rate of interest and corresponding changes in other shadow prices, which affect the size of the NPV of various projects in a differential way, depending on their time pattern and composition of inputs and outputs. Consequently, some projects with a high NPV in the original program may now drop out, some projects with more moderate NPV may be retained, and some projects that previously were excluded may now qualify. There is no single ranking of projects that are added or deleted from the program in accordance with variations in its size. Changes in the investment budget tend to affect its general composition, and not simply "marginal projects".

55. Current Bank practice calculates the economic rate of return, i.e. the rate of discount which results in a zero Net Present Value for the project.^{1/} If this rate of return exceeds the estimated shadow rate of interest, it indicates for a non-mutually exclusive project that it is acceptable; the NPV is then positive. Unfortunately, the rate of return is defective as a measure of the relative merits of mutually exclusive projects; a higher rate of return does not necessarily indicate the superior alternative. The economic rate of return thus may be misleading in comparing the economic merits of alternative projects and should not be used for this most essential function of project analysis.^{2/} However, the (internal) economic return is a widely understood concept and has merit as a compact summary measure of the economic result of a project. For this purpose alone, its use should be continued.

56. Both measures, the NPV and the economic rate of return, are sometimes misinterpreted. The essential purpose of project analysis is to sort out the best of the feasible alternatives, i.e. the project which makes the greatest contribution to the basic objectives of the economy. After the selection has been made on this basis, this contribution may be expressed as an NPV or economic return by comparing it with the situation without the project. As noted earlier, this measures the increase in rent (surplus) earned by the primary factors as compared to what they could earn

^{1/} This rate is usually referred to in the literature as the internal rate of return.

^{2/} Benefit/cost ratios are similarly misleading as well as suffering from other ambiguities, and should not be used. This also applies to traditional business criteria such as the payback period which are wrong indicators of economic profitability. The economic rate of return criterion can provide the correct decisions if applied to the difference in net benefits between two mutually exclusive projects. But in such cases the possibility of multiple solutions to the rate of return calculation is considerably increased.

without the project. It does not measure the contribution of the project in comparison with that of other (rejected) alternatives which may in fact have surpluses nearly as large as the selected projects.

Cost Minimization

57. Special variants of mutually exclusive projects are alternatives which produce the same benefits. This may be a question of choice of design, such as between hydro or thermal power generation, and rail or road transport. Whatever technical solution is chosen, the benefits are deemed to be the same. In such cases one only needs to consider costs and select the alternative with the lowest present value of cost when discounted at the appropriate rate of interest. For any given level of output and benefits, the least-cost alternative is to be preferred. But it should be clear that by itself this does not tell us anything about the economic merits of the project: even the least-cost project may have costs which exceed its benefits. The analysis should therefore not stop at a least-cost solution but consider wherever possible whether benefits are adequate. In cases where valuation of the benefits is difficult, for example improvements in health services, an assessment in terms of (least) cost per unit of physical output, such as number of beds made available, or reduction in morbidity, may be helpful.^{1/} But note that differences in costs as between the least-cost design and the next best alternative are not, and should not be used as a substitute for, a proper measure of the benefits of such projects.

First Year Return

58. An important choice of project alternatives concerns timing: when should the project be undertaken? In principle, alternative starting dates

^{1/} The analyst might also compute the value which would have to be attached to, say, the benefits from hospital beds in order to make NPV zero.

for the project, and other variations in execution such as stage construction, are subject to the normal NPV test (with all NPVs being calculated for the same/year, irrespective of the different starting dates of the projects). In some instances, however, a simpler test may suffice to determine the appropriate timing of the project. The so-called First Year Return (FYR) test involves calculating the ratio of net first year benefits to investment costs. If the ratio is below (above) the opportunity cost of capital, i.e. the shadow rate of interest, the project is premature (overdue). The test is strictly accurate only if benefits are time-dependent (and rising) rather than project-dependent, and project costs are not affected by postponement. In other words, the benefit stream must not shift depending on when the project is undertaken, and "tail-end effects" resulting from the timing of the project must be negligible. If these conditions are not fulfilled the FYR test is not applicable. Note also that this test is not a substitute for the standard requirement that the project should have a positive NPV; it is only a complementary test to determine its optimum timing.

Criteria for Public Utilities

59. As discussed earlier (para. 39), if an expansion of output increases supplies to users, its marginal value to the economy is measured by the demand price. In public utility project analysis, rates are often used as an approximation of such prices. They may or may not underestimate demand prices depending on whether or not demand for public utility service is rationed at the given rates or fully met. Furthermore, increases in public utility capacity are normally sufficiently large to reduce the market clearing rates, so that account should be taken of gains in consumer surplus. For these reasons the revenue^{1/} from additional sales is often referred

^{1/} Revenue must be expressed in real terms e.g. a constant tariff in money terms is decreasing in real terms at a rate equal to the rate of inflation.

to as a conservative measure of the benefits of such projects. However, the consumer surplus gains may need to be revalued to take account of their effect on income distribution, and the revenue benefits may need to be adjusted for the social costs (or benefits) of induced changes in consumption of other goods (see para. 48). In extreme cases, the social value of the consumer surplus might be negative, if the surplus accruing to the rich were counted for little and the cost of their additional consumption were high. In that case the revenue measure is not necessarily a conservative measure of benefits. On balance, additional revenues paid by the rich, as well as additional consumer surplus accruing to the poor through subsidized consumption, are likely to contribute to social gains.

Equivalent Criteria

60. As discussed earlier, the NPV and economic rate of return are two different ways of presenting the same information. The NPV is a measure of the project's value when due allowance has been made for all costs; the economic return is a measure of the project's value when due allowance has been made for all costs except capital as interest cost. It follows that the critical point for acceptance or rejection of a project on the NPV scale is zero,^{1/} while on the rate of return scale it is the accounting rate of interest.^{2/}

61. Tests similar to the economic return test could be derived for factors of production other than capital. For example, net benefits can be related to labor inputs (or foreign exchange inputs) by netting out all costs

^{1/} This disregards the qualifications discussed in Para. 47 that in practice the rent elements of cost are not normally included.

^{2/} Or opportunity cost of capital, if savings are considered equally valuable as consumption; see para. 28 ff.

and benefits other than labor (or foreign exchange). The critical point for acceptance or rejection becomes then the shadow wage rate (or shadow exchange rate). All such tests are equivalent, as long as the valuation of inputs and outputs remain the same, and do not provide any new information: they are simply transformations of the original NPV test. Hence, information on the employment or foreign exchange effects of a project should not be presented as a contribution (beneficial or otherwise) to the country's development objectives in addition to that measured by the NPV or economic rate of return. The weight attached to employment or foreign exchange earnings is already fully reflected in the shadow prices used in the NPV calculation.

62. Similarly, the effect of the project on investment and consumption is already adequately captured through the use of shadow prices. If the government values savings more highly than consumption, then this is reflected in the shadow wage rate and valuation of profits, and the accounting rate of interest. It is, therefore, fully taken into account in the calculation of the project's NPV. Discussion of the project's effects on saving and consumption must be consistent with the assumptions and data used in the NPV calculation. Consumption effects are, of course, closely related to employment effects.

Part V - Uncertainty, Sensitivity and Risk

63. Uncertainty is inherent in project analysis. Estimates of costs and demand, of shadow prices and the parameters underlying them, of consumer surplus and externalities, are approximate even for the present, and uncertainties increase when those estimates are projected into the future, as the analysis requires. A question therefore is how to take account of these uncertainties in the choice of projects.

64. The starting point is that the basic calculation of the NPV should incorporate the best estimates of the variables and parameters which determine the cost and benefit streams. The estimates should be the expected value obtained, in principle, by weighting each possible value by the probability of its occurrence. This ensures that the estimates are unbiased. Biased estimates, such as "conservative" estimates of costs (i.e., on the high side) and benefits (i.e., on the low side), should be avoided as much as possible since they distort the comparison of alternative projects.

65. Actual values may deviate from the most likely, expected values. It is important to investigate the impact of such deviations on the NPV of the project. A simple method is to vary the magnitude of the more important variables, singly or in combinations, by a certain percentage and see how sensitive the NPV is to such changes. Such sensitivity analysis helps in providing a better understanding of the key factors on which the outcome of the project depends. It may focus attention on the variables where a further effort should be made to firm up the estimates and narrow down the range of uncertainty. It also may aid the management of the project by indicating critical areas requiring close supervision in order to ensure the expected favorable return to the economy. The number of variables to be tested in this fashion is a matter of judgment, but care should be taken that all the plausible cases are covered. In particular, the significance of a certain sensitivity - i.e. the change in NPV resulting from, say, a 10% change in a certain variable - depends not just on its magnitude but also on the range of values which the variable is considered likely to attain; and some variables are likely to move together, or in opposite directions, in response to a common cause, or because of close interrelationships.

66. This points to the weakness of sensitivity analysis. It shows what the effect is on the NPV of a project if certain variables were to assume other values, all other things remaining equal. It does not show what the combined net effect is of changes in all variables, or the likelihood of various changes occurring together. Risk analysis (or probability analysis) is designed to throw light on these questions. It requires specifying, as best one can, probabilities for the several values that each variable entering into the project analysis may attain, as well as any covariances between the variables, i.e. the extent to which changes in one variable are correlated with changes in the other. (Specifying these covariances tends to be a stumbling block in practice.) Given these probability distributions, specific values of the underlying variables are randomly selected and combined into an estimate of the NPV of a project. Repeated application of this process produces a probability distribution of the NPV (or rate of return), i.e. the probabilities that the NPV take on certain values higher or lower than the "central" expected value calculated in the basic analysis. This gives the decision-maker a better picture of the degree of risk involved in the project than is given by a single valued calculation. It enables judgments that there is an X% chance that the project will result in a negative NPV, and a Y% chance of a surplus exceeding \$N million.

67. Risk analysis provides a better basis for judging the relative merits of alternative projects. However, it does nothing to diminish the risks. It was mentioned above, in connection with sensitivity analysis, that some risks can be reduced by further investigations, for example of the technical problems and costs, or market prospects. This may or may not

be worthwhile depending upon the cost of the investigation and the expected reduction in risk and the value attached thereto. Risk may also be reduced by a flexible design of the project which leaves future options open to cope better with unexpected changes in circumstances. Such flexible design is likely to impose additional costs which may or may not be justified, in view of the anticipated uncertainties and the benefits of greater responsiveness which the flexible design makes possible.

68. In current Bank practice, sensitivity analysis is a standard part of project analysis, as a check on the results of a project if key variables were to differ from the estimated most likely values used in the analysis. More elaborate risk analysis is undertaken only in special cases. It should be considered for larger more complex projects or projects with exceptional risks which cannot be adequately appreciated by means of a simple sensitivity analysis. The advantages of further study of certain project features or variables, and of a more flexible design to cope better with future uncertainties, should be part of the normal process of project preparation and appraisal.

69. Finally, it should be noted that the use of net present expected value as a measure of a project's worth implies that the government is indifferent to risk as measured by, say, the variance of expected value. This is justifiable provided the risks of all public sector projects are pooled and spread over the country's whole population so that a change in the outcome of any single project is unlikely to have a significant impact on the income of any single group. This is not necessarily true for all

projects. In some cases (e.g. agricultural projects) the risk may be borne by a relatively small section of the population; in other cases, the success or failure of the project may weigh heavily on national income. In such cases, one may wish to assess the "cost" of offsetting risk, for example, by maintaining sufficient foreign exchange reserves to offset fluctuations in export prices.

ECONOMIC ANALYSIS OF PROJECTS

ANNEX: DERIVATION OF SHADOW PRICES

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A N N E X

DERIVATION OF SHADOW PRICES

I INTRODUCTION

1. This Annex provides a self-contained explanation of shadow pricing. It is intended to give the country/project economist an intuitive appreciation of the techniques being recommended: however, it should not be viewed as a rigorous statement of the subject nor should it be assumed that all eventualities are covered. More detailed information on the technical derivation of shadow prices is provided in Appendix I where some of the complications, omitted in this section, are also considered. Possible methods of estimation are described in Appendix II.

Definition of Shadow Prices

2. Shadow prices are defined as the prices associated with the economy's optimal development path given the country's objectives and given all the constraints which limit the achievement of those objectives. Thus, shadow pricing presupposes that one has in mind a well-defined social welfare function (a mathematical statement of the country's objectives) and a precise understanding of the constraints, both now and in the future, which confine the country's development. The next two paragraphs consider the type of welfare function and the constraints which are thought to be most important in LDCs.

Social Welfare Function

3. Governments are making decisions every day in terms of some concept of welfare. Usually, the concept of welfare is not clearly defined and as a result decisions are often contradictory. Thus, a clear statement of the welfare function is essential to ensure consistent decision making. Countries have many so-called objectives such as better health services, efficient agriculture and so on, but one may

reasonably comment that such objectives are really means to attain more fundamental objectives which usually relate to the distribution of consumption both over time and at a point of time. It is these two aspects of consumption, i.e. its intertemporal and interpersonal distribution, which form the basis of the welfare function employed in this Annex. This enables us to concentrate on the crucial trade-off between growth (i.e. a redistribution of consumption from the present to the future) and the redistribution of consumption from the rich to the poor.

Constraints

4. Constraints can take various forms. All economies are faced by the basic constraints on the availability of resources and the possibilities for their technological transformation. In some circumstances market prices will correctly reflect the scarcity value of these resources but frequently other constraints operate to divorce market prices and economic values. For example, minimum wage legislation may keep the market wage above the foregone output in other occupations. Similarly, trade taxes cause a divergence between the value of commodities at domestic and international prices which means that the official exchange rate does not reflect adequately the value of foreign exchange. To correct for such distortions the economist recommends the use of efficiency prices ^{1/} i.e., prices which, despite the distortion, will ensure the efficient allocation of resources. Note, however, that efficiency prices as defined here do not necessarily assume the removal of the distortion. One is not trying to estimate, for example, the free trade exchange rate (unless one expects the country to adopt a free-trade policy) but an exchange rate which, given the distortion, will more accurately reflect the value of foreign exchange.

5. LDCs may also be constrained in other ways. For example, administrative costs or political pressure may limit the government's actions. Thus, the possibilities of taxing the agricultural sector may be limited by the costs of collection and

^{1/} we reserve the term "shadow price" for prices which include income distribution considerations. Efficiency price is used in the current Bank sense of opportunity cost.

administration, or the political power of the rich may be sufficient to prevent the government distributing income to the poor. Arguments of this type suggest that LDCs may also be faced by a fiscal constraint in the sense that the government cannot raise sufficient revenue to achieve its desired level of investment or its desired distribution of income. The obvious implication is that the government may wish to use project selection as an alternative, additional method of increasing public income or of redistributing income. Even within the public sector constraints may prevent the optimal use of the limited public revenue. The government may be committed to various expenditures which lead primarily to consumption (e.g. the payment of civil servants' salaries) so that public sector investment is constrained below its optimal level.

6. If such constraints are thought to be important, the value of a project depends not only on the benefits generated by the project but also on their distribution. In other words, besides looking at the effect of the project on the allocation of resources (i.e. the efficiency effect), we must also look at the effect on the incomes of different groups in society (i.e. the distribution effect). The Bank has been interested primarily in the efficiency aspect of projects. To incorporate the distributional aspect we could adopt one of two procedures:- firstly, we could price all factors of production at their efficiency price and then look at the distribution of benefits and weight accordingly; secondly, we could make use of the economic fact that the benefits of the project will accrue to the factors of production employed in the project. We can then define the shadow price of a factor as

$$\text{Shadow Price} = \text{Efficiency Price} + \text{Increase in Income} \times \text{Weight} \quad 1)$$

where the "increase in income" is the benefit of the project accruing to that factor and the "weight" reflects the social value of that income. The latter method may be

useful for some factors, e.g. unskilled labor, for which it is convenient to have an all-inclusive price for purposes of decentralized decision making. For other factors this may not be particularly interesting, in which case one could use the first method. Whilst both methods may be used in any single project, they must not be used for the same increase in income because that would involve double-counting.

7. In presenting the economic analysis of a project it will be instructive to indicate the project's worth at market, efficiency and shadow prices. The first evaluation will correspond to the financial appraisal of the project. The second will be similar to that currently used in the Bank, i.e. all incomes will be considered equally valuable, there will be no premium on public income or investment, the discount rate will be the opportunity cost of capital and other factor prices will be based on opportunity cost. In other words, the evaluation at efficiency prices corrects for the distortions in factor and product markets but does not assume any constraint on the government's ability to redistribute income or invest. The final evaluation will include the distribution weights (see equation 1)) if it is thought that the economy does suffer from a fiscal constraint. Inasmuch as the main innovation is contained in this final step we will pay particular attention to the derivation of distribution weights, devoting the whole of Section II to a discussion of both intratemporal and intertemporal weights. This is not to say that the methodology ignores efficiency. To illustrate this, in Section III we combine efficiency and distributional considerations for the particular case of labor. Finally, in Section IV we examine the prices to be used for commodities, both tradable and non-tradable.

II DERIVATION OF WEIGHTS

Numeraire

8. The choice of numeraire (standard of account) is basic to the determination of the weight. One is at liberty to choose any commodity or resource as numeraire but,

once it has been chosen, one must consistently express all values in terms of that numeraire. It is recommended that the Bank use as numeraire public income expressed in units of foreign exchange. This is considered convenient because most projects are in the public sector and involve considerable amounts of foreign exchange. A unit of private consumption expressed in units of domestic currency, therefore, has to be revalued

- i) to express it in units of foreign exchange, and
- ii) to express it in units of public income.

This may appear tedious, but if one used consumption expressed in domestic currency as numeraire, one would have to go through the reverse process in order to express, say, a foreign loan to the public sector in terms of the consumption numeraire.^{1/} The choice of numeraire also has implications for intertemporal, as well as for intratemporal, weights because the discount rate is defined as the rate of fall in the value of the numeraire over time. If all values are consistently expressed in terms of the numeraire in each period, then the discount rate provides the link between different time periods and enables us to express all costs and benefits in terms of present value.

9. The choice of numeraire essentially determines the absolute value of the weights to be applied to benefits accruing to different groups of society because the weight attached to the numeraire (public income expressed in foreign exchange) is to be set equal to unity by definition. The shadow price formula (equation 1)) may then be interpreted in the following manner. Assume in the first instance that the entire increase in income associated with the project accrues to the government. However, the government may have to pay some of this increase to, say, laborers in the form

^{1/} Note also that if one wishes to take account of the distribution of consumption the numeraire would have to be defined as the value of consumption at a particular level of consumption.

of increased wage payments. In line with para 8. this wage payment must be expressed in units of foreign exchange, i.e. one must determine the reduction in the government's foreign exchange income caused by the increased expenditure resulting from higher wages. Assume that the payment of one unit of wages reduces the government's foreign exchange income by β . We expect β to be less than one because of trade tariffs. This is intuitively acceptable because the government recoups some of the wage payment through the tariffs imposed on consumption goods.^{1/} We have now obtained the foreign exchange equivalent of the increased wage bill. Assume further that the weight attached to foreign exchange in the hands of wage-earners is w . Then the net effect of the transfer is to reduce foreign exchange in the hands of the government (which has a weight of one) and to increase that of wage-earners by an equal amount (which has a weight of w) so that the "net weight" is $(1 - w)$. This completes the second revaluation mentioned in para. 8. Equation 1) may now be rewritten as

$$\text{Shadow Price} = \text{Efficiency Price} + \text{Increase in Income} \times \beta \times (1 - w)^{\frac{2}{2}}$$

where β translates the increase in income into its foreign exchange equivalent and w reflects its value to the wage-earner in terms of its value to the government.

10. We can make five general points about equation 2). Firstly, if the increase in income is zero then the shadow price equals the efficiency price. This might occur in a perfect labor market where the transfer of labor does not involve a change in income. Secondly, if the wage-earner spends all his income on, say, duty-free imports or if there are no trade tariffs in the economy, then $\beta = 1$. In other

^{1/} Direct taxes should also be netted out, i.e. when we speak of increased wage payments we mean increased wage payments in the form of disposable income in the hands of the wage-earner.

^{2/} As we shall see in Section III the efficiency price will also be expressed in foreign exchange.

words, we can view β as the inverse of a shadow exchange rate ^{1/} designed to reflect the true value of foreign exchange in the presence of foreign trade distortions. Thirdly, if the government is interested in income distribution, W will tend to be low for the rich and high for the poor, and for some income level one would have $W = 1$, i.e. the government is indifferent between its own and private income at that particular level. If the increase in income accrues at this particular level, then, because $W = 1$, the shadow price equals the efficiency price. Fourthly, the government may not wish to include distribution weights in project selection. We examine the possible reasons behind such a wish in para. 17, but here we may note that the wish implies all W equal one so that the shadow price always equals the efficiency price. This has been the traditional Bank practice. Finally, in para. 6 we mentioned two possible ways of introducing income distribution weights into project selection. Thus far, we have only examined the second, which involved the inclusion of distribution weights in shadow prices, but the first method can be directly deduced therefrom. To determine the shadow price we originally assumed that the increase in wage income (ΔI) expressed in foreign exchange ($\Delta I\beta$) accrued to the government. We then included an income transfer effect in the shadow price which involved the transfer of $\Delta I\beta$ from the government to the wage-earner. The addition and subtraction of $\Delta I\beta$ to the government account cancel out, leaving the increase in income in the hands of the wage-earner which has a value of $\Delta I\beta W$. In other words, one can look directly at the distribution of benefits expressed in foreign exchange and weight those accruing to the private sector by W and those to the public sector by one.

^{1/} In fact, β translates domestic prices into international prices expressed in units of domestic currency. Strictly speaking, therefore, the shadow exchange rate = $\beta \div$ the official exchange rate.

Meaning of W

11. If the marginal increase in welfare from a unit of foreign exchange in the hands of the government is W'_G and that from the same devoted to private consumption is W'_F , then our choice of numeraire requires that we set W'_G equal to unity (i.e. divide throughout by W'_G) so that the weight, W , is

$$W = \frac{W'_F}{W'_G} \quad 3)$$

To evaluate this ratio we could make direct estimates of W'_F and W'_G ; however, it may be more convenient to adopt a slightly different approach. In particular, we will divide W'_F/W'_G into three components which are more convenient to estimate. To that end, we will establish first the value of the marginal increase in welfare from a unit of foreign exchange in the hands of the government (W'_G) measured in units which we define as the marginal utility of consumption at the average level of consumption ($W'_{\bar{c}}$). Define \bar{v} as

$$\bar{v} = \frac{W'_G}{W'_{\bar{c}}} \quad 4)$$

so that \bar{v} describes the premium (or discount) on government income in terms of $W'_{\bar{c}}$ where the bar over the c indicates average. If \bar{v} equals 2 (0.5) then a unit of government income is worth twice (half) as much as the marginal utility of consumption at the average level of consumption. Next, we want the value of a unit of foreign exchange accruing to a particular consumption group (W'_F) expressed in terms of the same units (i.e. $W'_{\bar{c}}$). We accomplish this in two steps. Firstly, we define d as

$$d = \frac{W'_c}{W'_{\bar{c}}} \quad 5)$$

i.e., d is the value of a unit of domestic currency to someone at a given consumption level measured in terms of the marginal utility of consumption at the average level of consumption. If d equals 2 (0.5) then, at the given consumption level, additional consumption is worth twice (half) as much as additional consumption at the average level. And secondly, we note that a unit of foreign exchange permits $1/\beta$ units of consumption expressed in terms of domestic currency (this is the reverse process to that used in para. 9). Given our definition of d and β , we now see that the value of a unit of foreign exchange accruing to a particular consumption group must be $1/\beta$ times as valuable as a unit of domestic currency, so that

$$\frac{W'_F}{W'_C} = \frac{d}{\beta} \tag{6}$$

12. Combining equations 4) and 6) we obtain

$$W = \frac{W'_F}{W'_G} = \frac{d}{\bar{v}\beta} \tag{7}$$

which says that the weight depends on a pure distribution-of-consumption weight (d), the premium (discount) on government revenue (\bar{v}), and the inverse of a shadow exchange rate (β). Note that both d and β will be different for different consumption groups whereas \bar{v} will remain the same because it depends on the value of consumption at the average level of consumption. The weights can also be considered in a slightly different way. From equation 2) we can derive

$$\text{Shadow Price} = \text{Efficiency Price} + \text{Increase in Income} \times (\beta - \beta W)$$

so that the first β gives us the foreign exchange cost to the government of increased income in the hands of the wage-earner and from the second β and equation 7) we observe that

$$\beta W = \frac{d}{\bar{v}}$$

whence

$$\text{Shadow Price} = \text{Efficiency Price} + \text{Increase in Income} \times \left(\beta - \frac{d}{v} \right)$$

The weight d/v (see equations 4) and 5)) gives the value of the increased income in terms of our chosen numeraire (w'_G) because

$$\frac{d}{v} = \frac{w'_c}{w'_c} \frac{w'_c}{w'_G} = \frac{w'_c}{w'_G}$$

In other words, the net weight to be applied to an increase in income expressed in foreign exchange ($\Delta I\beta$) is $(1 - w)$ but the net weight for the same expressed in domestic currency (ΔI) is $(\beta - \beta w)$ or $(\beta - \frac{d}{v})$.

13. Each of the elements of the net weight will be discussed in turn.

Paras. 14 to 18 deal with d , the pure distribution parameter, para. 19 with β , the inverse of a SER for consumption and paras. 20 to 24 with \bar{v} the value of government income. In para. 25 we turn to the derivation of intertemporal weights but we may note here that the discount rate is the proportionate rate of fall of the value of the numeraire over time. We have chosen public income in units of foreign exchange as numeraire (i.e. we set $w'_G = 1$) so that the discount rate (described as the accounting rate of interest or ARI) is

$$\text{ARI} = \frac{\dot{w}'_G}{w'_G} \quad 1/ \quad 8)$$

We will examine this equation further in paras. 25 to 28.

1/ \dot{w}'_G/w'_G is given its natural value, i.e. we drop the negative sign.

Consumption Distribution Weight (d)

14. In order to derive distribution weights it is necessary to specify a utility function. The basic assumption underlying the utility function is that the utility derived from an increment of consumption is less the higher the existing level of one's consumption, i.e. the marginal utility of consumption decreases as the level of consumption increases. If marginal utility is expressed as U'_c then this type of consideration may be formalised as

$$U'_c = c^{-n} \tag{9)}$$

where c is the level of consumption and n a parameter of the utility function.^{1/} whilst this formula is only one of many which could be used to depict the diminishing nature of marginal utility, this particular formulation has the advantage that n can be given an intuitively appealing meaning - namely, the higher n the more egalitarian the government's objectives because the higher n the higher the rate of diminishing marginal utility. For example, if $n = 2$ (1) marginal utility is four (two) times higher for a man with a given level of consumption than for a man with a consumption level twice as high. And if $n = 0$, the marginal utility of consumption is independent of the level of consumption. For most governments n would probably lie in the range 1 to 2. Values outside this range, although possible, may be considered extreme.

15. To compare the value of consumption to different people and at different points of time one needs a point of comparison. For example, one might choose the marginal utility of consumption at today's average level of consumption. That is, we can set

$$\frac{-n}{\bar{c}} = 1$$

^{1/} Total utility $\int U(c)$ is obtained by integrating equation 9), i.e.

$$U(c) = \frac{1}{1-n} c^{1-n} \quad \text{if } n < 1$$

and $U(c) = \log_e c \quad \text{if } n = 1$

where the bar indicates average. It follows that the marginal utility of consumption to someone with a level of consumption equal to $2\bar{c}$ ($0.5\bar{c}$) is 0.5^n (2^n) so that if $n = 2$, marginal utility is 0.25 (4). Formally, the consumption distribution weight (d) for marginal changes in consumption is

$$d = \frac{U'_c}{U'_c} = \left(\frac{\bar{c}}{c} \right)^n \tag{10}$$

Frequently, we will want to express non-marginal increases in consumption in terms of \bar{c}^{-n} . If the increase in consumption is $(c_2 - c_1)$, then the increase in utility is $U(c_2) - U(c_1)$ and to express this in terms of \bar{c}^{-n} we simply divide by \bar{c}^{-n} so that the normalised utility value is

$$\frac{U(c_2) - U(c_1)}{\bar{c}^{-n}}$$

We now want the weight, d, which can be applied directly to $(c_2 - c_1)$ to give us the normalised utility value, i.e.

$$(c_2 - c_1) d = \frac{U(c_2) - U(c_1)}{\bar{c}^{-n}}$$

hence

$$d = \frac{U(c_2) - U(c_1)}{(c_2 - c_1) \bar{c}^{-n}} \tag{11}$$

which formula is the non-marginal counterpart of equation 10).

16. Given the form of the utility function equation 11) can be expressed in terms of n , the basic parameter of the utility function, and two ratios, that of the old to the new level of consumption c_1/c_2 and that of the average to the new level of consumption \bar{c}/c_2 (see Appendix I, paras. 7 and 8). The following table indicates the numerical value of d for different values of n , c_1/c_2 and \bar{c}/c_2 .

TABLE 1

Values for d

n	\bar{c}/c_2			c_1/c_2			\bar{c}/c_2		
	0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.75
0	1	1	1	1	1	1	1	1	1
1.0	3.70	2.77	2.33	1.85	1.39	1.15	0.92	0.69	0.57
1.5	7.54	4.69	3.45	2.67	1.66	1.22	0.92	0.59	0.43
2.0	16.00	8.00	5.30	4.00	2.00	1.30	1	0.50	0.33

Provided one is talking about an increase in consumption, $c_1/c_2 < 1$ so that $c_1/c_2 = 0.5$ means that consumption has been doubled. \bar{c}/c_2 , however, can be ≤ 1 . If $\bar{c}/c_2 = 2$ (0.5) then consumption has been increased to a level half (twice) as high as average consumption. Thus, assuming $n > 0$, the higher c_1/c_2 and the higher \bar{c}/c_2 , the higher the weight. This is intuitively acceptable because if c_2 (the new level of consumption) is very much below \bar{c} (the average level of consumption) so that \bar{c}/c_2 is high, and if c_1 (the old level of consumption) is very much below c_2 (the new level of consumption) so that c_1/c_2 is small, then the

increase in consumption is going to someone who is very poor and will in fact still be worse off than the average citizen even after the increase. One would presumably want to attach a high weight to such consumption and this is precisely what the table tells us. For example, if \bar{c}/c_2 is 2 and c_1/c_2 is 0.5, then with $n = 2$, we observe that the value of d is 8. On the other hand, if the consumption accrues to the rich (e.g. $\bar{c}/c_2 = 0.5$ and $c_1/c_2 = 0.75$) then d will be low especially if n is high (i.e. with $n = 2$, $d = 0.33$).

17. The use of distributional weights in project appraisal raises various theoretical and practical questions. On the theoretical side one can question the need for such weights. For example, if the government values all consumption equally irrespective of its distribution then the need for distribution weights disappears. (Formally, this implies that $n = 0$ and so $d = 1$ regardless of how rich or how poor the beneficiaries of increased consumption happen to be.) Note, however, that the weights only apparently disappear. In reality they are still there (but all equal to unity) and reflect, what many people would consider, a rather extreme value judgment about the desired distribution of consumption. However, there is an alternative argument for excluding distribution weights. If the government, through its control of fiscal policy, is able to redistribute consumption as it sees fit then there is no need to include distribution weights in project selection. Project selection should then aim to maximise consumption allowing the fiscal system to redistribute it in a desirable fashion. To reverse the argument the inclusion of distribution weights implies that the government is constrained in its use of fiscal policy and therefore is unable to redistribute consumption to the extent desired. Viewing the very unequal distribution of income/consumption in most developing countries one is tempted to conclude that the government's use of the fiscal system is constrained. These constraints

reflect a general inability to raise sufficient revenue because of administrative costs and a particular inability to tax the rich sufficiently because of the political power wielded by such. If either (neither) of the arguments advanced in this paragraph is considered valid, then distribution weights are not (are) required for project selection.

Summary Distribution Measure (D)

18. Turning to practical matters there is the question of estimating n and of the additional work involved for the project economist. The former is considered in Appendix II. With regard to the latter the project economist must obtain information on the beneficiaries of the project. This is already done to some extent especially in agricultural projects where the levels of consumptions both with (c_2) and without (c_1) the project are reported. That is all the information that the project economist need collect. The value of \bar{c} and n will be provided by the country economist so that the weights can be determined directly from the table presented in para. 16.^{1/} Some effects of the project on consumption may be difficult to trace, too small to bother about or so general that all income classes would have to be examined. In such cases, it is recommended that one use a global distribution weight (D) which is defined as the normalised value of a unit of consumption which is distributed throughout the economy in such a way that the distribution of aggregate consumption is unaffected. This definition implies that the increase in consumption has a neutral effect on the distribution of consumption. Accordingly, one might wish to assign a slightly higher (lower) value to D if it is thought that the increase in consumption is improving (worsening) the distribution. A formula for D is derived

^{1/} Note that only one such table is required for all countries in the Bank because the inputs into the table are expressed as ratios.

in Appendix I from which the following table is deduced, where n is the parameter of the utility function and σ is a parameter of the Pareto distribution function.^{1/}

TABLE 2

Values for D

$\sigma \backslash n$	0	0.5	1.0	2.0	3.0
1.5	1.0	0.86	1.0	1.8	3.85
2.0	1.0	0.94	1.0	1.3	2.0

As the table illustrates, for $n \leq 1$, D tends to be close to unity. For $n > 1$, with the government giving weight to income distribution, plausible values range around 2, but may well be higher for a high n and low σ .

Derivation of β

19. The value of β is determined by estimating the increase in the value of consumption at domestic prices if one more unit of foreign exchange is committed to consumption. Consumers may increase their consumption of exportables, importables or non-tradables. To the extent that different income groups will buy different bundles of goods at the margin of their expenditure and given that trade distortions are different for different commodities, one ought to estimate a different β (or inverse of a shadow exchange rate) for different income groups. In practice, however,

^{1/} Note that σ is related to the Gini coefficient as follows

$$\text{Gini coefficient} = 2(1 - \sigma)/(1 - 2\sigma)$$

The Bank has information on Gini coefficients for many countries.

a separate β for rich and poor income groups will probably be sufficient. Calculating β requires information on the (marginal) consumption pattern. The ratio of the value of this consumption at domestic and border prices is the required SER. Thus, if tradable commodities (i.e. commodities which at the margin are being exported or imported) form part of consumption, the ratio will depend on the import/export tax/subsidy. But if non-tradables appear in the consumption pattern then one must apply more complicated methods which essentially involve valuing the inputs used in the production of non-tradables at world prices. This latter complication is explained more fully in paras. 52 to 54. To a reasonable approximation, especially if non-tradable consumption is small, we can write

$$\beta = \frac{M + X}{M(1 + t_m) + X(1 - t_x)} \quad 12)$$

where $M(X)$ is the imports (exports) in the marginal consumption bundle and $t_m(t_x)$ is the "average" tax on imports (exports), which may be measured by the ratio of the revenue from trade taxes on consumption goods to the value of those consumption goods fob or cif. If $M = X$ (i.e. the balance of trade is balanced), $t_m = 0.3$ and $t_x = -0.05$ (i.e. a subsidy) then $\beta = 0.85$. Note that the equivalence of X and M does not imply $\beta = 1$. The equivalence of X and M shows that we have an equilibrium situation but the presence of trade taxes implies a distortion: β is designed to correct for those distortions. However, it does not assume that the distortions will be removed, i.e. β is not an estimate of the inverse of the free trade exchange rate (see paras. 58 and 59).

Value of Public Income (\bar{v})

20. To obtain the value of public income we must examine the uses to which it is put. Assume that at the margin of expenditure a proportion, g , of each unit of

public income is assigned to investment and the remainder $(1 - g)$ to consumption, so that

$$\bar{v} = gv + (1 - g) \frac{D}{\beta} \quad (13)$$

The portion invested is weighted by the value of investment (v) and the portion used for current expenditure is weighted by the value of consumption (D/β) generated by foreign exchange. Note that the use of D implies that the impact of government expenditure is distributionally neutral. If $g = 1$ (i.e. all public income is invested) or $D/\beta = v$ (i.e. current expenditure is as valuable as investment), then $\bar{v} = v$. The latter condition ($D/\beta = v$) implies that the government allocates its resources optimally between current expenditure and investment. Given that current expenditure is often fixed by salary requirements, etc., v may often be greater than D/β . We have already derived expressions for D and β so we now turn to v , the value of public investment.

Value of Public Investment (v)

21. We will evaluate public investment by valuing the stream of future consumption which it generates. Assume that the investment provides q units of foreign exchange which are devoted to consumption every year forever (i.e. q is net of the cost required to maintain the capital stock intact). In terms of normalised utility this is worth qD/β where the β allows for the distortion caused by trade taxes and D reflects the utility value of consumption.^{1/} However, if the level of consumption is increasing over time and if we accept diminishing marginal utility, then future consumption must be discounted by a rate which reflects the growth rate of consumption (g) and the rate of diminishing marginal utility (n). Furthermore, if the government regards future consumption as less valuable simply because it occurs

^{1/} The use of D implies that the increment in consumption (i.e., q) is distributionally neutral, i.e. does not change the distribution of aggregate consumption.

in the future, we must include an element reflecting pure time preference (ρ). The resulting discount rate, known as the consumption rate of interest (i), may be expressed as

$$CRI = i = nG + \rho \tag{14}$$

(see Appendix for derivation.) We can now denote the present value of the consumption generated by a unit of investment as

$$v_0 = \sum_{t=0}^{\infty} \frac{qD}{\beta(1+i)^t} = \frac{qD}{\beta i} \tag{15}$$

It follows that if qD/β (the rate at which consumption is generated) equals i (the rate at which consumption is discounted) then $v_0 = 1$. In many LDC's, however, there is reason to suppose that $qD/\beta > i$ because of insufficient investment, in which case $v_0 > 1$.

22. Consider the following numerical example.

$\beta = 0.35$	$n = 2$	$G = 0.03$
$\rho = 0.02$	$q = 0.1$	$\sigma = 2$

Substituting these values in equation 14) gives

$$i = 2 \times 0.03 + 0.02 = 0.08$$

And from Table 2, $D = 1.3$, so that

$$v_0 = \frac{0.1 \times 1.3}{0.35 \times 0.08} \doteq 2$$

In other words, a unit of foreign exchange devoted to investment is worth twice as much as the same devoted to the consumption of someone already enjoying the average level of consumption. The example illustrates that the inclusion of an income distribution objective does **not mean that growth is abandoned**: in fact, investment is worth **more** than consumption at the average level whereas in the traditional Bank

approach they would be worth the same. On the other hand, growth is not considered to the exclusion of income distribution: in fact, consumption below a level equal to one half of average consumption is worth more than investment,^{1/} whereas in the traditional Bank approach they would be worth the same. Consideration of growth and income distribution objectives does not mean the exclusion of either but does require a careful specification of the trade-off between the two.

23. The following formulae for v consider more realistic situations. In particular, they allow for the possibility of reinvestment out of q and for the possibility that the values of the underlying parameters will change over time. If s is the proportion of q reinvested and the subscripts refer to time periods, then

$$v_0 = \sum_{t=0}^{\infty} (1 - s_t)q_t \frac{D_t}{\beta^t} \frac{\prod_{t=1}^t (1 + s_t q_t)}{\prod_{t=0}^t (1 + i_t)} \quad 2/ \quad 16)$$

The formula may be interpreted as follows: in any period the consumption generated equals $(1 - s)q$ times the capital stock in that period; but the capital stock is growing at a rate equal to the rate of reinvestment (sq) and hence the term $\prod_{t=1}^t (1 + s_t q_t)$; and finally, we translate the consumption into units of marginal utility (by multiplying D/β) and then discount to the present (hence the term $\prod_{t=0}^t (1 + i_t)$). This is repeated for every period and the resulting values are then summed to give the present value of v_0 .

24. In principle, one needs to know s , q , D , β and i for every period in the future. In practice, one will have to make simple guesses about future development. The most important guesses concern the relative value of i and sq . This can be seen intuitively because sq determines the growth rate of the capital stock and i is the discount rate. It follows that if $s_t q_t > i_t$ for all t the growth of capital

^{1/} From equation 11), $d = \left(\frac{2}{c}\right)$. If $c = 0.5\bar{c}$ and $n = 2$, $d = 4$.

^{2/} The symbol $\prod_{t=1}^t$ means the product of each period's value over the periods $t = 1$ to $t = t$.

will dominate the discount rate and if this happens over an infinite period $v_0 = \infty$. Alternatively, if $i_t > s_t q_t$ for all t at some date in the future the present value of the consumption generated in that year will approximate zero, so that the value of v_0 will be finite. Imagine that at some date in the future, T years from the present, the economy is expected to be on a reasonably stable growth path in which i and sq may be expected to remain more or less constant. Furthermore, it is unlikely that on such a path sq_T would be greater than i_T . If it were, then $v_T = \infty$, but if $sq_T < i_T$, then

$$v_T = \frac{(1 - s_T)q_T D_T}{(i_T - s_T q_T)\beta_T} \quad (17)$$

It follows that if $T = 0$, we have a simple method of estimating v_0 . If $T \neq 0$, then one might use the following formula

$$v_0 = \left[\frac{(1 - s_0)q_0 D_0}{(i_0 - s_0 q_0)\beta_0} \right] \left[\frac{1 - \left(\frac{1 + s_0 q_0}{1 + i_0} \right)^T}{1 + i_0} \right] + \left[\frac{1 + s_0 q_0}{1 + i_0} \right]^T v_T \quad (18)$$

where v_T must be determined as in equation 17. Note that if T is large and $i_0 > s_0 q_0$, then the terms to the power of T will be small so that

$$v_0 \doteq \left[\frac{(1 - s_0)q_0 D_0}{(i_0 - s_0 q_0)\beta_0} \right] \quad (19)$$

may still be a reasonable approximation. To reverse the argument we must estimate the values of i, s , and q in the near future more carefully if $s_0 q_0 > i_0$.

Accounting Rate of Interest (ARI)

25. We have defined \bar{v} as the marginal utility of a unit of public income (W'_G) expressed in units of marginal utility of a unit of average consumption

$(W'_{\bar{c}})$ i. e.,

$$\bar{v} = \frac{W'_{\bar{g}}}{W'_{\bar{c}}}$$

Differentiating with respect to time and dividing through by \bar{v} gives

$$\frac{\dot{\bar{v}}}{\bar{v}} = \frac{\dot{W}'_{\bar{g}}}{W'_{\bar{g}}} - \frac{\dot{W}'_{\bar{c}}}{W'_{\bar{c}}} \quad 20)$$

But $\frac{\dot{W}'_{\bar{g}}}{W'_{\bar{g}}}$ is the proportionate rate of fall of the marginal utility of public income which, by definition, is the ARI (see equation 8); and $\frac{\dot{W}'_{\bar{c}}}{W'_{\bar{c}}}$ is the proportionate rate of fall of the marginal utility of average consumption which, by definition, is the CRI (see equation 14). Therefore,

$$\text{ARI} = \text{CRI} + \frac{\dot{\bar{v}}}{\bar{v}} \quad 1/ \quad 21)$$

If we assume that β and g are reasonably constant over time then from equation 13)

$$\frac{\dot{\bar{v}}}{\bar{v}} = g \frac{\dot{v}}{v} + (1 - g) \frac{\dot{D}}{D\beta} \quad 22)$$

which says that the proportionate rate of fall of \bar{v} is the weighted average of the rate of fall of v and D , the weights being the proportions of marginal public income devoted to investment and consumption respectively.

26. Given our general formula for the ARI (equation 21)) and for the rate of fall of \bar{v} (equation 22) we can now examine specific cases. For example, if $\frac{\dot{\bar{v}}}{\bar{v}} = 0$, then

$$\text{ARI} = \text{CRI} \quad 23)$$

$1/ \frac{\dot{\bar{v}}}{\bar{v}}$ is expressed as a rate of fall and given its natural sign.

This may be quite a likely occurrence because one might expect v to decline over time (as the government increases its control over the level of investment) and D to rise (as the government increases its control over the distribution of public consumption), so that their net effect may be negligible. Alternatively, if both v and D change at the same rate and in the same direction (which implies that the government allocates public income optimally between investment and consumption) or if $g = 1$ (i.e. all public income at the margin is invested), then

$$ARI = CRI + \frac{\dot{v}}{v} \quad 24)$$

where \dot{v}/v is the proportionate rate of fall of the relative value of public investment. Note that if one estimates v from equation 19) one is assuming that v will be constant over time so that $\dot{v}/v = 0$ and $ARI = CRI$. However, if one uses equation 18), which allows for $\dot{v}/v \neq 0$, the ARI will exceed the CRI . In Appendix I we show that

$$\frac{\dot{v}}{v} = r - CRI \quad 25)$$

where r may be interpreted as the social return on public investment. Hence, given the assumptions implicit in equation 24)

$$ARI = r \quad 26)$$

To a reasonable approximation the return on public investment expressed in terms of our chosen numeraire is

$$r = sq + (1 - s)q \frac{D}{\beta v} \quad 27)$$

where sq is the proportion reinvested and $(1 - s)q$ the proportion consumed,

revalued to express it in units of public income/investment (the two are of equal value given the particular assumptions of this paragraph). Note that if $s = 1$ (i.e. all of the return is reinvested) or $D/\beta v = 1$ (i.e. consumption is as valuable as investment) then

$$\text{ARI} = r = q \quad 28)$$

This is the rationale of the traditional Bank use of the opportunity cost of capital as the appropriate discount rate.

Example

27. The following examples are intended to give some quantitative significance to the results obtained thus far. Assume the following data:

- σ (parameter of the distribution of consumption function) = 2
- G (growth rate of per capita consumption) = 3%
- s (marginal propensity to save) = 0.2%
- g (proportion of government income invested) = 0.4
- β (inverse of the shadow exchange rate) = 0.8

With these basic data we can test the sensitivity of the values of v , \bar{v} and the ARI to different assumptions about n (the parameter of the utility function),

ρ (pure time preference), q (the marginal product of capital) and T (the number of years until the economy attains a reasonably satisfactory and stable growth rate).

Table 3

	q(%)	n	ρ (%)	CRI(%)	D	T = 40				T = ∞		
						v	\bar{v}	ARI(%)		v	\bar{v}	ARI(%)
1	15	0	0	0	1.0	23.9	10.3	4	3	∞	∞	3
2	15	1	0	3	1.0	9.9	4.7	5	4	∞	∞	3
3	15	2	0	6	1.3	5.7	3.3	6	6	6.5	3.6	6
4	15	2	2	8	1.3	3.9	2.5	8		3.9	2.5	8
5	10	2	2	8	1.3	2.6	2.0	8		2.6	2.0	8

The CRI is computed from equation 14) and D , the distribution summary measure, is derived from Table 2. For $T = \infty$, v , the value of public investment, is derived from equation 19), and the ARI equals the CRI. For $T = 40$, v is derived from equation 18) assuming a value of $i_T = 8\%$, the other variables retaining their original values. Under column 1 of the ARI for $T = 40$ it is assumed that $\dot{D} = \dot{v}$ (which implies that the government allocates its income optimally) so that from equation 22 $\frac{\dot{v}}{\bar{v}} = \frac{\dot{v}}{v}$ and the latter can then be derived from equations 25) and 27). Under column 2 it is assumed that $\dot{D} = 0$ so that from equation 22) $\frac{\dot{v}}{\bar{v}} = g \frac{\dot{v}}{v}$ and once again \dot{v} can be derived from equations 25) and 27). Finally, \bar{v} was deduced from equation 13.

28. Two general points emerge from Table 3. Firstly, the ARI appears to be more closely related to the CRI than to q , the opportunity cost of capital; and secondly, the results are only sensitive to the value of T if $i < sq$. On specific points, the ARI in row 1 for $T = \infty$ equals sq because in the economy envisaged here the government only values investment (i.e. $v = \infty$) so that the appropriate discount is the rate of reinvestment. The difference between columns 1 and 2 of the ARI for $T = 40$ disappears in rows 4 and 5 because $i_0 = i_T$. Finally, note that traditional Bank analysis would imply the following values:

$$D = 1, \quad v = 1 \quad \text{and} \quad \bar{v} = 1$$

and would use a discount rate of 15% (10% in row 5).

III SHADOW WAGE RATES

29. Thus far, we have shown how one may calculate weights which reflect the basic trade-off between growth and income distribution. This, however, is only part of the estimation of shadow prices and in this section we turn to the other elements of the shadow price, i.e. the foregone output or opportunity cost and the increase in income (if any) accruing to the factor of production. As an illustration we consider the shadow wage rate (SWR) but the principle is perfectly general.

One general point must be stressed at the outset: shadow prices for labor will vary considerably depending on such factors as skill and location. We will present a general discussion of these factors and then conclude with a specific illustration of one shadow wage rate which, however, may have a fairly wide application.

Foregone Output

30. The use of labor in a project prevents its use elsewhere. The foregone output of this labor in its best alternative use is a major component of the social cost of using that labor, since productive efficiency is presumably a basic objective of policy. We need therefore an estimate of output foregone. If the market for the type of labor concerned is reasonably efficient, then the market wage gives a good measure of the marginal product of that labor at market prices (m) as well as the foregone output. In general, this is a good approach for the output foregone of skilled labor, but labor markets for unskilled labor may also be sufficiently active, even in rural areas, to permit the use of this method. The unskilled labor may be drawn from family farms (as is often the case in rural areas), but it is still acceptable to estimate its marginal product by the going (rural) wage rate provided that the labor market is fairly active and that, at the margin, the family farms generally participate in that market. Note here that the

relevant labor market and wage, is not where the labor is to be employed but where it comes from. If rural labor is drawn into, say, industrial employment, with industrial wages well above rural ones, the question is whether rural wages form an acceptable measure of output foregone; the higher industrial wage may or may not reflect marginal labor output in industry, but is certainly no yardstick of rural labor output foregone. In all these cases, the estimate of labor output foregone at market prices may need further adjustment by means of an accounting ratio (α) which transforms its market value into its social equivalent in foreign exchange.^{1/}

31. The estimation procedure of para. 30 relies on the equality of the foregone output and labor's marginal product, and of the marginal product and the market wage. This approach is not always suitable or feasible. For example, if more than one rural worker migrates to the urban sector in response to the creation of only one job in that sector, the foregone output will be considerably greater than one worker's marginal product. Whether this is a serious complication is as yet a moot question. For the many Bank projects situated in rural areas the problem probably does not arise. If there is good reason to believe that an urban project will have an "excess migration" effect then some attempt should be made to assess its cost.

32. If the relevant labor market is imperfect then it is not correct to equate the foregone output with the market wage concerned. Imperfect markets may often be encountered in rural areas especially in the slack agricultural seasons. Frequently, the market wage will be above the supply price of labor (i.e. the wage at which labor is willing to work^{2/}), which implies that there is a labor surplus in

^{1/} For some categories of labor, especially semi-skilled and skilled labor, it may not always be possible to identify the nature of the foregone output even though it is safe to assume that the market wage paid, both in the project and elsewhere, is a good measure of the market value of the foregone output. In other words, it may not always be possible to identify the appropriate accounting ratio, in which case it will be necessary to resort to a "standard conversion factor" (see para. 55).

^{2/} This is further discussed in the next subsection, para. 34 ff. Here we are only concerned with foregone output.

in the area. Output foregone when employing workers from the area is less than the market wages prevailing there. However, output foregone is not necessarily zero. For example, the "unemployed" labor may occupy themselves with some form of self-employment, such as house repair or fishing. Even if there is no foregone output at all in the slack season, it may be expected that the labor force will be more or less fully employed during the peak agricultural season. In determining the foregone output, and hence the cost of labor, it becomes therefore necessary to specify the season(s) for which the labor is required. Moreover, the labor surplus may disappear over time, especially if the area experiences a reasonable rate of economic development. Hence, if the labor is required for a project lasting twenty years, it may be misleading to assume that currently surplus labor will have a zero foregone output over the whole life of the project. This is one aspect of the general problem of predicting future prices for the purpose of project analysis.

33. Lastly, in some rural areas there is no labor market. On family farms which do not hire, or hire out, workers, labor will be employed up to the point where the marginal product equals the disutility of extra work (i.e. the value of foregone leisure). Removing one worker will mean an immediate loss of output equal to that worker's marginal product. But, assuming diminishing returns, the removal of one worker will increase the marginal product of the remaining members of the family who will therefore increase their work input up to the point where their marginal product again equals their marginal disutility of effort. If this marginal disutility is constant over the relevant range of hours worked per man, the net effect on output will be zero. On the other hand, if the marginal disutility rises sharply with extra work, the remaining family members will hardly increase their working hours and the net foregone output will approximately equal the marginal product of the removed worker. In general the foregone output will be somewhere

between zero and labor's marginal product.^{1/}

Disutility of Effort

34. A new job frequently calls for an increase in effort on the part of the worker either because he has to work more hours or because the work is more arduous. The disutility of this increased effort can be measured by the difference between labor's supply price for the new and the old jobs. This supply price is the wage that must be paid to induce the worker into a particular employment and reflects his private evaluation of all its aspects, pleasant and unpleasant. In a perfect labor market, the supply price of labor equals the market wage. In imperfect markets, however, the market wages will exceed labor's supply prices, so that wage differentials are a poor guide to differences in supply prices for different occupations. This may often be the case in LDC's, especially with respect to the transfer of labor from the rural to the urban sector. In such cases one needs to resort to a direct assessment of any disutility of effort that may be involved in the new job. For labor on family farms, in an area without an active labor market, changes in marginal labor product provide a rough estimate of changes in supply price and increased effort (see para. 33 above). Finally, the supply price of an unemployed man is not necessarily zero. There is considerable evidence that unemployed labor cannot be tempted into employment below a (subsistence) wage of three kilograms' grain equivalent per day. In some cases it may be possible to ascertain the specific minimum or "reservation" wage necessary to activate the unemployed in any particular area; otherwise this "universal" subsistence figure may be used.

35. Crude estimates of the disutility of increase effort probably suffice in practice. For example, if the labor for a project is drawn from full-time employment, it is often reasonable to assume that there is no increased effort involved.

^{1/} Note that similar complications arise, even with a perfect labor market, if the project's demand for labor is so large as to affect the wage level. Output foregone in that case depends on the elasticity of labor response to higher wages in the area. Wages are then not a good measure of output foregone (cf discussion of accounting prices, in Appendix 1, para. 17).

For previously unemployed labor a rough estimate of the "reservation" wage, as indicated above, will give an acceptable measure of the disutility of effort. Where more information is available, the estimates can be improved. The resulting value will be a measure of the private cost of increased effort in terms of the additional income which is required to just offset that increased effort. The government, however, may not regard the private cost of increased effort as an accurate measure of its social cost.^{1/} In some cases, the additional income received may more than offset the increased effort. Let E be the ratio of the wage earner's own evaluation of the disutility of effort to his additional income and ϕ be the ratio of the social to the private evaluation of the disutility of effort. Then the social cost per unit of additional income is ϕE . If the government costs increased effort in the same way as the private individual, then $\phi = 1$. However, in its desire for development (i.e. to increase consumption), the government may not consider increased effort as a cost, in which case $\phi = 0$. Intermediate values can also be used. If $E = 1$ then the increased income for the wage earner is exactly offset by the increased effort and $E = 0$ means that there is no increased effort.

Changes in Income

36. Employment on the project frequently involves changes in income especially if the labor is drawn from the rural sector. In general, a shift in employment of industrial/skilled workers does not result in increased labor income, so the following discussion mainly applies to unskilled rural labor. The transfer of one worker from rural un(der) employment to full-time employment on a project has different effects on income depending on where he comes from. If the labor is drawn, directly or indirectly, from an area with an efficient labor market, then

1/ Note that given a welfare function which only includes consumption, it is not strictly correct to introduce the disutility of effort or the value of leisure into the SWR. Theoretically, one would have to redefine the welfare function to include leisure and then deduce a new set of shadow prices. However, one might expect that the SWR would be the only price affected to a significant extent.

the increase in income will equal the difference between the new wage and the wage in the alternative employment. If the laborer is landless, this increase in income will accrue solely to him: if the wage in the new job is w , then the increase in his income is $(w - m)$, where m , as before, is the marginal product in his previous employment which, in an efficient labor market, equals the rural wage. For farm family labor, however, part of the increase in income may accrue to the transferred worker's family. For example, if the worker was enjoying an income of a on the farm, where $a > m$, then, when he transfers to his new employment, $(w - a)$ accrues to the transferred worker while the remaining members of the family enjoy the residual increase of $(a - m)$. Furthermore, if the worker comes from a farm which neither hires nor hires out labor, then the increase in income accruing to the remaining family members would be greater than $(a - m)$ because the foregone output is likely to be less than his output (see para. 33 above). Finally, note that if labor is transferred from the rural to the urban sector part of the increase in income may be offset by higher prices.

37. The changes in income should be adjusted to obtain their social value/cost. If the increase in income is $(w - m)$ then the first step is to obtain the cost to the government in terms of foreign exchange, i.e. $\beta(w - m)$ (see paras. 8 and 9). The second step is to obtain the social value of the increased income to the wage earner. This will depend on the proportions consumed and saved and on the disutility of effort. Assume that s_w is the proportion saved then the value of this is $s_w \frac{v}{v}$ where v (\bar{v}) is the value of investment (public income). If we treat leisure as a consumption good then the net increase in consumption per unit of increased consumption is $(1 - s - E)$ where E is the ratio of the value of foregone leisure to the increase in income. We wish to obtain its social equivalent. The disutility of effort must be weighted by ϕ , the ratio of the social to the private value of leisure. This gives a net increase in consumption in the eyes of the government of $(1 - s - \phi E)$ which must be revalued in terms of public income. The weight (W) was expressed as $W = d/\beta\bar{v}$, where d and β will be specific to this income group.

Thus, the net social cost of the increased income per unit of income is

$$\left[1 - \frac{sv}{v} - (1 - s - \phi E) \frac{d}{\beta v} \right].$$

The numerical implications of this result will be examined for a particular case in the following four paragraphs.

The SWR: an illustrative example

38. We can now insert the various elements of the SWR into the basic formula for a shadow price, which was written in equation 2) as

$$\text{Shadow Price} = \text{Efficiency Price} + \text{Change in Income} \times \beta \times (1 - W)$$

The efficiency price, or opportunity cost of labor has been discussed in paras. 30 to 33, the change in income in paras. 36 and 37 and the weight (W) and β have been discussed in paras. 8 to 24. In the particular case of the SWR we have an additional element in the form of the disutility of increased effort (see paras. 34 to 35). From the discussion; it should be apparent that the various elements of the formula depend on the type of labor, i.e., we must estimate a SWR for each particular type of labor. Consider the case of an unskilled worker being drawn from a perfect labor market into employment which pays a fixed wage (w) which exceeds the foregone marginal product (m). If the worker consumes the entire increase in income then, using the notation already established,

$$\text{SWR} = m\alpha + (w - m)\beta \left[1 - (1 - \phi E) \frac{d}{v\beta} \right] \quad 29)$$

where $m\alpha$ is the foregone output measured at border prices (i.e. the efficiency price), $(w - m)\beta$ is the increase in consumption measured at border prices which is multiplied by a weight reflecting the loss of government income (hence the figure one) and the gain in private welfare (hence the term $d/v\beta$). The gain in private welfare is reduced by any disutility of effort (ϕE).

39. It is useful to consider further the implications of certain critical values of the parameters, or of certain simplifying assumptions that may be appropriate:

- i) Set $d / \bar{v}\beta = 1$ (i.e. the government is indifferent about the distribution of income between the private and public sectors)
and set $\emptyset = 0$ (i.e. the social cost of increased effort is zero).

Then,

$$SWR = m\alpha \quad (30)$$

This SWR only measures foregone output (in terms of accounting prices) and is a good starting place for the examination of alternative assumptions.

- ii) Set $v = \infty$ (i.e. the government does not value consumption), so that $\bar{v} = \infty$, and set $\emptyset = 0$. Then,

$$SWR = m\alpha + (w - m)\beta \quad (31)$$

This SWR would be appropriate if the government's sole aim is to maximize growth. Equation 31) can be rewritten as

$$SWR = w\beta + (\alpha - \beta)m \quad (32)$$

The factor $(\alpha - \beta)$ adjusts the marginal product so that it reflects accounting rather than market prices (see Section IV below). α is applied to m when it is viewed as output: β is applied to m when it is viewed as consumption goods bought with the income represented by m . If $\alpha = \beta$, then the $SWR = w\beta$, i.e., the consumption cost of the market wage paid on the project (in terms of accounting prices).

- iii) Set d and \bar{v} equal to specific values based on the country economist's assessment of the country's income distribution and growth objectives and set $\emptyset = 0$. Then,

$$SWR = m\alpha + (w - m)\beta \left[1 - \frac{d}{\bar{v}\beta} \right] \quad (33)$$

iv) Set d and \bar{v} equal to specific values and set $\phi = 1$. Then,

$$SWR = m\alpha + (w - m)\beta \left[1 - (1 - E)\frac{d}{\bar{v}\beta} \right] \quad (34)$$

This SWR considers the social cost of private effort on a par with other costs and benefits. The SWR will be lower if ϕ is set at a level less than unity, reflecting a judgment that the government does not consider increased private effort as much of a cost as output foregone or consumption.

40. In the past, Bank appraisals have usually assumed that the SWR equals the foregone marginal output at market prices i.e., $SWR = m$. In other words, the implicit assumptions have been:

- i) the government does not regard increased effort as a social cost so that $\phi = 0$;
- ii) the distribution of consumption is considered optimal or the government does not wish to use project selection to influence the existing distribution so that $d = 1$;
- iii) there are no trade taxes affecting consumption so that $\beta = 1$;
- iv) public income is considered as valuable as private consumption so that $\bar{v} = 1$;
- v) the market price of the foregone output reflects the social value of that output so that $\alpha = 1$, and
- vi) the foregone output equals labor's marginal product.

Example

41. Assume the following best estimates of the parameters required for the SWR given by equation 29):

$$\begin{array}{lll}
 m/w = 0.5 & \bar{c}/w = 1.0 & E = 0.5 \\
 \alpha = 0.9 & \beta = 0.8 & \\
 n = 2 & \phi = 0.5 & \\
 & \bar{v} = 4 &
 \end{array}$$

Given the value of n and the ratio \bar{c}/w , the distribution parameter, d , can be determined from table 1. The value of \bar{v} implies that public income is considered four times as valuable as average income. Using the formulas given in paras.

38 and 39, the alternative SWR estimates are:

i) Using equation 29)

$$SWR = \left[0.5 \times 0.9 + 0.5 \times 0.8 \left\{ 1 - (1 - 0.5 \times 0.5) \frac{2.3}{4 \times 0.8} \right\} \right] w = 0.64w^{1/}$$

ii) Using equation 30)

$$SWR = 0.5 \times 0.9 w = 0.45 w$$

iii) Using equation 31)

$$SWR = \left[0.5 \times 0.9 + 0.5 \times 0.8 \right] w = 0.85w$$

iv) Using equation 33)

$$SWR = \left[0.5 \times 0.9 + 0.5 \times 0.8 \left(1 - \frac{2}{4 \times 0.8} \right) \right] w = .60 w^{1/}$$

v) Using equation 34)

$$SWR = \left[0.5 \times 0.9 + 0.5 \times 0.8 \left\{ 1 - (1 - 0.5) \frac{2.7}{4 \times 0.8} \right\} \right] w = .68w^{1/}$$

As one might expect the smallest SWR occurs when one only considers foregone output (equation 30) which is the traditional Bank approach. If one then treats the increased consumption as a pure cost (equation 31) we obtain the maximum SWR.

Recognizing that consumption does have some value (equation 33) reduces the SWR, but the inclusion of the disutility of effort (equation 34) again raises the SWR.

Finally, if the government only costs part of the disutility of effort (equation 24) we arrive at a slightly lower SWR.

42. The discussion of the SWR showed how the increased private wage income generated by employment should be weighted to reflect both its foreign exchange cost to the government and its value to the worker. The former received a weight of one; the latter a weight represented by the symbols $d/\sqrt{\beta}$ or v/\sqrt{v}

1/ The value of d is taken from table 1 using a value of $c = w - \phi E(w - m)$. For equation 33) $\phi = 0$; for equation 34) $\phi = 1$ and for equation 29) $\phi = 0.5$.

depending on whether the income is consumed or invested, where d is the distributional parameter, β an accounting ratio for consumption, v the shadow price of investment, and \bar{v} the shadow price of public income. All increases in income attributable to the project, from profits, rents, consumer surplus, should be treated in a similar manner, but four points should be borne in mind. Firstly, the value of d will vary with the existing level of the individual's consumption. For example, one might want to attach a high weight if the increased consumption accrues to peasant farmers and a very low weight if it takes the form of profits paid out to the rich. Secondly, one should only consider increases in income. For example, if it is reasonable to assume that a rentier will receive the same interest payment wherever he invests his capital, then investing in a government project will not imply any increase in income and hence consumption and/or savings. Thirdly, some increases in income may appear on the cost side and some may appear on the benefit side. In the SWR case, the increased income was included on the cost side. If, however, one wanted to transfer it to the benefit side, a change in sign is all that is required. In other words, the numerical value of the weight is not affected by the transfer but the sign must be changed. And, finally, note that distributional weights are not applied to the output or sales generated by the project, but only to the increases in income to which it gives rise. In other words, the benefits of a project are not greater because its output is sold to the poor rather than the rich (unless sales to the poor involve subsidies, i.e. income transfers). What matters is whether their consumption (income) increases because of the project.

Consumer Surplus

43. Consumer surplus is usually defined as the area below the demand curve and above the price line. A reduction in the price of a commodity causes an immediate gain to consumers represented by the quantity they consume times the price reduction. This increase in consumers' income is partially saved and partially consumed. The additional consumption has a foreign exchange cost to the govern-

ment and a benefit to the consumer, each of which must be valued in the manner described in para. 41. The price reduction may also induce consumers to buy more of the commodity and this will again lead to an increase in consumer surplus, i.e. the small consumer surplus "triangle." This triangle represents an increase in the utility that the consumer derives from his income but not an increase in consumption. The consumer surplus triangle, therefore, does not have a foreign exchange cost and so should only be weighted by the ratio of the distributional parameter, expressed in foreign exchange (d/β) to the shadow price of public income (\bar{v}). For small price changes it may be reasonable to exclude the triangle, but for large price changes the triangle becomes more important and some attempt should be made to measure it.^{1/}

IV COMMODITY PRICES

Accounting Prices for Traded Commodities

44. It is convenient to distinguish three categories of tradables:
- i) Commodities which, at the margin, are being imported (exported) and for which the elasticity of world supply (demand) is infinite.
 - ii) Commodities which, at the margin, are being imported (exported) and for which the elasticity of world supply (demand) is less than infinite.
 - iii) Commodities which are not currently being traded but which ought to be traded if the country adopted optimal trade policies.

Each category will be discussed in turn.

Infinite Elasticities

45. Imported commodities falling in category (i) should be valued/costed at the cif border price, plus the relevant marketing margin revalued at accounting prices.^{2/} Similarly, exported commodities falling in this category should be valued/

^{1/} This discussion ignores accounting ratios to convert the market value of consumption to their social values. The valuation of accounting ratios is further discussed below in Section IV.

^{2/} This revaluation is an aspect of the general revaluation of non-traded commodities and will be discussed in paras. 52-54. It is recommended that the marketing margins be kept separate and then be converted en bloc into accounting prices at the end of the exercise.

costed at the fob border price, minus the relevant marketing margin revalued at accounting prices.^{1/}

46. If the project data include inputs/outputs in physical units, the border prices can be applied directly. If, however, the inputs/outputs are expressed in value terms at domestic prices, as will often be the case for minor items, it becomes necessary to estimate the ratio between (adjusted) border and domestic prices. Domestic prices may be obtained directly from wholesale price statistics or be estimated from the border price. For importables, the domestic price will be $(1 + t_m) (1 + h)$ times the border price (expressed in units of domestic currency at the official exchange rate), where t_m is the ad valorem tariff and h the appropriate wholesale margin expressed as a proportion of the cif-plus-tariff price. Similarly, the domestic price of an exportable is $1/(1 + t_x) (1 + h)$ times the fob border price, where t_x is the export duty if positive or export subsidy if negative, and h is again the appropriate wholesale margin. Too much effort should not be put into estimating wholesale margins; relatively crude efforts will suffice. Usually, the main adjustment will be for import tariffs and export duties or subsidies about which information should be readily available.

47. Numerous practical complications have been omitted from this account. For example, a domestically-produced version of an importable may be considered qualitatively inferior (superior) to the imported article; border prices may fluctuate; domestic prices may include an excise tax. In principle, all such aspects should be considered; in practice, it is recommended, unless a commodity is a major input or output, that estimates be based on information in trade statistics and data on tariffs and marketing margins. Finally, direct projections of border prices over time tend to be easier than projections of domestic prices converted into border prices by means of the projected future ratio between domestic and border prices.

^{1/} This revaluation is an aspect of the general revaluation of non-traded commodities and will be discussed in paras. 52-54. It is recommended that the marketing margins be kept separate and then be converted en bloc into accounting prices at the end of the exercise.

Finite Elasticities

48. If a project causes an increase in the demand for or supply of commodities falling in category (ii), there will be a change in the border price which will have repercussions on domestic consumers and producers. Most LDCs are too small to influence the border prices of importables. The following discussion is therefore couched in terms of an increase in output of an exportable for which the world demand is less than perfectly elastic. In this case it is still necessary to establish the relationship between the border and domestic price, but in principle a further adjustment is now required to allow for the transfers of income caused by the price change and the effects on foreign exchange. This includes the social value and (foreign exchange) cost of changes in producer and consumer income plus the foreign exchange effects of a larger volume of exports at lower prices and of switches in domestic production and consumption. In practice, it may be sufficiently accurate to only consider the direct foreign exchange effect and ignore the income transfers. The appropriate accounting ratio is then $\left(1 - \frac{1}{\epsilon}\right)$ (where ϵ is the elasticity of foreign supply) which when multiplied by the border price is the marginal export revenue.^{1/}

Potentially Traded

49. Category (iii) includes commodities which are not currently being traded but which "ought" to be traded if the country adopted "optimal" trade policies. This applies to industries which produce behind prohibitive tariffs or quotas and for which the marginal cost (at accounting prices) of increasing domestic production exceeds the cost of importing. In the evaluation of projects which use inputs supplied by such industries the evaluator faces a dilemma. On the one hand, he does not want to jeopardize the project by pricing the input at the marginal cost of inefficient domestic production when, in the absence of the protective

^{1/} Note that if foreign demand is perfectly elastic (i.e. $\epsilon = \infty$), then the correct accounting price is the border price, as prescribed for commodities falling in category (i).

barrier, the input could be imported at a much lower cost; on the other hand, he does not want to use the (relatively) low border price if in fact the input will be supplied by a high cost domestic producer. The solution is to predict the actual source of supply, and to price the input according to the cost of that supply. However, the presumption should be that the predicted supplier will be the lowest cost supplier, and that the government can be persuaded to lower the prohibitive tariff (or remove the quota) so that at the margin the input is actually imported.^{1/} If this proves impossible, the government may permit at least the project access to imports, thereby making the input an importable for the purposes of the evaluation. If, despite all efforts, it is clear that the project will be supplied by the high-cost domestic producer, the input should be regarded as a non-tradable (see paras. 52-54). Note, however, that production may take place behind a high tariff, while at the margin additional demand, e.g. for the project, is met by imports; the inputs should then be treated as traded.

50. There is one important exception to this general prescription. Some industries are afforded temporary protection during their early development, whilst their efficiency is being increased to a level which will permit them to compete successfully against imports. Such industries should be encouraged. It is recommended, therefore, that if an infant industry is clearly identifiable, project demand should be supplied by that industry but the input costed at its border price in order not to jeopardize the project. However, caution should be exercised in deciding whether a protected industry can be considered in its infancy. Frequently, import substitution industries never become competitive with imports and so each case must be examined on its merits.

51. Similar comments apply to the valuation of a project's output which, although potentially importable, is not currently being imported at the margin because

^{1/} What matters is not whether the project imports its inputs, but whether the demand from the project leads to additional imports to meet the increase in domestic demand.

of high import tariffs or quotas. Every effort should be made to persuade the government to remove the protective barrier (unless the infant industry argument applies) so that the output can be treated as a tradable. If this fails, the output should be regarded as a non-tradable and valued accordingly (see paras. 52-54). In that case it is a useful exercise to evaluate the project also as though its output were tradable. If the project is still profitable when the output is valued on the basis of the cif price, then the project will survive even if at some future date the protective barrier is removed. If the project is not profitable at border prices, then the excess cost of domestic production (properly assessed) over the cost of imports measures the cost of retaining the protective barrier. The government should be made fully aware of the cost that will be incurred if they proceed with the project rather than lower the protective barrier to permit imports.

Accounting Prices for Non-Traded Commodities

52. Non-tradable commodities are defined as having a domestic supply price, at the given level of local demand, below the cif price of imports but above the fob price of exports.^{1/} Depending on the elasticities of supply and demand, an increase in demand for non-tradables on account of the project will be satisfied by decreased consumption elsewhere in the economy and/or increased production. If the main source of supply is increased domestic production, without a significant price increase, it is recommended that the accounting price be interpreted as the marginal social cost (MSC) of increased production. Alternatively, if the main source of supply is reduced consumption elsewhere, with a significant price increase, it is recommended that the accounting price be interpreted as the foregone marginal social benefit (MSB) in consumption. In the long-run, it may be reasonable to assume that demand is primarily met by increased production but in the short-run, especially for capital intensive non-tradables, the supply may be relatively fixed.

^{1/} This definition should also include commodities which are potentially tradable but actually non-tradable because of trade barriers. See paras. 49-51.

Estimating MSC

53. The MSC of a non-tradable is determined as follows: decompose the non-tradable into its constituent inputs and value each input at its accounting price. Some of these inputs will be tradables with accounting prices as discussed in paras. 44-51. Others will be primary factors, with shadow prices determined in the manner used for labor (see paras. 29-43). The remaining inputs will themselves be non-tradables, which in turn must be evaluated in this manner through a further round of decomposition. Eventually everything will be expressed in terms of tradables and primary factors. The degree of sophistication required will depend on the case in hand and the availability of time and data.

Estimating MSB

54. If demand is met by decreasing consumption elsewhere, the accounting price is the MSB. This may be calculated by observing the effects of withdrawing a unit of the commodity from consumption elsewhere. In the first instance, consumers will switch their expenditure elsewhere which will reduce the amount of foreign exchange (either directly through imports and exports or indirectly through non-tradables) available to the government. Thus, if the market price is p , then the foreign exchange cost is $p\beta$ where β is the inverse of a SER^{1/} (i.e. the ratio of international to domestic prices). However, the price increase required to reduce consumption will cause a transfer of income from consumers to producers^{2/} equal to the original quantity consumed times the change in price. The social cost/benefit of this transfer will depend on the weights appropriate to the income groups involved. These weights must be derived in the manner described in para. 12. If it is thought that in general producers are richer than consumers the net effect of the transfer would constitute a

1/ More accurately $\beta = \frac{OER}{SER}$ where OER is the official exchange, i.e. β translates domestic prices into international prices expressed in units of the domestic currency. Dividing by the OER translates them into foreign exchange proper.

2/ The consumer surplus "triangle" is omitted on the grounds that it will be negligible but see para. 43.

social cost, but if producers and consumers are indistinguishable it will be reasonable to assume that the transfer has a zero net social cost.

Standard Conversion Factor (SCF)

55. Whilst in general it is recommended that one estimate a different SER for different non-tradables and different baskets of consumption goods, it is useful to have available a standard conversion factor or general SER which can be used for minor non-tradables or for the non-tradables remaining after one or two rounds of decomposition. For this purpose, one might use the ratio of the value at international prices of all exports and imports to their value at domestic prices.^{1/} This is a generalisation of the formula for β , which only included commodities entering final consumption, and would correspond to the inverse of the SER if only one such rate were calculated.

Dependence on Policy Assumptions

56. The accounting ratios are sensitive to the assumptions made about the future development of the economy and, in particular, of trade policy. Changes in tariffs, quota-restrictions and the exchange rate will affect the accounting ratios and the remuneration of primary factors as relative (domestic) price change and resources are reallocated. The range of possible policy scenarios is obviously large. Only two (extreme) alternatives are considered here to illustrate the considerations that should be borne in mind in adjusting shadow prices to expected policy developments.

57. In the first case the country is faced with a balance of payments deficit caused by "living beyond one's means", while domestic factor prices are inflexible. If the country economist envisages a devaluation to cope with this situation, then it may be appropriate to recalculate some of the shadow prices. Prices of tradables will

^{1/} Imports subject to fixed quotas should be treated as non-tradables in perfectly inelastic supply provided that they are already fully used and that they are not expected to be relaxed in the near future.

not be affected because they are already valued at border prices (in foreign exchange). Non-tradables will be affected by substitution in production and consumption, reflecting the increase in the domestic prices of tradables relative to non-tradables. Real wages and hence the foreign exchange cost of labor's consumption (and of primary factors in general) will be reduced. The information required to trace through these effects is formidable and approximations will be necessary in practice. For example, it may be reasonable to assume, especially in the short-run, that non-tradable production has fixed input-output coefficients, i.e. constant costs. If so, MSC is not affected (except for its consumption component). The major change will occur in the foreign exchange cost of consumption, i.e. in β . If substitution in consumption is small, the reduction in the foreign exchange cost of consumption is measured by multiplying the previous estimate of β by the ratio of the old to the new official exchange rate, defined as so many units of domestic currency per dollar.^{1/} Since this tends to lower the SWR (and other factor prices), the return on public investment may be increased. Thus the balance of payments deficit is overcome by reducing consumption and investment levels.

58. In the second case the economy is thought to be moving rapidly towards a (relatively) free-trade policy. Now market prices are expected to correspond to world prices so that there is no need to estimate SERs but one must estimate the free-trade exchange rate, which will depend on the elasticities of domestic supply of exports and demand for imports, which themselves will depend on substitution pattern in production and consumption changes in the prices of primary factors. As a first approximation, a convenient simple formula is

$$\frac{\text{OER}}{\text{FTER}} = \frac{XE + M\eta}{XE(1 - t_x) + M\eta(1 + t_m)} \quad 30)$$

^{1/} These comments do not apply to the type of economy which is experiencing successive rounds of exchange rate devaluation and domestic price inflation. As a first approximation one might assume that in such an economy the real exchange rate is constant.

where X is the fob value of exports and M the cif value of imports under protection; ϵ the elasticity of export supply and η the elasticity of import demand; t_x the average export tax (negative if it is a subsidy) and t_m the average import tax or tariff equivalent if quantitative restrictions are used; OER the existing official exchange rate and FTER the free trade exchange rate (per unit of foreign currency). For SCF and/or β we now substitute an estimate of $\frac{OER}{FTER}$, as a measure of the foreign exchange cost of a unit of domestic expenditure. ^{1/} An estimate of MSC is facilitated if we may assume that substitution possibilities in production are limited so that the existing input-output structure can be used to estimate MSC. However, MSC now needs to be adjusted to reflect changing factor prices on account of the trade liberalization. Again it may be necessary to reassess the return from public investments.

59. The approach to estimating the free trade exchange rate, and MSC, depends on the nature of the exercise. If the country economist confidently expects that a free trade policy will be implemented in the immediate future then considerable care should be taken in estimating both the FTER and the likely effects on the prices of primary factors. Cruder methods will be appropriate if the intention is simply to test the effects of a free trade policy if such a policy were implemented. t_m and t_x can be set equal to the ratio of total import duties to total imports and of total export taxes to total exports, respectively. If quantitative restrictions are employed to restrain imports, some attempt should be made to calculate the tariff equivalent. If the country is initially in balance of payments equilibrium, the only estimates required are for the elasticities, and M and X . The following table shows the sensitivity of the ratio of the OER to the FTER for different assumptions about the elasticities assuming that $t_m = 0.3$, $t_x = -0.05$ and $X = M$.

1/ Note that if $\epsilon = \eta$, the $\frac{OER}{FTER}$ (equation 30) equals the SCF (para. 55) if there are no quantitative restrictions on trade in the non free-trade position.

Sensitivity of $\frac{OER}{FTEP}$

$\epsilon \backslash \eta$	1	2	4	6
1	0.85	0.82	0.80	0.79
2	0.88	0.85	0.82	0.81
4	0.91	0.88	0.85	0.83
6	0.92	0.90	0.87	0.85

The table shows that the higher the elasticity of supply (ϵ) the lower the ratio $\frac{OER}{FTEP}$, and that the higher the elasticity of demand (η) the higher the ratio.^{1/}

In the event that no information is available on the elasticities, a reasonable approximation is to assume that the elasticities are the same so that they cancel from the formula. The resulting formula then equals the average SCF discussed in para. 55.^{2/} As is apparent from the table, the ratio $\frac{OER}{FTEP}$ is not very sensitive to different assumptions about the elasticities.

60. The country economist should estimate the main conversion or accounting ratios (i.e. β for a high and low income group, and SCF). He should also analyze the taxes assessed on non-tradable productions. These data provide sufficient information for a rudimentary analysis of accounting ratios for non-tradables (see para. 53). Where more time and information are available, it would be useful for project economists to estimate specific accounting ratios for the more important non-tradables (e.g. construction and electricity). In order to ensure consistency throughout a country, the country economist should act as coordinator. The country economist should also estimate the (first best) free trade exchange rate as a bench mark for sensitivity analysis and a basis for discussions of government policy.

^{1/} The result holds as long as $t_m > t_x$ which is probably the typical case.

^{2/} However, the formula developed in this paragraph includes, in principle, the effects of quantitative restrictions and tariffs whereas that of para. 55 assumes that the quantitative restrictions will be retained and therefore excludes them.

ECONOMIC ANALYSIS OF PROJECTS

APPENDIX I: TECHNICAL DERIVATION OF SHADOW PRICES

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A P P E N D I X I

TECHNICAL DERIVATION OF SHADOW PRICES

I INTRODUCTION

1. The Annex has discussed in fairly general terms the ideas underlying the derivation of shadow prices. The derivation itself, however, was not rigorous, the intention being to present an intuitively acceptable rationale of shadow pricing. Ideally, the complete set of shadow prices should be deduced from a fully specified model of the economy, in which the various constraints are explicitly identified. The general equilibrium approach to shadow pricing has obvious conceptual advantages over partial equilibrium analysis, but the general equilibrium models presently amenable to analytical solution are necessarily fairly simple. In the following, the basic ideas are established in very general terms, but for the derivation of individual shadow prices we resort to partial equilibrium analysis.^{1/}

II DERIVATION OF WEIGHTS

Welfare Function

2. The welfare function assumes the following
- i) No consumption externalities, i.e. the individual's utility derives solely from his own consumption;
 - ii) Total welfare in any period is the sum of the individual utility levels; and
 - iii) Each individual's utility function is the same and displays diminishing marginal utility.

^{1/} The DRC is currently engaged on research to develop a general equilibrium model which will permit the derivation of the shadow prices discussed here.

Given these assumptions welfare in period t may be expressed as:

$$W_t = \int_{c_0} U(c) f(c) dc \quad 1)$$

where $U(c)$ is the utility from consumption level c , $f(c)$ is the density function of the distribution of consumption and $U'_{cc} < 0$. The minimum level of consumption is denoted by c_0 . The government is assumed to maximize the following objective function:

$$\text{Max} \int_0^{\infty} W_t e^{-pt} dt \quad 2)$$

where $p \geq 0$ and is the rate of pure time preference.

Constraints

3. Assume that a project earns a unit of foreign exchange, π of which accrues to the government and the remainder $(1 - \pi)$ to the private sector in the form of increased consumption. The increase in welfare (ΔW) may be written as

$$\Delta W = W'_G \pi + W'_F (1 - \pi) \quad 3)$$

where W'_G (W'_F) is the increase in welfare generated by a marginal increase in the quantity of foreign exchange devoted to public income (private consumption). In certain circumstances, the government would be able to secure, through the use of the fiscal system, the equality of W'_G and W'_F . If such were the case, the task of the project analyst would be greatly eased because benefits could be summed without regard to the recipients of those benefits. The equality of W'_G and W'_F however, requires that

- i) the government is not compromised by the political power of non-representative sections of society;
- ii) the administrative costs of a taxation/subsidy policy are not large;
- iii) the disincentive costs of the same are not large.

If these conditions are not fulfilled, the inclusion of distribution weights in project selection offers an alternative method of maximizing welfare.

Numeraire

4. We choose as numeraire public income expressed in units of foreign exchange, i.e. w'_G is set equal to one. The weight attached to private consumption is then w'_F/w'_G . In the next 8 paragraphs, we present a method which enables the analyst to determine the value of w'_F/w'_G for different income groups. Note that w'_F reflects the value of a marginal increase in the quantity of foreign exchange devoted to consumption. Accordingly, our estimate of w'_F must take account of any distortion between foreign exchange and domestic currency caused by trade taxes. We, therefore, define

$$w'_C = \beta w'_F \quad 4)$$

where w'_C is the marginal increase in welfare derived from an additional unit of consumption when the unit is expressed in terms of domestic currency. In other words, β serves as the inverse of a shadow exchange rate (SER) designed to reflect the true value of foreign exchange in a distorted economic environment.^{1/} Inasmuch as different income groups consume different baskets of commodities which are taxed differentially, then a different β must be estimated for each income group. Finally, define

$$d = \frac{w'_C}{w'_G} \quad \text{and} \quad \bar{v} = \frac{w'_G}{w'_C} \quad 5)$$

where w'_C is the increase in welfare from additional consumption at the average level of consumption. Inspection of equations 4) and 5) reveals that

$$\frac{w'_F}{w'_G} = \frac{d}{\bar{v}/\beta} \quad 6)$$

The remainder of this section will discuss methods of estimating d , \bar{v} and β thus defined.

^{1/} In fact, β translates domestic prices into international prices expressed in units of domestic currency. Strictly speaking, therefore, the SER = β \dagger the official exchange rate.

Accounting Rate of Interest (ARI)

5. The discount rate is defined as the proportionate rate of fall of the value of the numeraire over time. Differentiating \bar{v} with respect to time, yields

$$\frac{\dot{\bar{v}}}{\bar{v}} = \frac{\dot{W}'_G}{W'_G} - \frac{\dot{W}'_C}{W'_C} \quad 7)$$

or
$$ARI = CRI - \frac{\dot{\bar{v}}}{\bar{v}} \quad 1/ \quad 8)$$

where ARI is the required discount rate and CRI is the consumption rate of interest defined as the proportionate rate of fall of the welfare value of average consumption. It is apparent from equation 8) that $ARI \geq CRI$ as $\frac{\dot{\bar{v}}}{\bar{v}} \leq$ zero.

Consumption Rate of Interest (CRI)

6. Given our definition of the CRI and given our particular formulation of the welfare function (equation 2)) we have in period t

$$W'_C = U'_C e^{-\rho t} \quad 9)$$

so that
$$CRI = \frac{-\dot{W}'_C}{W'_C} = \rho - \frac{\dot{U}'_C}{U'_C}$$

or
$$CRI = i = n G + \rho \quad 10)$$

where $n = \frac{U''_C}{U'_C} \cdot \frac{C}{C}$ and $G = \frac{\dot{C}}{C}$. Thus, the consumption rate of interest

is the sum of the product of the elasticity of marginal utility with respect to per capita consumption (n) and the growth rate of per capita consumption (G), and the rate of pure time preference (ρ).

1/ In this Appendix we permit $\frac{\dot{\bar{v}}}{\bar{v}}$ to be negative when v falls over time.

Derivation of "d"

7. In order to determine d we must specify a utility function. The function usually chosen possesses a constant elasticity of marginal utility with respect to consumption (n), i.e.

$$U' = c^{-n} \quad 11)$$

where $n \geq 0$ in order that marginal utility be non-increasing. Integrating equation 11) gives

$$U(c) = \left. \begin{array}{l} \frac{1}{1-n} c^{1-n} \quad \text{for } n \neq 1 \\ \log_e c \quad \text{for } n = 1 \end{array} \right\} \quad 12)$$

We may interpret d as a distributional weight which translates non-average consumption into the marginal utility of average consumption. For infinitesimal changes in consumption

$$d = \frac{U'_c}{U'_\bar{c}} = \left(\frac{c}{\bar{c}} \right)^n \quad 13)$$

Note that this formula expresses a relationship which depends on the consumption level of the individual receiving the increment in consumption and the average level of consumption. If the individual's level of consumption increases at a rate other than the rate at which average consumption increases, the value of d for that individual will change over time.

8. For non-marginal changes in consumption, we redefine d as

$$d = \frac{U(c_2) - U(c_1)}{U'_c (c_2 - c_1)} \quad 14)$$

where $c_2 - c_1$ represents the non-marginal increase in consumption. From the utility function if $n \neq 1$

$$d = \frac{c_2^{1-n} - c_1^{1-n}}{(1-n)\bar{c}^{-n}(c_2 - c_1)} = \frac{c_2^{-n} (1 - c_1^{1-n} c_2^{n-1})}{\bar{c}^{-n} (1-n)(1 - c_1 c_2^{-1})}$$

Write $x = \bar{c}/c_2$ and $y = c_1/c_2$, then

$$d = \frac{x^n (1 - y^{1-n})}{(1-n)(1-y)} \quad 15)$$

Alternatively, if $n = 1$,

$$d = \frac{\log_e c_2 - \log_e c_1}{\bar{c}^{-1} (c_2 - c_1)} = \frac{\log_e y^{-1}}{1-y} \quad 16)$$

Derivation of "D"

9. Some effects of a project on the distribution of consumption may be difficult to trace, too small to bother about or so general that all income classes would have to be examined. In principle, one should evaluate the impact on each consumption class and integrate over the affected income classes, i.e.

$$D = \frac{\Delta W}{U'_c} = \int_{c_0}^{\infty} \frac{U'(c) g(c) dc}{U'_c} \quad 17)$$

where $g(c)$ describes the distribution of the increase in consumption across consumption classes. In practice, one might be able to obtain specific information about $g(c)$ but, in the absence of such, one might assume that the increase in consumption is distributionally neutral, i.e. the increase in consumption is distributed in the same way as aggregate consumption. This implies that

$$g(c) = f(c) \frac{c}{\bar{c}} \quad 18)$$

$f(c)$ being the density function of the distribution of consumption. Assuming that consumption is distributed according to the Pareto function, for which the cumulative distribution function $[F(c)]$ is

$$1 - F(c) = \left(\frac{c_0}{c}\right)^\sigma$$

then $f(c) = F'(c) = \sigma \frac{c_0^\sigma}{c^{\sigma+1}}$ 19)

Inserting equation 19) into 18) and thence 17) gives

$$D = \int_{c_0}^{\infty} \frac{\sigma \frac{c_0^\sigma}{c^{\sigma+1}}}{\bar{c}^{1-n}} dc$$

Noting that for a Pareto distribution, provided $\sigma > 1$,

$$\bar{c} = \frac{\sigma c_0}{\sigma - 1}$$

so that

$$D = \int_{c_0}^{\infty} \frac{\sigma^n (\sigma - 1)^{1-n}}{c_0} \left(\frac{c_0}{c}\right)^{n+\sigma} dc$$

$$= \frac{\sigma^n (\sigma - 1)^{1-n}}{(1 - \sigma - n)} \left[\left(\frac{c_0}{c}\right)^{n+\sigma-1} \right]_{c_0}^{\infty}$$

$$D = \frac{\sigma^n (\sigma - 1)^{1-n}}{(n + \sigma - 1)} \quad 20)$$

which formula depends only on n , the elasticity of marginal utility, and σ the parameter of the Pareto function.

Derivation of β

10. We defined β as

$$\beta = W'_F / W'_c \quad 21)$$

If we write

$$U(c) = U(x, m, N) \quad (22)$$

where x , m and N are the quantities of exportables, importables and non-tradables consumed at income level c and assume a constraint on foreign exchange, then

$$U'_c = U'_x dx + U'_m dm + U'_N dN - \lambda (P_x dx + P_m dm + P_a dN) = 0 \quad (23)$$

where $\lambda = W'_F / W'_C = 1 / \beta$, P_x (P_m) is the world price of exports (imports), P_a is the accounting price for the non-tradable (see para 19). Solving for β , we have

$$\beta = \frac{W'_c}{W'_F} = \frac{P_x dx + P_m dm + P_a dN}{U'_x dx + U'_m dm + U'_N dN} \quad (24)$$

The consumer will equate U'_x etc. with market prices so that

$$\beta = \frac{P_x dx + P_m dm + P_a dN}{P_x (1-t_x) dx + P_m (1+t_m) dm + P_a dN} \quad (25)$$

where t_x (t_m) is the export (import) tax and P_a is the domestic price of the non-tradable. Given an expenditure analysis one can determine the various increments in commodities, but in the absence of such, one might assume that the income elasticities are unity and if one further assumes that dN is small, then, as a first approximation,

$$\beta = \frac{X + M}{(1 - t_x)X + (1 + t_m)M} \quad (26)$$

where X (M) is the value at fob (cif) prices of consumption exports (imports).

Value of Public Income (\bar{v})

11. Public income can either be used for investment or consumption. At the margin of expenditure assume that a proportion (g) of public ^{income} expressed in foreign exchange is invested and the remainder $(1 - g)$ consumed. Then,

$$\bar{v} = \frac{U'_I}{U'_C} = \frac{gU'_I}{U'_C} + (1 - g) \int_{c_0}^{\infty} \frac{U'(c)g(c)dc}{\beta U'_C} \quad (27)$$

where U'_I is the value of investment and the integral describes the distribution of government consumption. If we write $v = \frac{U'_I}{U'_C}$ and assume that government consumption is distributionally neutral (see para. 9) then

$$\bar{v} = gv + (1 - g) \frac{D}{\beta} \quad (28)$$

The implication of this formulation is that the government is constrained both in its ability to allocate expenditure between investment and consumption and in its ability to distribute consumption amongst income groups. Neither assumption need be correct. For example, government consumption expenditure may improve the distribution of consumption through the payment of subsidies. In this case one may wish to use a higher value for D than is implied by equation 20) (see para. 12). Alternatively, if the government's ability to distribute consumption is constrained it may still be able to secure the optimal allocation between investment and consumption (i.e. $v = D/\beta$) in which case $\bar{v} = v$. This result also follows if $g = 1$, i.e. all public income at the margin is allocated to investment.

12. If the distributional impact of public consumption is not thought to be neutral, then the formulation of D , which assumes a constant distribution of aggregate consumption, is no longer satisfactory. Substituting the particular forms of the utility function (equation 12)) and the distribution function (equation 19)) into the expression for total welfare in any period (equation 1)) gives

$$W = \int_{c_0}^{\infty} \frac{1}{1-n} c^{-\delta-n} \delta c_0^{\delta} dc \quad (29)$$

or

$$W = \frac{(\sigma-1)^{1-n} \bar{c}^{1-n}}{(n-1)(n+\sigma-1)\sigma^{-n}} \quad 30)$$

Partially differentiating with respect to \bar{c} shifts the entire distribution function upwards but leaves the shape of the distribution unchanged (i.e. $\sigma = \text{const.}$).

Partially differentiating with respect to σ changes the distribution but leaves total consumption unchanged. Therefore,

$$dW = \frac{\partial W}{\partial \bar{c}} d\bar{c} + \frac{\partial W}{\partial \sigma} d\sigma$$

Defining

$$D' = \frac{dW}{d\bar{c}}$$

gives

$$D' = D \left[1 + \frac{\bar{c} d\sigma}{\sigma d\bar{c}} \frac{n(\sigma-1)^{-1}}{(n+\sigma-1)} \right] \quad 31)$$

where D is determined by equation 20. We may interpret $\frac{\bar{c} d\sigma}{\sigma d\bar{c}}$ as an "elasticity" of σ with respect to average consumption. $D' = D$ if this elasticity is zero, i.e. if public consumption changes average consumption, \bar{c} , while leaving the distribution, σ , unchanged. Plausible values for the elasticity are probably small, say, between -0.1 and +0.1, in which case D' is unlikely to differ from D by more than 10 per cent.

Value of Investment (v)

13. A marginal unit of investment will produce a stream of consumption and a stream of reinvestment. If q is the net return expressed in units of foreign exchange and s is the propensity to save then

$$V_0 = \sum_{t=0}^{\infty} (1-s_t) q_t \frac{D_t}{\beta^t} \frac{\prod_{t=1}^{\infty} (1+s_t q_t)}{\prod_{t=0}^{\infty} (1+L_t)} \quad 32)$$

which shows the sum of the present value of the consumption created in each period from a capital stock which grows according to the rate of reinvestment, sq , the discount rate being the CRI. The subscripts indicate the time period. It should be apparent

that if, in general, $s_t q_t > i_t$, $v_0 \rightarrow \infty$; alternatively, if $i_t > s_t q_t$ then the present value of incremental consumption as t increases becomes very small. For all economies, one would expect that eventually $i_t > s_t q_t$ so that at some date in the future the present value of the consumption generated in that year will approximate zero. In other words, at that date the present value of the capital stock generated by a unit of investment today approximates zero. The significance of these comments is that provided at some date in the future $i_t > s_t q_t$ and will remain $> s_t q_t$ we don't have to worry unduly about the exact values of i_t and $s_t q_t$. To reverse the argument we must estimate with some degree of accuracy the values of i , s and q in the near future especially if $i_0 < s_0 q_0$. If $i_0 > s_0 q_0$ and we expect their relative values to remain more or less constant for some time in the future we can approximate v_0 by

$$v_0 = \frac{(1 - s_0) q_0 D_0}{(i_0 - s_0 q_0) / \beta_0} \quad (33)$$

But if $i_0 < s_0 q_0$ we must specify their time paths more carefully, in particular up to the date when we can replace the summation by a formula corresponding to equation 33), which requires that $i_t > s_t q_t$ and that both will be relatively constant. If this is never expected to occur then $v_0 = \infty$

Further Comments on the Accounting Rate of Interest (ARI)

14. The ARI was expressed in equation 8) as

$$ARI = CRI - \frac{\dot{\bar{v}}}{\bar{v}}$$

where \bar{v} , the value of public income, is given by

$$\bar{v} = gv + (1 - g) \frac{D}{\beta} \quad (\text{see equation 28})$$

If we assume that g and β are fairly constant over time then

$$\frac{\dot{\bar{v}}}{\bar{v}} = g \frac{\dot{v}}{v} + (1 - g) \frac{\dot{D}}{\bar{v}\beta} \quad 34)$$

Given the definition of v (para. 11) and of D (equation 17)) we have

$$-\frac{\dot{v}}{v} = r - i \quad 35)$$

where r is the proportionate rate of fall of the value of public investment, and

$$-\frac{\dot{D}}{D} = R - i \quad 36)$$

where $R = \frac{(\dot{\Delta W})}{\Delta W}$, whence

$$ARI = i + g(r - i) \frac{v}{\bar{v}} + (1 - g) \frac{(R - i)D}{\beta \bar{v}} \quad 37)$$

which is the general formula for the discount rate, and may be rewritten as

$$ARI = g r \frac{v}{\bar{v}} + (1 - g) \frac{RD}{\beta \bar{v}} \quad 38)$$

15. Given our general formulae for the ARI we can now consider special cases. For example, from equation 8) if $\frac{\dot{v}}{v} / \bar{v} = 0$, then

$$ARI = CRI \quad 39)$$

This may be quite a likely occurrence because one might expect v to decline over time (as the government increases its control over the level of investment) and D to rise (as the government increases its control over the distribution of public consumption), so that their net effect may be negligible. Alternatively, from

equation 37) if $r = R$ (i.e. both v and D change at the same/proportionate rate and in the same direction) or if $g = 1$ (i.e. all marginal public income is invested), then

$$\text{ARI} = r \quad (40)$$

Noting that r is the proportionate rate of fall of the value of public investment, we may interpret it as the social return on public investment with investment as numeraire. We know, therefore, that r must be greater than the rate of return on foreign investment, or, if all the return from investment is reinvested, we know that

$$\text{ARI} = q \quad (41)$$

i.e. the correct discount rate is the marginal product of capital. More generally, if only part of q is reinvested, then the return of investment which determines the ARI is

$$\text{ARI} = sq + (1 - s)q \frac{D}{\beta v} \quad (42)$$

III COMMODITY PRICES

16. We can examine the appropriate shadow prices for tradables and non-tradables in terms of a general formula which can be adjusted to fit specific cases. The only limitation on the formula is that it must be specified either for an exportable or an importable. Whichever is chosen the implications for a non-tradable follow immediately. Consider the case of an exportable. Assume the following information

$$\text{Domestic demand curve } p = D(C)$$

$$\text{Foreign demand curve } p = D(E)$$

$$\text{Domestic supply curve } p = S(Q)$$

where

C = domestic consumption

E = exports

Q = domestic production = E + C

The private value of production (W_p) may be expressed as

$$W_p = \left[\int_0^D (C) dC - pC \right] + \left[\int_0^D (E) dE - pE \right] + \left[pQ - \int_0^Q s(Q) dQ \right] \quad (43)$$

where the terms in square brackets reflect respectively domestic consumer surplus, foreign consumer surplus and domestic producer surplus. Assume that project demand leads to a slight increase in price then the change in private utility is

$$\left[-C - E + Q \right] \Delta p \quad (44)$$

In determining the change in social welfare we must revalue this in terms of our numeraire (public income expressed in foreign exchange) and consider any other repercussions of the price change. In particular, we will need to examine the foreign exchange effects of the change in the value of consumption, exports and production.

In order, these are given by

$$(1 - \eta) C \Delta p, \quad (1 - \xi) E \Delta p, \quad \text{and} \quad (1 + \epsilon) Q \Delta p$$

where η (ξ) is the elasticity of domestic (foreign) demand defined so as to be positive, and ϵ is the elasticity of domestic supply.

The weight to be applied to private welfare (consumption) expressed in units of domestic currency was defined as d / \bar{v} , which weight may differ for consumers (d_c / \bar{v}) and producers (d_p / \bar{v}) and will equal zero for foreigners. Thus, the social value of equation 44) is

$$\left[-C \frac{d_c}{\bar{v}} + Q \frac{d_p}{\bar{v}} \right] \Delta p \quad (45)$$

If the foreign exchange cost of consumption depends on β_c for consumers and β_p for producers, and if the foreign exchange cost of production depends on $\alpha^{1/}$, then the change in foreign exchange is

$$(1 - \nu)C\beta_c \Delta p + (1 - \varepsilon)E \Delta p - (\beta_p + \varepsilon\alpha) Q \Delta p^{2/} \quad (46)$$

Noting that equations 45) and 46) are expressed in the same units and recognizing that the increase in demand is $[\nu C + \varepsilon E + \varepsilon Q] \Delta p$, the social cost of the increase in demand per unit of demand is the domestic price times

$$\frac{\left(\beta_p - \frac{d_p}{\bar{v}}\right) - \left(\beta_c - \frac{d_c}{\bar{v}}\right) \pi + \varepsilon\alpha + \nu\beta_c \pi - (1 - \varepsilon)(1 - \pi)}{\varepsilon + \nu\pi + \varepsilon(1 - \pi)} \quad (47)$$

where $\bar{\pi} = C/Q$

Tradables

18. Equation 47) expresses the accounting ratio for an exportable. Note that if income transfers may be neglected in the sense that the government places the same value on its own income (foreign exchange) and private income (i.e. if $\beta_p = d_p/\bar{v}$ and $\beta_c = d_c/\bar{v}$), then the ratio becomes

$$\frac{\varepsilon\alpha + \nu\beta_c \pi - (1 - \varepsilon)(1 - \pi)}{\varepsilon + \nu\pi + \varepsilon(1 - \pi)} \quad (48)$$

It may also be reasonable to assume that domestic production is relatively inelastic (i.e. $\varepsilon \rightarrow 0$), especially in the short-run. If, in addition, domestic demand is relatively inelastic (i.e. $\nu \rightarrow 0$) or domestic consumption is small compared to

1/ See para. 20

2/ Note that for producers $Q \Delta p$ represents an increase in income but $\varepsilon Q \Delta p$ represents an increase in production.

exports (i.e. $\Pi \rightarrow 0$), then the ratio becomes

$$\left(1 - \frac{1}{\xi} \right) \quad 49)$$

which, when multiplied by the border price, is the marginal export revenue. And finally, if foreign demand is perfectly elastic $\xi = \infty$ and the correct social price is the border price. A similar formula can be derived for an importable but in view of the fact that most importables are in perfectly elastic supply the correct price will be the cif. price.

Non-Tradables

19. If we assume that there are no exports (i.e. $\Pi = 1$) then equation 47) gives us the accounting ratio for a non-tradable, i.e.

$$\frac{\left(\beta_p - \frac{d_p}{\bar{v}} \right) - \left(\beta_c - \frac{d_c}{\bar{v}} \right) + \epsilon \alpha + \nu \beta_c}{\epsilon + \nu} \quad 50)$$

If supply is perfectly elastic (i.e. $\epsilon = \infty$), then there is no change in price and the social cost is simply α_p , the marginal social cost (MSC) of supply. Alternatively, if supply is inelastic (i.e. $\epsilon = 0$) and the income transfers do not involve a social cost or gain (i.e. $\beta_p = d_p / \bar{v}$ and $\beta_c = d_c / \bar{v}$), then the social cost is $\beta_{c,p}$, the marginal social benefit (MSB) of demand.

20. The MSB (β) has already been considered (see para. 10). The MSC (α) is determined as follows: Decompose the non-tradable into its constituent inputs and value each input at its accounting price. Some of these inputs will be tradables, others will be primary factors, and the remaining inputs will themselves be

non-tradables, which in turn must be further decomposed. Eventually everything will be expressed in terms of tradables and primary factors. The ratio of the accounting value of the marginal inputs (A) to the market value of the output (V) is then the required accounting ratio (α). Symbolically, this market value is composed of

$$V = \sum_j \left[V_j + K_j (r_m) \right] + \sum_n \left[V_n + K_n (r_m) \right] + \sum_i w_i + T_x + P \quad 51)$$

where V is the gross market value of the output, $V_j(K_j)$ the cost of current inputs of other non-tradables, $V_n(K_n)$ the cost of current (capital) inputs of tradables, w_i the cost of inputs of primary factors (i.e. different types of labor and possibly land), T_x is tax (or subsidy if negative), P is excess profits and r_m is the market rate of interest.^{1/} The accounting cost (A) of the same output is

$$A = \sum_j \left[V_j + K_j (r) \right] \delta_j + \sum_n \left[V_n + K_n (r) \right] \delta_n + \sum_i w_i \delta_i + P(\beta_p - d_p) \quad 52)$$

where \bar{r} is the accounting rate of interest, the δ 's are the accounting ratios for the various inputs, d_p is the distributional parameter applied to profits, \bar{v} the shadow price of public income, and β_p the accounting ratio applied to consumption out of profits. The ratio of the MSC to the market value of the output is then

$$\frac{MSC}{Price} = \alpha = \frac{A}{V} \quad 53)$$

Thus, α will be $>$ or $<$ unity

as δ 's $>$ or $<$ unity

$\bar{r} >$ or $<$ r_m

$T_x <$ or $>$ zero

$d_p / \bar{v} =$ or $>$ zero

and $\beta_p >$ or $<$ unity

^{1/} $K_n (r_m)$ is the interest and depreciation cost on the n^{th} capital input, i.e.

$K_n (r_m) = \frac{r_m}{1 - (1 + r_m)^{-\tau}} \tau$ where τ is the length of life of the capital

Standard Conversion Factor

21. In certain circumstances, it may be convenient to use a Standard Conversion Factor which will translate the domestic value of non-tradables in general into their equivalent foreign exchange value. In principle, for the non-tradables used in any project, one wants a weighted average of the individual accounting ratios as defined by equation 53). In practice, one might substitute the ratio of the value at border prices to the value at domestic prices of the tradable inputs typically used in non-tradable production. Examination of equation 52) reveals that this will be an approximation insofar as

i) the weights need not correspond to the actual combination of tradables used in non-tradable production;

and ii) no allowance is made for the social cost of consumption out of labor incomes and profit.

Provided these limitations are borne in mind, however, the Standard Conversion Factor may be used as a convenient short cut. At an even more approximate level one could use a Standard Conversion Factor for all non-tradables and consumption, which might be defined as the ratio of the value at border prices to the value at domestic prices of all imports and exports.

IV REFERENCES

22. The following is a selected list of the main contributions in the literature which underlie the ideas presented here. The approach adopted here follows very closely that presented in:

Guidelines for Project Evaluation, New York, UNIDO, 1972 - Dasgupta, P; Marglin, S. and Sen, A.

Manual of Industrial Project Analysis in Developing Countries, Vol. II, Paris, Development Centre of the OECD, 1969 - Little, I.M.D. and Mirrlees, J.A.

Useful discussions of the above-mentioned books are contained in:

The Rationale and Relevance of the Little-Mirrlees Criterion, Bulletin of the Oxford University of Economics and Statistics, February 1972 - V. Joshi

A Comparative Analysis of the UNIDO Guidelines and the OECD Manual, Bulletin of the Oxford University of Economics and Statistics, February 1972 - P. Dasgupta

References to more specific topics are:

Foreign Exchange Shadow Prices : A Critical Review of Current Theories, Quarterly Journal of Economics, May 1971 - Bacha, E. and Taylor, L.

Estimating the Shadow Price of Foreign Exchange in Project Appraisal, December 19, 1972 - Balassa, B.

Disutility of Effort, Migration and the Shadow Wage Rate, Oxford Economic Papers, 1973 - Lal, D.

Estimates of Shadow Wages in Kenya, February 1973 - Scott, M. FG.

On the Social Rate of Discount and Price of Capital in Cost-Benefit Analysis, Development Research Center, IBRD - Blitzer, C.R.

On Estimating Certain Inter-Temporal Parameters for Project Analysis Development Economics Dept., IBRD - Lal, D.

Examples of the techniques being recommended are contained in the Guidelines and Wells and Welfare, Cost Benefit Analysis, Case Study No. 1, OECD, Paris, 1972 - Lal, D.

Experience with the use of the Little-Mirrlees Method for an Appraisal of Small-Holder Tea in Kenya, Bulletin of the Oxford University Institute of Economics and Statistics, February 1972 - Stern, N.H.

ECONOMIC ANALYSIS OF PROJECTS

APPENDIX II: ESTIMATION OF SHADOW PRICES

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A P P E N D I X I I

ESTIMATION OF SHADOW PRICES

I INTRODUCTION

1. In this Appendix we describe various ways in which the shadow prices discussed in the Annex may be estimated. As usual in applied economics there will be more than one method of estimation for each parameter and those selected here may not turn out to be the most appropriate for all situations. To give the country economist the greatest possible freedom in refining the techniques described here, we define each parameter very carefully before presenting the suggested method of estimation. The country economist can then improve the estimate as he sees fit in order to move closer to the true value of the parameter thus defined.

Procedure

2. We follow the Annex in presenting the material, i.e. Section II discusses estimation techniques for the parameters required for the distribution weights including the accounting rate of interest (ARI); Section III examines the same for the shadow wage rate (SWR); and Section IV suggests methods of estimation for commodity prices. Finally, in Section V we illustrate the approach by a case study, which should be viewed as a preliminary desk study using only readily available data to estimate some shadow prices for a particular country (Malaysia). The methods used for this estimation are crude but it is recommended that each country economist perform such a desk study before attempting anything more sophisticated. The desk study will give rough orders of magnitude, will pinpoint the most important parameters and reveal the data weaknesses.

3. When calculating shadow prices, because there will often be more than one method for estimating underlying parameters, and because of uncertainty in data validity, it is useful to specify a range of values for basic parameters rather than only a single best estimate. Such a range will provide an indication of the precision with which it has been possible to estimate the shadow prices given the context of a particular country, and would be useful in sensitivity analyses in subsequent project appraisals. In making such estimates, what one aims for is not a range within which the true value will certainly lie, but a range within which the true value will lie with a given probability. It is recommended here that a level of probability equal to .8 be employed. This can conveniently be interpreted to mean that there is a one in ten chance that the true value is greater than the upper limit, and a one in ten chance that the true value is less than the lower limit. While it is recognized that accuracy in the specification of such an interval is impossible, subsequent analyses will be better informed, given the country economist's best (subjective) judgment about the likely range of particular variables.

Equations

4. The following is a condensed list of the basic equations required for the estimation of both inter- and intratemporal weights. See the cited paragraphs of the Annex for a more complete discussion of definitions and equations.

$d = d(n)$	}	Distribution Weights	(Paras. 14-19)
$D = D(n, \sigma)$			
$CRI = nG + \rho$		Consumption rate of interest	(Para. 21)
$\bar{v} = gv + (1 - g) \frac{D}{\beta}$		Value of public income	(Para. 20)
$v_0 = \left[\frac{(1 - s_0)q_0 D_0}{(i_0 - s_0 q_0)\beta_0} \right] \left[1 - \left(\frac{1 + s_0 q_0}{1 + i_0} \right)^T \right] + \left[\frac{1 + s_0 q_0}{1 + i_0} \right]^T v_T$		Value of public investment at t = 0	(Paras. 21-24)
$v_T = \left[\frac{(1 - s_T)q_T D_T}{(i_T - s_T q_T)\beta_T} \right]$		Value of public investment at t = T	(Para. 24)
$ARI = CRI + \frac{\dot{v}}{\bar{v}}$		Accounting rate of interest	(Para. 25)
$\frac{\dot{v}}{\bar{v}} = f(r)$		Rate of fall \bar{v}	(Para. 26)
$r = sq + (1 - s)q \frac{D}{\beta v}$		Return on government investment	(Para. 26)
$SWR = \alpha m + \beta(w - m) \left[1 - (1 - \phi E) \frac{d}{v\beta} \right]$		Shadow wage rate	(Para. 29-42)

Parameters

5. The parameters to be estimated for these equations are

n	.. .. .	parameter of the utility function
ρ	.. .. .	pure time preference
G	.. .. .	rate of growth of per capita consumption
σ	.. .. .	parameter of the distribution function of consumption

g	.. .. .	marginal propensity to invest out of government income
s	.. .. .	marginal propensity to reinvest
q	.. .. .	opportunity cost of capital
β	.. .. .	inverse of a SER for consumption goods
α	.. .. .	conversion factor for foregone output
T	.. .. .	number of years until economy attains a stable growth path
m	.. .. .	marginal product of labor
w	.. .. .	wage rate
ϕ & E	.. .. .	parameters relating to disutility of effort

We examine each in turn commencing with the subjectively determined parameters, n and ρ .

II DISTRIBUTION WEIGHTS

Value Judgments and Interpretation

6. Government objectives concerning growth and distribution often remain implicit. Basic policy choices and investment decisions become clearer if they are made explicit. The key value judgment involved is reflected in the value assigned to n , the parameter of the utility function. If the government values all consumption equally, regardless of the recipient's existing level of consumption, then n is zero. This has implications also for the desired growth rate, since a zero value for n implies a very low consumption rate of interest and hence a high shadow price of investment (v) and a low accounting rate of interest (ARI) (see Annex, Section II). In other words, a low value for n indicates a bias against income distribution and in favor of rapid growth. On the other hand, if a government tends to discount the future heavily, n must be high, which, in turn, means that the government puts a high priority on redistribution. Thus, the value of n reflects the

basic, subjective trade-off between allocating resources to redistribution and to investment and growth. Whatever decisions are made, they involve an implicit value for n . Making n explicit helps to ensure more consistent decisions and provides a better understanding of the trade-off.

7. It is recommended that an estimate of n be made by the country economist for all countries. Inevitably, these estimates will only give orders of magnitude, and, to some extent, will reflect his own subjective preferences. As a rough guide, judgments about n should be made in the light of

- i) both the stated objectives and observed actions and policies of the government; and
- ii) the nature of the type of project which will be favored as the value of n changes.

Other things being equal, a high (low) value of n will favor projects which promote redistribution (growth). If the government shows little interest in redistribution but is mostly concerned with growth, decrease the value of n . Most countries will probably desire some redistribution and some growth so that for many countries n should be set between 1 and 2. A value of two implies a strong egalitarian bias and may be considered the upper limit for n .

8. One other value-judgment parameter needs to be examined - namely, ρ , the element of pure time preference in the CRI. It is recommended that in general ρ be set equal to zero, unless there is some reason to suppose that the government discounts the future more heavily than the rate implied by the product of n and G . In any event, values of ρ in excess of 2 or 3% are difficult to defend and should be avoided. Note, however, that a positive value for ρ does permit the government some flexibility in determining the trade-off between growth and income distribution because, although ρ affects the CRI and hence the discount rate, it does not affect the interpersonal distribution weights.

Estimating G and σ

9. To complete the estimate of the CRI and D, the global distribution parameter, we must estimate G, the rate of growth of per capita consumption, and σ the parameter of the function describing the/distribution of consumption. Note that both are in terms of consumption, whereas they are usually expressed in terms of income. G will equal the growth rate of per capita income (usually estimated in economic reports) provided the proportion of income devoted to investment remains constant. If the proportion of investment in national income is increasing (decreasing), G will be less (greater) than the growth rate of per capita income. Similarly, σ will equal the equivalent income distribution parameter if the proportion of income saved remains constant as the level of income increases. More realistically, one might expect the proportion saved to increase with income, in which case the value of the consumption distribution parameter will be greater than the value of the income distribution parameter. σ is related to the Gini coefficient (see Annex, para. 18, footnote) and the Bank already has estimates of Gini coefficients for many LDCs.

Savings Propensities (g and s)

10. It is at this point that the possibilities of refining estimates really become apparent. We define g as the public sector's marginal propensity to save. This raises questions of how one can identify the margin and also what is the exact definition of government saving. We suggest as a first step that one estimate the average proportion of government income allocated to capital formation. If this average is changing over time, the analyst should measure g by the increase in capital formation occurring as a result of an increase in public income between any two years. Estimates should be made for each pair of years over, say, a five year period and the average taken so as to avoid the influence of year-to-year fluctuations. However, inasmuch as we are interested in the future values of g the country economist

should take account of any discernible trends.

11. We define s as the public sector's marginal propensity to reinvest out of the return from public sector investment. At first sight this appears to be the same as g and in certain circumstances this may indeed be the case. However, of the total return to investment (denoted by q) some may be committed to consumption because of an increased wage bill. Of the remainder g will be reinvested, but reinvestment will not equal gq because of the increased wage bill. It follows that $s < g$ unless the project does not cause an increased commitment to consumption. One method of estimating s is to look directly at government projects and assess the the commitment to consumption therefrom. The remainder accrues to the government of which g is reinvested. For example, if the employment/capital ratio is $l \frac{1}{q}$ and the average increase in income (consumption) per worker is Δw , then

$$s = g(1 - \frac{\Delta w l}{q})$$

whence $s = g$ if $\Delta w = 0$

Marginal Product of Capital (q)

12. Estimates of the marginal product of capital can be of varying degrees of sophistication. We define q as the marginal return from investment in the public sector in terms of foreign exchange, i.e. q is the foreign exchange value of the return an additional generated by/ unit of foreign exchange expressed as a percentage. The best guide

1/ We examine l further in para. 12

to q , therefore, is the return which public sector projects are currently earning or which proposed public sector projects are expected to earn. Whilst the actual appraisal of existing and future projects will probably provide the best indication of q , one can also look at the economy as a whole. As a rough guide one might estimate q from the following relationship:

$$q = k - ml$$

where k is the incremental output/capital ratio (expressed in accounting prices - see para. 13), l is the incremental labor/capital ratio (also expressed in accounting prices - see para. 13), and m is the marginal product of labor.^{1/} In principle, investment and output should be measured at accounting prices. In many cases, the accounting ratios converting market values into social values will differ significantly for investment and output, so that estimation in terms of accounting prices alters the value of q . An estimate of l can be derived from employment (and investment) data. Both k and l should be averages over, say, five years in order to remove the effects of short-term fluctuations, and be estimated in constant prices. Although m does not necessarily equal average labor earnings (see Section III on the shadow wage rate), in general this may be a reasonable approximation. Allowance should be made for any increase in m in real terms over the five year period. For some countries it

^{1/} Labor in this context represents all types of labor.

may be preferable and possible to exclude subsistence agriculture from the estimates of k and l and thereby obtain the marginal productivity of capital for the "advanced" sectors.^{1/}

13. The accounting ratios required to translate market prices into foreign exchange values should be averages reflecting the outputs and inputs of the sectors included in the estimate of q . For example, if one bases q on GDP then the required average accounting ratio is the standard conversion factor (see para. 29).

Alternatively, if one only uses the "advanced" sector to estimate q the appropriate

^{1/} The equation suggested for estimating q is clearly a simplification since among other factors it ignores (i) rents and (ii) depreciation. This latter consideration could lead to a significant underestimation of q (properly defined in net of depreciation terms) as is shown by the following relationships:

Define $I = N + D$ where I = national investment in gross terms;
 N = national investment net of depreciation;
and D = depreciation (the amount required to keep the stock of capital goods intact).

Divide each term of the above equation by ΔY , the incremental national output and multiply the last term by Y/Y . Next substitute the following variables:

$k = \Delta Y/I$, the output capital ratio in gross terms;
 $k' = \Delta Y/N$, the output capital ratio in net terms;
 $\alpha = D/Y$, the percentage of depreciation in output;
 $z = \Delta Y/Y$, the growth rate of GNP. Then:

$$\frac{1}{k} = \frac{1}{k'} + \frac{\alpha}{z}$$

$$k' = \left(\frac{z}{z - \alpha k} \right) k$$

Thus k' will be greater than k and therefore q defined in net terms would be larger than q defined in gross terms.

average will depend on the outputs and inputs in that sector. Finally, one could take a weighted average of different sectors, the weights being the proportions of government investment in each sector. The accounting ratios should then be specific to the sectors chosen. Similar problems are encountered in identifying the appropriate accounting ratio for the wage bill. As a first approximation one could multiply the wage bill by the standard conversion factor but if more information is available on the sources of supply of the incremental labor force one could make more specific estimates. The accounting ratio for capital may be equated with the ratio of the domestic value of capital imports to their cif value. This ratio may be close to unity in many countries because trade tariffs on capital imports are usually low. For capital in the form of buildings one requires a conversion factor for construction.

Estimating β

14. β is an accounting ratio similar to those discussed in the previous paragraph except that it only includes consumption goods. As with the other accounting ratios one can estimate β with varying degrees of refinement. Ideally, one should work from an expenditure analysis for a particular income group. The various commodities consumed at the margin should be divided into importables, exportables and non-tradables. The cif (fob) prices of importables (exportables) should then be obtained either directly from the trade statistics or indirectly through the use of tariffs (see para. 27). For non-tradables, one either estimates the tradable inputs into non-tradable production (see para. 28), or uses a standard conversion factor (see para. 29). An easier but more approximate estimate can be obtained by taking the ratio of the foreign exchange value of the consumer goods appearing in the foreign trade statistics to their domestic value.

Estimating T

15. We define T as the number of years until the economy can be expected to achieve a fairly stable growth path at an acceptable rate of growth of per capita consumption. To estimate such a number will require considerable guesswork and so it might be useful to review the situations when T is not needed. If the CRI (i) exceeds the rate of reinvestment (sq) and if the economy is on a fairly stable growth path, then T can be set equal to ∞ in the formula for the value of public investment (para. 4). In other words, it only becomes necessary to make an estimate of T if the initial values are such that $sq > i$. The value of s, the marginal propensity to save, and of q, the marginal product of capital, may be in the order of 0.2 and 0.15 respectively giving a value of $sq = 0.03$. It will be recalled that i is determined by the sum of the product of G, the growth rate of per capita consumption, and n, the parameter of the utility function, and ρ , the rate of pure time preference. We argued (para. 6) that for most economies $1 < n < 2$ and $0 < \rho < 0.03$. It follows that $i < sq$ will occur if the growth rate of per capita consumption is low. For example, if $G = 0$, then $i = \rho$ which means $0 < i < 0.03$. Alternatively, if $G = 0.03$ and $n = 1.5$ then $0.045 < i < 0.075$. We determine T, therefore, by asking when the economy can be expected to achieve a rate of growth of per capita consumption of the order of 2 or 3% per annum. In addition, the growth path should be fairly stable which requires that the proportion of income which is invested remain more or less constant.

The Value of Public Investment (v)

16. In principle, one requires estimates of s, q, D, β and i from now until infinity in order to estimate v, the value of public investment. In practice, it is recommended that if $i > sq$, one use the simple formula, i.e.

$$v_0 = \frac{(1 - s_0)q_0D_0}{(i_0 - s_0q_0)\beta_0}$$

which assumes that the parameters underlying v remain constant over time so that v also remains constant over time. If the analyst has good reason to believe that this is not a good assumption, then the formula will require adjustment. In particular, if $sq > i$ one can expect changes because this condition implies a low (possibly zero) rate of growth of per capita consumption. The formula for v then becomes

$$v_0 = \left[\frac{(1 - s_0)q_0D_0}{(i_0 - s_0q_0)\beta_0} \right] \left[1 - \left(\frac{1 + s_0q_0}{1 + i_0} \right)^T \right] + \left[\frac{1 + s_0q_0}{1 + i_0} \right]^T \left[\frac{(1 - s_T)q_T D_T}{(i_T - s_Tq_T)\beta_T} \right]$$

This formula assumes that there is only one change in the economy in period T . In other words, the parameters underlying v retain their initial values until period T and then suddenly switch to put the economy on a satisfactory growth path. In reality the parameters would be changing slowly from $t = 0$ to $t = T$ but data inadequacies may not warrant any attempt at more precision. Furthermore, we might assume that some of the parameters do not change significantly over time. We expect i to increase as the growth rate increases and s may increase as well but the change in the other parameters (q , D and β) may be sufficiently small, relative to the change in i and s , to omit.

Estimating the ARI

17. The accounting rate of interest (ARI) is determined primarily by the CRI for which the required parameters have already been discussed. To obtain the ARI one adjusts the CRI by the proportionate rate of fall of \bar{v} , the value of public income. Since $ARI = CRI + \frac{\dot{\bar{v}}}{\bar{v}}$, if $\frac{\dot{\bar{v}}}{\bar{v}} \geq 0$ then $ARI \geq CRI \frac{1}{\bar{v}}$, and $\frac{\dot{\bar{v}}}{\bar{v}}$ will in turn depend on the rate of fall of the parameters determining \bar{v} , i.e. g, β, D and v . If these parameters are thought to be constant over time or the individual rates of change are thought to be offsetting

1/ $\frac{\dot{\bar{v}}}{\bar{v}}$ is defined as a rate of fall and given its natural sign.

then $\frac{\dot{\bar{v}}}{\bar{v}} = 0$ and $ARI = CRI$. This may often be a good measure of the ARI especially if the CRI is fairly high, say greater than 8%. If the CRI is of this order of magnitude then the analyst will probably be using the simple formula for \bar{v} (see para. 15) which implies that $\frac{\dot{\bar{v}}}{\bar{v}}$ is zero. Alternatively, if the more complex formula is used then $\frac{\dot{\bar{v}}}{\bar{v}} > 0$, i.e. the value of public investment is falling over time. One might suspect that some of the other parameters determining \bar{v} work in the opposite direction. D , for example, might increase over time (i.e. the value of government current expenditure is increasing) which implies that $\frac{\dot{\bar{v}}}{\bar{v}} < \frac{\dot{v}}{v}$, so that as a maximum estimate of the ARI we could take

$$ARI = CRI + \frac{\dot{\bar{v}}}{\bar{v}}$$

and as

$$\frac{\dot{\bar{v}}}{\bar{v}} = r - i$$

$$ARI = r = sq + (1 - s) \frac{qD}{\beta v}$$

In general one might expect $CRI \leq ARI \leq r$, and one should estimate \bar{v} over a series of years with projections into the future where possible and deduce the rate of change of \bar{v} therefrom.

III ESTIMATING THE SHADOW WAGE RATE

18. The shadow wage rate (SWR) can be expressed as a relationship with the following terms:

$$SWR = \text{Foregone Output} + \text{Foreign Exchange Cost of Increased Consumption} - \text{Increase in Private Welfare Expressed in Terms of Public Income}$$

In symbolic form we can write:

$$SWR = \alpha_m + \beta (w - m) \left[1 - (1 - \phi E) \frac{d}{\bar{v}\beta} \right]$$

where the parameters are as previously defined.

Because the shadow wage rate is discussed in some detail in the Annex (paras. 24-42), this section will only highlight and emphasize those points considered most important for estimation purposes.

19. The shadow wage rate depends upon the marginal product of labor, m , and the increase in income accruing to labor ($w - m$). It will therefore almost always be necessary to calculate several such shadow wage rates. The marginal product, m , itself depends upon different skill levels, and on any seasonality in demand for labor. In practice it may be possible for most countries to identify several categories of labor relevant to Bank projects (e.g. non-peak season rural laborers), estimate their marginal products periodically and employ these standard estimates in project appraisals. To the extent that well-defined wage levels exist for the standard labor categories it will be possible to compute the SWR for each standard category. In instances where projects will create income (consumption) levels that deviate substantially from the pre-determined wage levels for given labor categories it will be necessary to compute project specific SWRs.

Foregone Output

20. In most countries it can be anticipated that well developed markets will exist for skilled labor, and for those countries the best estimate of the marginal product of skilled labor will be the market wage. Even for unskilled labor in countries faced with high levels of unemployment, there may be seasons during the year when the hiring of labor is sufficient to eliminate unemployment, and when the wage rate approximately equals the marginal product. Where seasonality is important, even in the slack season the foregone output may not be zero if labor is engaged during these periods in economically productive activity such as fishing, or home repair, or maintenance of productive equipment. In countries with no labor market,

i.e. where only family labor is used, it may be necessary to attempt to obtain a direct measure of marginal product.

21. In cases where a direct estimate of marginal product is necessary, estimation is clearly difficult and crude estimates may need to suffice. For example, it is generally possible to make a reasonable estimate of labor's average product, and the marginal product may then be set equal to one half of the average product.^{1/} The estimation procedure and the assumptions should be specified in the project report.

22. Special care must be taken when migration occurs. The marginal product in the equation defining the SWR is the marginal product in the area from which the migration occurs, not the area into which the labor is migrating. Furthermore, if a project should have the effect of attracting more labor to the project area than can be employed there, this also must be taken into account. The marginal product in this case should be multiplied by the number expected to migrate in response to the creation of one project job. This number can either be estimated directly or deduced from one of several formulae, the simplest of which predicts the number migrating per job as a proportion of the ratio of the urban wage to the migrants previous income.

23. By whatever means the estimate of labor output foregone is arrived at, its value in market prices, must be converted into its social equivalent in foreign exchange through the conversion factor α . For example, an export tax on output will mean that the foreign exchange earned by a unit of output is greater than its market price by the export tax so that $\alpha = 1 + tx$ where tx is the export tax.

1/ This would be exactly correct for a Cobb-Douglas production function with an elasticity of output with respect to labor of 0.5. Most empirical estimates indicate that this elasticity is approximately 0.5 in underdeveloped agriculture.

Increase in Income

24. Where an increase in income occurs, this increase is measured in the equation for the SWR by the term $(w - m)$ where w is the new wage and m is the marginal product in labor's farmer use. Any such increase in income leads to a component of the SWR representing increased consumption cost (resource use) to the economy, and a component representing the increase in private welfare to the recipient. The former component is obtained by multiplying $(w - m)$ by β , while the latter is obtained by multiplying by the weight $\frac{d}{v}$. Any disutility of effort involved reduces the welfare gain by the factor $(1 - \phi E)$.

25. In some cases, a differential in prices between rural and urban areas will make the real gain in income smaller than the nominal gain. Where this occurs, the term $(w - m)$ should be adjusted by revaluing m to arrive at the cost in the project area of resources equivalent to those consumed in the rural area. (The first term, αm , which measures foregone output in the equation for the SWR would not be revalued.)

26. In addition to the above considerations, it furthermore may not be appropriate in all instances to employ the same term $(w - m)$ to reflect both the cost to society of increased consumption, and the increase in private welfare to the recipient due to that consumption. This would be the case, for example, when the government provides certain additional benefits not otherwise accounted for in the project evaluation such as subsidies or social services. Transportation and adjustment costs borne by the worker have the same effect, as does the loss of any economically free goods (e.g. abundant wild vegetables) in rural areas. Since these factors increase the resource cost of employing labor without increasing private welfare, two separate factors may have to be employed in place of the single estimate $(w - m)$.

IV COMMODITY PRICES

Tradables

27. Exported and imported commodities must be valued at fob/cif prices adjusted by relevant marketing margins. In many cases, it is relatively easy to ascertain the border price. In many project reports, imported equipment is already expressed in terms of cif prices. For most important commodities, fob/cif prices in the principal sources and destinations are regularly estimated by the Bank's Commodity and Export Projections Division. For other inputs/outputs border prices may not be readily available, but can be estimated from trade statistics if both quantity and value data are provided.

Non-Tradables

28. Decomposition of non-tradables into its constituent inputs to determine marginal social cost (MSC) would ideally be accomplished through an input-output table, but existing or ad hoc industry studies are also appropriate. In some cases only a crude analysis of inputs will be necessary.^{1/} As a first approximation one could simply "deflate" the market values of the output net of corporate and business taxes (and any excise tax included in the gross value of final output) by an average accounting ratio; to increase accuracy one could decompose for one round and then use the average accounting ratio for the remaining non-tradable inputs; and for greatest accuracy one could decompose completely thereby avoiding the use of the average accounting ratio. A first round decomposition into tradables, non-tradables, and labor will give a useful insight into the likely magnitude of MSC. The general approach essentially involves a cost-benefit analysis of the non-traded industry. If this is kept in mind, it should help in deciding which approximations are or are not acceptable.

^{1/} In principle, one is looking for the marginal input output relationships, but in practice the average relationships will be sufficiently accurate. If constant returns prevail, then marginal and average coincide.

Standard Conversion Factor

29. When a single average conversion factor, or a conversion factor for minor non-tradables is necessary, a standard conversion factor (SCF) can be employed. The SCF can be computed by taking the ratio of the total value of imports plus exports valued in border prices, to that same total adjusted by net average tariffs and duties (or subsidies). Obtaining values of the average rate of tariffs and duties is therefore useful. One relatively simple way of accomplishing this is to divide the value of total revenues from import tariffs by the value of total imports. This gives the average tariff rate on imports. An identical procedure can be employed to get the average rate of duties on exports using total revenues from export duties and the value of total exports. The averages thus obtained must be further adjusted when any significant fraction of exports (imports) receive subsidies.

V EXAMPLE OF SHADOW PRICE ESTIMATION

30. This desk study attempts to illustrate through an example how shadow prices can be computed. The country selected was Malaysia. Only data available at the Bank has been employed in the study and no field work was done. Because of this limitation, the estimates are relatively crude. The desk study demonstrates, however, that much of the data required for the computation of shadow prices already exists in Bank documents such as the country economic reports. It is recommended that similar desk studies be attempted for other countries before field work commences, so that the most important parameters can be identified and data weaknesses pinpointed. Country economists should note that for many parameters more than one method of estimation exists, and the method most appropriate for particular countries should be selected in the light of the available data.

31. The following shadow prices and parameters have been estimated:

A. Standard Variables

- 1) Consumption Rate of Interest, i
- 2) Distribution Summary Measure, D
- 3) Conversion Factors for Tradable Goods
 - a) Conversion Factor for Consumption Goods, β_c
 - b) Conversion Factor for Capital Goods, β_k
 - c) Standard Conversion Factor, β
- 4) Shadow Price of Investment, v
- 5) Shadow Price of Government Income, \bar{v}
- 6) Accounting Rate of Interest, ARI

B. Examples of Items Specific to Different Projects

- 1) Shadow wage rate for rural laborers
- 2) Shadow price of automobiles (a tradable)
- 3) Shadow price of construction (a non-tradable)

Consumption Rate of Interest

32. The consumption rate of interest (CRI) can be computed from the following equation:

$$\text{CRI} = i = nG + \rho \quad (\text{Annex, para. 21})$$

where n = parameter of the utility function

G = growth rate of per capita consumption

ρ = rate of pure time preference

Two of the parameters of this equation, n and ρ , require explicit subjective judgments for their estimation. The first of these parameters, n , is defined as the elasticity of marginal utility with respect to consumption. The parameter n would normally be expected to lie in the range from 1 to 2. A value of n at the low end of the range would be appropriate for a government whose objectives favored growth over income distribution, while a value of n at the higher end of this range would imply government policies strongly emphasizing redistribution.^{1/} In Malaysia, the aim of the Government's New Economic Policy (NEP) as expressed in the second 5 year plan, is to accelerate the restructuring of the economy to correct imbalances in income distribution (especially imbalances arising out of race).^{2/} On the other hand, Malaysian Government actions still appear to retain a certain emphasis on growth. The parameter n therefore, for purposes of this study, has been set equal to 1.5. The second factor in the equation for the CRI requiring that a subjective judgment be made is ρ , the rate of

^{1/} A value of n equal to zero implies that no weight attaches to income distribution at all.

^{2/} See IBRD, Development Problems and Prospects of Malaysia, Vol. I (Draft, dated March 19, 1973), Page 40

pure time preference. In this case study, ρ has been set equal to 1%. Reasonable range for the values of n and ρ are estimated (see para. 3) to be as follows:

$$1.25 < n < 1.75; \text{ and } 0 < \rho < 2.$$

33. The final factor remaining to be estimated before the CRI can be calculated is G the growth rate of per capita consumption. Table 1 below shows values of per capita consumption for the five year period 1968 to 1972. The average growth rate was approximately 4.5% per annum. In this study we take this four year average as the best estimate of the mean rate of future growth. A likely range for this mean rate over the time horizon for project analysis is considered to be $4 < G < 5.4$.

TABLE 1

Growth Rates of Per Capita Consumption ^{1/}

<u>Year</u>	<u>Per Capita Consumption</u> ^{2/}	<u>Per cent Charge</u>
	MS\$	
1968	790.9	
1969	806.1	1.9
1970	847.0	5.1
1971	893.8	5.5
1972	937.6	4.9
	Average =	4.4%

34. The consumption rate of interest can therefore be computed as:

$$\begin{aligned} \text{CRI} &= nG + \rho \\ \text{CRI} &= (1.5)(4.5) + 1 \end{aligned}$$

$\text{CRI} = i \approx 8\%$

1)

^{1/} From Tables 1.1 and 2.1 of Development Problems and Prospects of Malaysia Volume II Statistical Appendix (Yellow Cover Report dated March 15, 1973) hereafter referred to as DPP Vol. II.

^{2/} All figures in this and subsequent tables are given in current rather than constant prices. While the price index in Malaysia was very stable over this period, changing less than a percentage point per year, a more refined analysis should be performed in constant value terms.

Distribution Summary Measure

35. The distribution summary measure, D, is defined as the change in utility with respect to a unit of consumption generated by additional investment. In principle one would want to measure the marginal value of increased consumption. If, however, one assumes that in general future investment will have a similar effect on consumption as past investment, then the value of D can be estimated from Table 2, para. 18 of the Annex, or computed as:

$$D = \frac{\sigma^n}{(n + \sigma - 1)(\sigma - 1)^{n-1}} \quad (\text{Appendix I, para. 9})$$

for $n \geq 1$ where σ is a parameter of the Pareto distribution function fitted to the existing pattern of the distribution of consumption in the country, and n is the elasticity of marginal utility with respect of consumption.

36. If on the average one expected future investment to result in a more equitable distribution of consumption one might want to adjust the value of D upward. On the other hand, available data on which the value of σ would be based, will in most cases describe the distribution of income rather than consumption. Since consumption is typically more evenly distributed than income, this would lead to a downward adjustment of D. In this study no adjustment to D is made.

37. The parameter σ is related to the Gini coefficient, λ . The Development Research Center (DRC) of the Bank has estimates of the Gini coefficient for many LDCs. For Malaysia, the Gini coefficient has been estimated by DRC to be between .46 and .49. Taking $\lambda = .48$, we have:

$$\sigma = \frac{2 - \lambda}{2(1 - \lambda)} \quad (\text{Annex, para. 18, note 1})$$

$$\sigma = \frac{1.52}{1.04}$$

$$\sigma = 1.46$$

The distribution summary measure is then:

$$D = \frac{(1.46)^{15}}{(1.96)(.46)^5}$$

D = 1.3

2)

Conversion Factors for Tradable Goods

38. It is useful to have general summary conversion factors for valuing project inputs and/or outputs in border prices when the given data for such items are in terms of domestic value. Such factors are estimated in the following three sections for consumption goods, for capital goods, and for an average of all tradables taken together.

a) Conversion Factor for Consumption

39. The total cif value (border prices) of imported consumption goods, and the fob value of exported consumption goods is shown in Table 2.

TABLE 2

Imports and Exports of Consumption Goods (M\$ mill.)

	1/	1968	1969	1970	1971	4 Year Average
Imports	<u>1/</u>	1275	1139	1212	1127	1188
Exports	<u>2/</u>	263	286	349	386	321

40. Discussions with the country economist led to an estimate of the average tariff on imports of consumption goods at 25%. Exports of consumption goods were estimated to have a net subsidy of about 5%. The conversion factor β_c is defined as

1/ From Table 3.6, DPP, Vol. II, 1973

2/ From Table 3.3, DPP, Vol. II, 1973

the weighted average of the ratio of border prices to their domestic prices.

Therefore:

$$\beta_c = \frac{M + X}{M(1 + t_m) + X(1 - t_x)} \quad (\text{Annex, para. 19})$$

$$\beta_c = \frac{1188 + 321}{1485 + 337}$$

$$\beta_c = .83$$

3)

b) Conversion Factor for Capital Goods

41. The value of capital goods imports and exports in Malaysia is given in Table 3.

TABLE 3

Imports and Exports of Capital Goods (M\$ mill.)

	1968	1969	1970	1971	4 Year Average
Imports ^{1/}	750	742	1151	1269	978
Exports ^{2/}	73.5	84	84.1	82.1	81

42. Imports of capital goods were estimated to have a net tariff of 10%, while exports of capital goods were estimated to have a net subsidy of 5%. The conversion factor for capital goods β_k is therefore:

$$\beta_k = \frac{978 + 81}{1076 + 85}$$

$$\beta_k = .91$$

4)

^{1/} From Table 3.6, DPP, Vol. II, 1973

^{2/} From Table 3.3, DPP, Vol. II, 1973

c) Standard Conversion Factor

43. To convert tradable goods of an undifferentiated nature into border prices one employs the standard conversion factor, β . The value of all imports and exports are shown in Table 4.

TABLE 4

Total Imports and Exports (MS\$ mill.)

	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>4 Year Average</u>
Total Retained Imports ^{1/}	3182	3237	3935	3960	3580
Total Exports ^{2/}	4122	5052	5163	5009	4840

44. Revenues ^{3/} from import tariffs average 15% of the value imported, while revenues from export duties amount to an average of 5% of total exports. Ten per cent of total exported value, however, is subsidized at a rate of approximately 5%, leaving a net export duty of approximately 4.5%. The standard conversion factor is therefore:

$$SCF = \beta = \frac{3580 + 4840}{4117 + 4622}$$

$\beta = .96$

5)

^{1/} From Table 3.6, DPP, Vol. II, 1973
^{2/} From Table 3.3, DPP, Vol. II, 1973
^{3/} From Table 5.3, DPP, Vol. II, 1973

45. Estimates for the ranges of tariffs and duties were as follows:

tariffs on the imports of consumption goods	:	20 - 30%;
subsidies on the export of consumption goods	:	0 - 10%;
tariffs on import of capital goods	:	5 - 15%;
subsidies on export of capital goods	:	0 - 10%;
tariffs on total imports	:	12 - 18%; and
duties on total exports	:	1 - 9%.

These led to the following ranges in estimates of the conversion factors:

$$.80 < \beta_c < .85$$

$$.87 < \beta_k < .94$$

$$.95 < \beta < .98$$

46. It should be noted that because the standard conversion factor is higher than the conversion factor for both consumption and capital goods, the conversion factor for intermediate goods must be higher than the standard conversion factor.

Shadow Price of Public Investment

47. The value of public investment at time 0, v_0 can be computed as:

$$v_0 = \left[\frac{(1 - s_0)q_0 D_0}{(i_0 - s_0 q) \beta_0} \right] \left[1 - \left(\frac{1 - s_0 q_0}{1 + i_0} \right)^T \right] + \left[\frac{1 + s_0 q_0}{1 + i_0} \right]^T \left[\frac{(1 - s_T)q_T D_T}{(i_T - s_T q_T) \beta_T} \right]$$

where:

s is the marginal savings propensity

q is the marginal product of capital

T is the number of years until the growth path of the economy is acceptable

i, β, D are as previously defined.

48. This formula assumes that all parameters in the equation, s, q, D, β maintain their initial value throughout the planning period until time T when they

suddenly switch to the values corresponding to the desired growth path. If, however, $i > sq$, then it may be a reasonable approximation to employ the more simple formula:

$$v_0 = \frac{(1 - s_0)q_0D_0}{(i_0 - s_0q_0)\beta_0} \quad (\text{Annex, para. 24})$$

which assumes that the parameters underlying v , and therefore v itself, remain constant over time. Use of such a formula would not be reasonable if $sq > i$ since this would imply a very low rate of growth per capita consumption.

49. In the case of Malaysia, the value of sq is greater than i , as shown below (para.30) and as an approximation to the true value of v , we will employ the shortened formula. Two parameters, s and q , must be estimated before v can be computed.

a) Public Sector Savings Propensity s

50. The parameter s is defined as the public sector's marginal propensity to reinvest out of return from public sector investment. It is estimated from the following data:

TABLE 5

Public Consumption and Capital Formation

(M\$ mill.)							
Year	(a) Public 1/ Consumption	(b) Public Capital 1/ Formation	(c) Total Consumption plus capital	(d) b/c	(e) <u>Δ Total</u>	(f) <u>Δ Capital</u>	f/e
1967	1704	622	2326	.26			
1968	1744	626	2370	.26	44	4	.09
1969	1826	620	2446	.25	76	-6	-.08
1970	2062	693	2755	.25	309	73	.24
1971	2443	856	3299	.26	544	163	.30
1972	2780	1200	3980	.30	681	344	.51
			Averages:	.26			.21

1/ From Table 2.1, DPP, Vol. II, 1973.

The last column, representing the marginal as distinct from average propensity to reinvest, shows a marked yearly increase. In this analysis we are interested in the sustained future propensity to reinvest on the part of the government and select:

$$s = .25$$

The range of values within which this mean marginal value of s is judged to lie with about .8 probability is $.20 < s < .33$.

b) Marginal Product of Capital

51. The remaining parameter necessary to calculate v , the shadow price of investment, is q , the marginal product of capital. We define q as the return from a marginal investment in the public sector expressed in terms of foreign exchange. We use as a guide to the estimation of q the following relationship:

$$q = k - m_n l$$

where k is the incremental output/capital ratio;
 m_n is the marginal product of labor for the national economy;
 l is the employment/capital ratio;
All parameters are expressed in accounting prices.

Using such a relationship to estimate q requires that national data be employed, since such data do not exist for the public sector.

52. To determine k , the incremental output/capital ratio, the following data were obtained:

TABLE 6

Output and Capital Formation

<u>Year</u>	<u>Output</u> ^{1/}	<u>Δ Output</u>	<u>Δ Capital</u> ^{2/}	<u>Δ Output ÷</u> <u>Δ Capital in t-1</u>
1967	8378		1510	
1968	8692	314	1548	.21
1969	9636	944	1559	.61
1970	10096	460	1874	.29
1971	10563	467	2089	.25
1972	11260	697	2470	<u>.33</u>
			Average:	.34

The mean future incremental output/capital ratio k is therefore estimated at .34.

Its range is judged to be from .25 to .38.

53. Employment data in Malaysia are not as readily available as other types of data, but reasonably reliable estimates are available for the year 1970. In that year total employment was estimated at 3.493 million, with a growth rate of 2.8%. Annual employment growth in 1970 was therefore .097 million. The marginal employment/capital ratio, l , is estimated as:

$$l = \frac{\Delta \text{ Employment}}{\Delta \text{ Capital } t - 1}$$

$$l = \frac{.097}{1559}$$

$$l = 6.22 \times 10^{-5}$$

A reasonable range of values for l is considered to be: $5.5 \times 10^{-5} < l < .70 \times 10^{-5}$

^{1/} GDP at current factor cost from Table 2.3, DPP, Vol. II, 1973

^{2/} Annual gross fixed capital formation from Table 2.1, Vol. II, 1973

54. The country-wide average wage has been estimated at 150 MS\$ per month. Taking this as an estimate of the marginal product of all labor ^{1/} we have $m_n = 1800$ MS\$ per year. It is considered that this estimate, if in error, would most likely be in error on the low side and a reasonable range of values for m_n is from MS\$1600 to MS\$2400. For some countries, estimates of the total national wage bill may be available, in which case that figure can be divided by total employment to arrive at an estimate of m_n .

55. The marginal product of capital, q , can now be estimated as follows:

$$\begin{aligned} q &= k \left(\frac{\beta}{\beta_k} \right) - m_n l \left(\frac{\beta}{\beta_k} \right) \\ q &= .34 \left(\frac{.96}{.91} \right) - (1800)(6.22 \times 10^{-5}) \left(\frac{.96}{.91} \right) \\ q &= .36 - .12 \\ q &= .24 \end{aligned}$$

56. In the formula for estimating q , k (the output/capital ratio) is multiplied by the ratio of β (the conversion factor for output) to β_k (the conversion factor for capital). This converts that term into units of foreign exchange. Similarly, the term $m_n l$ was multiplied by the ratio of β (applicable to labor's marginal product) to β_k (applicable to capital).

57. The use of the model as formulated above for estimating the marginal product of capital can be criticized on several counts. First, the investment data are presented in gross rather than net terms, leading to an underestimate of q . (See Page 9, footnote 1.) Second, the two factor model ignores returns to other factors such as land and entrepreneurship, which would tend to reduce the estimate of the marginal product of capital. Although obtaining data on these additional considerations would be difficult for many countries, it does not appear justified to assume that the values

^{1/} The treatment of all labor as homogenous is, of course, a simplifying assumption.

would cancel out and that they could therefore be neglected. Rather, the analyst should consider other procedures for determining q , and compare the values thus obtained with the value obtained using the method above. One alternative procedure would be to look at the rates of return obtained from past projects, where all prices for inputs and outputs in these projects are measured in terms of foreign exchange. No systematic analysis along these lines was possible within the time frame of this desk study, and we take $q = .24$. The range of values of the underlying variables is such that a substantial uncertainty in the estimate of q is acknowledged.

58. It should be noted that according to current Bank practice, q is the value that should be used as the cut off point for economic rates of return.

C. Calculation of v

59. With values of s (para. 50), q (para. 57), i (para. 34), B (para. 44) and D (para. 37), the value of the shadow price of public investment, v , can now be computed. For Malaysia, since $s = .25$, $q = .24$, and $i = .08$, we have: $i > sq$, and, as an approximation, we employ the shorter of the two formulae given for v (para. 48).

$$v = \frac{(1 - s_0) q_0 D_0}{(i_0 - s_0 q_0) B}$$

$$v = \frac{(1 - .25)(.24)(1.3)}{(.08 - .06)(.96)}$$

$v = 12$

6)

Shadow Price of Government Income, \bar{v}

60. The key parameters on which the shadow price of government income depends are g , the public sector's marginal propensity to save, and v the shadow price of public investment. The parameter g is related to the parameter s (see para. 11) and can be estimated using the following relationship.

$$s = g(1 - \Delta w l/q)$$

or

$$g = s/(1 - \Delta w l/q)$$

61. The average increase in consumption, Δw , associated with governmental projects is taken to be MS\$80 (para. 65), and g is therefore estimated as:

$$g = .25 / [1 - 80 (.0000622) / .24]$$

$$g = .26$$

The parameter Δw is judged to lie within the range MS\$20 to MS\$140.

62. Taking .26 as the value of g , we can compute \bar{v} as follows:

$$\bar{v} = gv + (1 - g) \frac{D}{\beta} \quad (\text{Annex, para. 20})$$

$$\bar{v} = (.26)(12) + (.74) \frac{(1.3)}{(.96)}$$

$$\bar{v} = 4.1 \quad 7)$$

Accounting Rate of Interest, ARI

63. In arriving at the estimate of v , the assumption was made that v itself and the parameters underlying v would remain constant over the planning time horizon. This permitted the use of the short form for computing v and obviated the need to arrive at values of s , q , β , and D for more than one time period. Since the accounting rate of interest, ARI, is defined as

^{1/} Note that for this relationship to hold, all underlying parameters must be interpreted as either national parameters, or public sector parameters. We assume all values to correspond to public sector rather than economy wide investments. For l , the marginal employment/capital ratio, see para. 53 above.

$$ARI = CRI + \frac{\dot{v}}{v}$$

the ARI is greater than or less than the CRI depending on the value of $\frac{\dot{v}}{v}$. But if g and v are constant over time then $\frac{\dot{v}}{v}$ equals zero, and the ARI equals the CRI. In the case of Malaysia:

$ARI = CRI = .08$	(Annex, para. 16) 8)
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Shadow Wage Rate for Rural Laborers

64. The shadow wage rate (SWR) is composed of a term representing foregone output, a term representing the foreign exchange cost of increased consumption, and a term representing the increase in public welfare due to income redistribution. The SWR is computed by:^{1/}

$$SWR = \alpha m + \beta_c (w - m) \left(1 - \frac{d}{\bar{v} \beta_c}\right) \quad (\text{Annex, para. 39})$$

- where m is the marginal product of labor;
- α is the accounting ratio applied to foregone output (in this case $\alpha = \beta$);
- w is the wage rate;
- d is the distribution factor applied to wages; and
- β_c and \bar{v} are defined as before.

65. We compute in this study the SWR for rural laborers employed in the construction industry. It has been estimated that the marginal product (foregone output) of such laborers on the farm in agricultural areas is MS\$50 per month. On the other hand, because of such factors as increased prices, the loss of the opportunity of free food sources (e.g. fishing and wild vegetables) and because of the cost of transportation, the supply price of labor in construction areas has been estimated at MS\$70 per month. The actual wage rate in construction projects is MS\$150. In this study we take m , the marginal product of labor to be MS\$50, with a range of - MS\$20.

^{1/} We ignore here considerations of disutility of effort, and assume that all increased wage income goes to consumption.

Because of cost differentials between construction areas and farm areas, however, we take the term representing increased income ($w - m$) to be equal to the wage rate minus the higher supply price of labor in construction areas, i.e. (150 - 70).

66. The remaining parameter to be estimated before the SWR can be computed is d , the distribution parameter. This distribution parameter is a function of \bar{c} , the average level of consumption, and c_1 and c_2 , the initial and final levels of consumption. Given the ratios $x = \bar{c}/c_2$ and $y = c_1/c_2$, d can be estimated from Table 1 given in para. 16 of the Annex, or from the following equation:

$$d = \frac{x^n(1 - y^{1-n})}{(1 - n)(1 - y)} \quad (\text{Appendix I, para. 8})$$

67. We have seen (para. 54) that the economy-wide average wage in Malaysia is MS\$150 per month, and that this is also the wage to be paid to construction laborers. The ratio $x = \bar{c}/c_2$ is therefore equal to 1. While it is likely that each wage supports more than one person, the fact that we are interested in the ratio of two consumption levels mean that we can ignore this consideration since any adjustment would cancel out. We take as a range for x the values .88 to 1.3. The ratio $y = c_1/c_2$ is the ratio of the initial to the final level of consumption. Because it has been estimated that the wage rate in construction areas equivalent to the MS\$50 level of income ^{1/} in farm areas, is MS\$70 per month, the best estimate of the ratio of the initial level of consumption to the final level of consumption is $y = 70/150 = .47$. It is further estimated that $.40 < y < .55$. From Table 1, the distribution parameter d is estimated to be:

$$d = 1.7$$

1/

The assumption is made that a well-defined market exists in the rural agricultural areas, so that labor's wage equals its marginal product.

68. The shadow wage rate for rural laborers can finally be estimated as

$$SWR = \alpha_m + \beta_c (w - m') \left(1 - \frac{d}{\sqrt{\beta_c}}\right)$$

$$SWR = (.96)(50) + (.83)(150 - 70) \left(1 - \frac{1.7}{(4.1)(.83)}\right)$$

SWR = MS\$81 per month

9)

Expressed as a percentage of the market rate, the shadow price of labor is 81/150 or approximately .54%.

Shadow Price for Construction^{1/}

69. A recent proposal for a road project in the State of Perak in West Malaysia led to the following breakdown of construction costs:

	<u>Unskilled Labor</u>	<u>Skilled Labor</u>	<u>Foreign Exchange</u>	<u>Local Non-Labor</u>	<u>Total</u>
Construction	7.45%	6.29%	48.59%	37.67%	100%

These data were provided in the consultants report as a part of the normal requirements for a standard Bank appraisal. The 37.67% of total construction costs allocated to local non-labor in the above table may be further broken down: more than half, i.e. 21.3% of total construction, comprises local materials. An analysis of these data by a Bank staff member who interviewed local manufacturers led to the further breakdown of the local materials item, roughly estimated as follows:

^{1/} Information for this section and the following section on Automobiles is from S. Anand "A Comparison of the IBRD and Little Mirrlees Appraisal of a Highway Project in Malaysia". IBRD draft for discussion dated March, 1973.

TABLE 7

Components of Local Construction Materials
of which:

<u>Item</u>	<u>% of Total Construction</u>	<u>Unskilled Labor</u>	<u>Skilled Labor</u>	<u>Foreign Exchange</u>	<u>Local Non-Labor</u>	<u>Total</u>
Reinforced Steel	.66			100%		100%
Wood	2.32	89%		11%		100%
Concrete Pipes	1.16	9%	8.5%	24.5%	58%	100%
Cement	1.22	5%	3.5%	35%	56.5%	100%
Bituminous Products	7.60	3.2%	2.8%	80.8%	13.2%	100%
Quarry Products	<u>8.27</u>	8.1%	6.9%	62.5%	22.5%	100%
	21.23%					

70. With the above further breakdown, the components of total construction cost become:

	<u>Unskilled Labor</u>	<u>Skilled Labor</u>	<u>Foreign Exchange</u>	<u>Local Non-Labor</u>	<u>Total</u>
Construction	10.6	7.2	61.5	20.7	100

71. To obtain the shadow price for construction we must multiply the unskilled labor component by the shadow wage rate ^{1/} times the standard conversion factor; multiply the skilled labor component by the standard conversion factor; multiply foreign exchange by unity; and multiply local non-labor by the standard conversion factor. This gives:

Shadow price for construction = 92% of market costs

10)

1/ Expressed as a percentage of the market wage.

Shadow Price of Automobiles

72. Import duties on motor vehicles are high in Malaysia relative to the average level of duties. For passenger cars the duty is 49%. In addition there is a sales tax of 5% levied on the base of the duty inclusive value. This brings the effective domestic price to a level of 156% of the cif price. The shadow price of automobiles, defined as the ratio of foreign to domestic prices is therefore:

$$\text{Shadow Price} = \frac{1}{1.56}$$

Shadow Price for Automobiles = 64% of market price

11)

Summary and Sensitivity Test

73. Table 8 summarizes the shadow prices for Malaysia that were calculated in this desk study. It also summarizes the judgments that were made on ranges for the values of underlying parameters.

74. After considering the government of Malaysia's stated emphasis on reducing income inequalities and its current attitude towards growth (para. 32), the value of n , the elasticity of marginal utility with respect to consumption was set at 1.5. The rate of pure time preference, ρ , was set at 1%. Since the setting of these parameters is a purely subjective judgment, a sensitivity test was performed, with both of these parameters set at the upper end of their estimated range.^{1/} The results are shown below in Table 8.

^{1/} It should be noted that, assuming correct specification of ranges for estimates of variables, the probability of extreme values occurring simultaneously for all or most of the underlying variables is infinitesimally small. A systematic analysis of the sensitivity of the shadow prices to underlying variables should therefore make due allowances for relevant probabilities.

TABLE 8

Summary of Shadow Prices and Underlying Parameters for Malaysia

A. SHADOW PRICES

Variables	V A L U E	
	Base Case $n = 1.5, \rho = 1$	Sensitivity Test $n = 1.8, \rho = 2$
CRI	8%	10%
D	1.3	1.7
β_c	.83	.83
β_k	.91	.91
β	.96	.96
v	12	8
\bar{v}	4.1	4.0
ARI	8%	10%
SWR ^{1/}	54%	52%

B. UNDERLYING PARAMETERS

Parameter	Best Estimate	Range
n	1.5	1.2 - 1.8
ρ	1	0 - 2
G	4.5	4 - 5.4
σ	1.46	1.43 - 1.48
s	.25	.20 - .33
k ^{2/}	.34	.25 - .38
l ^{2/}	6.22×10^{-5}	5.5×10^{-5} - 7.0×10^{-5}
m ^{2/}	1800	1600 - 2400
Δw ^{3/}	80	20 - 140
m ^{3/}	50	30 - 70
\bar{c}/c_2 ^{3/}	1	.88 - 1.3
c_1/c_2 ^{3/}	.47	.40 - .55

^{1/} Estimated for rural laborers in construction and expressed as a % of the market rate.
^{2/} Applicable to the estimation of q, the marginal product of capital.
^{3/} Applicable to the calculation of the SWR for rural laborers in construction.

Mr. Frederick H. Howell

June 26, 1974

Dennis Anderson

Economic Analysis of Projects

1. The following are my comments on the revised draft of the above report by Messrs. Squire, Linn and van der Tak, and the covering memorandum of Mr. van der Tak, both dated May 31.

2. Although Herman's covering memorandum suggests there is only one issue, there are really four issues on which decisions are required. There are two new issues of method:

- (i) Should we systematically allow for the income distribution impact of projects during appraisal?
- (ii) Should we systematically allow for constraints on the Public Revenue during appraisal?

There is one issue regarding operational procedures:

- (iii) Should "The Regions, and in particular their country desks" be responsible for providing the general ground-rules for appraisal?

Finally, there is one general issue regarding method:

- (iv) Should the Bank "adopt the approach outlined in these papers as its official guidelines for the economic analysis of projects?"

3. Paragraphs 4 and 5 of Herman's memorandum suggest that to accept (iv) requires only the acceptance of (i) and (ii). However, I do believe that the issues are independent: it is very reasonable to accept (i), (ii) and (iii) without concurring entirely with the methods of doing the job outlined in the papers. This is roughly my position.

(i) Income Distribution

4. Promoting projects which help low income groups is already a part of Bank policy. Many projects now being financed, and areas for new investment, are a reflection of this policy; for example:

- sites and services;
- small farms;
- water supplies and sanitation in urban and rural areas;
- health and education;
- rural electrification

Nevertheless it is true that, though such projects help low income groups, they are appraised in efficiency terms with no "systematic" weighting for their income distribution impact. But isn't this the way justification should be? Preparing and appraising projects in efficiency terms is an inducement towards finding an efficient solution - such as 'low quality' or 'minimum standard' supplies to serve many people instead of 'higher quality' supplies to serve a few. There is no presumption that projects to serve low income groups must generally be inefficient (where an 'inefficient' project means one that has an economic rate-of-return below the test discount rate).

5. Where, however, such projects are inefficient, it is always possible to argue for lenience on an ad hoc basis. It is wrong, it seems to me, to be systematic and consistent when allowing for income distribution, even within a single country. Water supply and sanitation projects, for example, may do far more good for low income groups than, say, electricity or telecommunications, and accordingly deserve a greater weight. Also, there are many local factors, unrelated to local incomes, which may influence the social desirability of projects; if social arguments are to be taken seriously, the selection criterion needs to be sensitive to them. In this respect, the universal social weighting (or welfare) function (SWF) which the paper recommends fails, paradoxically, precisely because of its merits: it is consistent and systematic, but for this reason is totally insensitive to local circumstances. Social weights may be important, but the weights vary, as does everything else, with the case.

6. Apart from:

- (i) the totally arbitrary nature of the SWF used in the paper; and
- (ii) the insensitivity of the approach to local circumstances;

there are three other serious defects with the proposed approach:

- (iii) it is unnecessarily complicated;
- (iv) it totally avoids analysis and justification of the social benefits; and
- (v) it is likely to give silly results on account of the non-linear and arbitrary form assumed for the SWF.

What needs to be done is this: when the economic rate of return (IER) is low, some tolerance might be allowed for projects that do some social good. The appraiser should be asked to show why by descriptive analysis of local problems. From this it may follow that a project with an IER of, say, 5% may be acceptable; the IER and the analysis are intelligible to everyone. The approach recommended, on the other hand, hides all this by scaling up the IER on the basis of an arbitrary SWF unrelated to analysis of local

problems. At one extreme, it is quite possible, using the function proposed, to convert IERs of say -20% into socially weighed IERs of +20%. The non-linear form assumed has some very odd properties once it is transferred into the IER. Why not weight the IER directly (according to the case) and avoid such complications?

(ii) Public Revenue Constraints

7. I am surprised the paper argues that the Bank evaluates projects "without taking into account the effects of the project on government revenues" In Public Utilities, constraints on the Public Revenue have been, perhaps, the major influence on financial and tariff policies. The omission of any useful discussion of the connection between pricing policy and project evaluation and justification is a serious weakness of the paper. (It is of course true that projects which help or put less demand on the Public Revenue deserve special weight, as the paper argues; but there is an important connection between the IER and pricing policy which has been missed.)

(iii) Ground Rules and Country Reporting

8. It has always seemed reasonable to expect the country economic reports to provide groundrules for project preparation and appraisal. This can be done by discussion of problems regarding:

1. the foreign-exchange rate;
2. unemployment;
3. capital and savings;
4. the public revenues;
5. income distribution.

Some elementary groundrules might be suggested for dealing with the first four items in project analysis.

(iv) Official Guidelines (for Determining Groundrules)

9. It is also evident that some guidelines should be provided regarding the determination of the groundrules. In deference to Haman's opinion that the present paper needs only "minor editing" (para. 4) and is "feasible in practical work" (para. 11) I would have serious misgivings about it were I a country economist:

1. There are serious doubts about the way the paper proposes to deal with income distribution and social factors;

2. It is inflexible, and the formulae it proposes are
(a) rigid (b) can be questioned and (c) try to quantify things that are often best left to judgement.

It is also complicated, though this is a defect which can no doubt be overcome with time.

10. Some specific comments:

- (1) Part II. Discussion proceeds as if everything has to be measured, including things like consumers surplus. Often this is not necessary if (a) what can be measured gives a good return and (b) the net effects of unmeasured things are thought to be positive. The advantage of making sure pricing policy is good is that (a) is generally the case. Also, a little sensitivity analysis of things unmeasured may be useful in establishing if they need to be measured.
- (2) Paragraph 53. Projects with negative NPVs may also be acceptable for reasons given in para 54 for rejecting projects with positive NPVs. Not everything can be quantified.
- (3) Paragraph 60. The suggestion that we measure consumers surplus is impractical except in a very few cases (such as agro-industrial and farm consumers in rural electrification). To a large extent, it is also unnecessary if pricing policies make sense. (See comment (1) above.) This is why we are proposing to use the IER calculation as a test of pricing policy by omitting, except in some cases, the estimates of consumers surplus.
- (4) Throughout. More discussion is needed of what the analyst can do when he can't measure something. Is there a basis for forming rough and ready judgements? I think so. He needs to be given this option in the "official guidelines."
- (5) Omissions. The paper, as far as I understand it, has rejected more traditional methods of dealing with (a) the shadow-rate of foreign exchange and (b) the problem that the discount-rate for social time preference may not equal the opportunity cost of capital. If the new techniques are equivalent but more convenient, this should be said; if they are not, some review is required. Also, new terminology is introduced - "consumption rate of interest," "accounting rate of interest," "standard conversions factor," etc. A glossary, and contrast with old terms is required.

Recommendations

- (1) Agree wholeheartedly with the aims of the paper, namely:

- to respect the public revenue;
 - to analyse social factors;
 - to ask country economists to provide groundrules;
 - to provide official guidelines.
- (2) Seriously doubt the techniques proposed and the adequacy of the guidelines.

D Anderson

cc: Messrs. Rowland, Warford, Jennings, van der Tak, Linn, Ray
Files

Mr. Adalbert Krieger, Director, LAC I

June 19, 1974

Guy P. Pfeffermann, Senior Economist, LAC I

"Economic Analysis of Projects" Meeting

1. Mr. Stern chaired a meeting on Mr. van der Tak's document proposing the generalized and mandatory use of shadow prices (including incomes weights) for Bank project appraisal. Among others the chief economists and projects directors of the regions (or their representatives) attended the meeting. Messrs. Dosik, Balassa, Ahluwalia, Bruce and Willoughby also attended.

2. With the exception of Mr. Bruce, who thought Mr. van der Tak's proposal was feasible and did not involve much additional work on anybody's part, the participants unanimously agreed that on the evidence presented the costs of the proposal hardly seemed to be justified by the benefits to the Bank. More specifically, the following points were made:

- (a) nothing in the proposed method would help us to know relationships that we do not now know (on who benefits from projects, on inter-relationship between the economy as a whole and the projects, etc.); therefore the new proposal would add considerably to our workload without solving some of the critical problems to which we now have no solution, or only very imperfect solutions;
- (b) the appraisal stage is much too late for such a method to have any impact; however, the identification stage is too early to have the figures that are necessary to use the method.

3. Mr. Stern did not clearly state his conclusion, other than summing up the difference of views that exists between the regions on the one hand and Mr. van der Tak on the other. My own feeling is that the recommendation will be in line with this region's position: to experiment with the new method at the margin in a few cases selected by the region, but not to go beyond an experimental stage in the foreseeable future.

cc: Mr. Knox, Director, Projects - LAC
Mr. Avramovic, Chief Economist, LAC
Mr. Holsen, Senior Economist, LAC I

GPfeffermann:ms.



Mr. Edward V.K. Jaycox

June 17, 1974

H.B. Dunkerley

Economic Analysis of Projects (van der Tak Paper)

1. Two important issues occur to me on a quick reading of this paper. I have raised them frequently in the past but believe they merit repetition:

- a) Is any numerical evaluation procedure leading to a single project solution conceptually valid when dealing with numerous conflicting social objectives?
- b) Is the use of shadow prices justifiable as a basis for project selection, and if so within which limitations, if actual prices are not aligned with the shadow prices either directly or via taxes and subsidies?

2. Social Objectives. Economic analysis, even with weighting techniques, cannot adequately resolve problems of equity and other social values. There are conflicting social objectives, for example more health services versus more education, more prevention of child deaths against those of old age, providing for the present generations against providing for future generations (the discount varying between sectors), helping inner-city residents against those at the periphery in the same income group. Social objectives also change over time, frequently over the life of a project. In these circumstances what the policy-maker needs is the clear presentation of several project alternatives which will involve different packages of benefits and disadvantages - which cannot be summed up in a single measure. The politician/decision-maker does have a role which the economist cannot effectively usurp and should not try to. Should we then not be concerned with how to present reasonable, feasible alternatives and the consequences of varying the variables rather than with how to pick a unique solution ourselves? Or can this be handled during the course of project preparation? If so, how?

3. Shadow Prices. Is not the question largely overlooked of what the consequences will be if projects are chosen on the basis of such shadow prices (whether from comprehensive or partial analysis), and if actual prices are not aligned with the shadow prices? 1/ And how do we analyze such a situation to make sure that the result of using inoperative shadow prices in the project decisions does not result in a worse allocation of resources in the long run? e.g. overloading of capacity or decapitalization of the entity. And what are the consequences if some prices are adjusted to shadow prices and not others?

4. First Year Rate of Return. The handling of this in para 59 is better than some descriptions but still does not deal adequately with periods of benefit build-up (whether or not the benefit curve varies with date of commencement) e.g. the several years before adaptation is complete in major urban transport projects.

1/ Aligned directly or indirectly, e.g. by subsidies for utilization of labor or taxes penalizing use of capital.

5. Risk Analysis. Though somewhat more sophisticated than the general Bank practice, the proposals still seem inadequate. Fundamentally the methodology treats the incidence of risks on an already determined project (based on calculations excluding risk) rather than considering the modification of design of the project to best accommodate the risks. A quite different type of project may emerge in the latter case.

6. This is a hurried note based on a rapid scanning of the text to which it may not do justice. There are also many minor points which seem to deserve further thought e.g. measurement of income distribution and equity considerations in the context of changing the balance of population brought about by a project. These are issues that perhaps cannot be readily resolved - but at least it would seem worthwhile signalling more clearly the limitations of the methodology proposed.

HBDunkerley:go

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OFFICE MEMORANDUM

TO: Regional Vice Presidents

FROM: J. Burke Knapp

SUBJECT: Issues/Decision Process

(R.C. 465-07)

Handwritten: ~~Mr. Lutzgow~~
Guidelines file*Handwritten:* OP-G. G.P. - AMMANOU AND

DATE: March 7, 1974

Handwritten: PREPARATION OF PROJECTS*Handwritten:* Mr. King

1. The Issues Paper/Decision Meeting/Decision Memorandum procedure can be fully effective only if the several steps required follow each other promptly. It is difficult to stipulate maximum periods during which these steps should be completed. The Guidelines on the Issues/Decision Process which were distributed last July only state that the Decision Memorandum should be circulated "at most five days after the meeting" but they also imply clearly that the Decision Meeting should be called very shortly after the Issues Paper has been distributed. It is excessive if four, five, or even more weeks pass between the date of the Issues Paper and the Decision Memorandum. Unfortunately, delays have occurred in the last few months. To name only a few cases: On the Botswana Development Corporation Project, 69 days passed between the date of the Issues Paper and the Decision Memorandum, 46 days on the Yugoslavia - Morava River Basin Development Project, 45 days on the Indonesia - Jakarta Urban Development Project, and 35 days on the Brazil - Third Livestock Project. I believe that, as a general rule, no more than two or at most three weeks should pass between the Issues Paper and the Decision Memorandum.

2. One factor that probably has contributed substantially to recent delays is the tendency to provide more and more detailed information in Issues Papers and Decision Memoranda, making these papers unnecessarily long and cumbersome. The Guidelines contain detailed suggestions on what should, and what should not, be dealt with in those memoranda.

3. Please urge your staff to schedule decision meetings and to issue Decision Memoranda promptly, and to keep Issues Papers and Decision Memoranda as short and succinct as possible.

cc: Messrs. Baum
Broches
Chenery
Kearns

OFFICE MEMORANDUM

Yellow

TO: Mr. Michael L. Hoffman

DATE: March 7, 1974

FROM: Vincent J. Riley *VJR**LI-UNACC-SUBCOMMITTEE 2/2/74**✓ CC: OP-6 O.P. - APPRAISAL &**PREPARATION OF PROJ.*SUBJECT: ACC Subcommittee on Water Resources

In Mr. Shipman's memorandum of February 14 on the February 4-8 meeting of the above committee he reports on a discussion dealing with the role of the Bank as Executing Agency. In it (Pages 3 and 4) he notes that for the second time the UN Resources and Transportation Division questioned the designation of the Bank as Executing Agency for the Mexican Water Study and he goes on to state that during informal discussions with representatives of FAO, WHO, and WMO, "there was unanimity in view that IBRD should not be Executing Agency", for any UNDP pre-investment projects.

I find this view, and in fact the whole of this part of Mr. Shipman's report and recommendations most disturbing. I certainly would oppose the Bank taking an apologetic stance regarding its acting as Executing Agency. I doubt that the representatives at this meeting represented the official view of their agency heads on this subject. Even if they did, their "prevailing argument" that the Bank should stay out of pre-investment to insure unbiased appraisal just does not hold water. The Bank has tried hard (and successfully) to keep its appraisals unbiased. The Bank finances itself a lot of pre-investment, and would probably finance much more if it were barred from executing projects which UNDP financed. The primary reason is that governments and the Bank in many instances have absolutely no confidence in the capacity of many of the specialized agencies to do a competent, timely job in pre-investment. "Special Interest" and the Cooperative Programs have improved somewhat their capacity in this area, but there is a long, long way to go.

The Mexican Water Study partially illustrates the point. The project began as an effort by the Mexican Government to get the Bank to do (or help it do) this study. At the same time the Bank had its own interests in terms of its research programs in this field. UNDP entered the picture only late in the game as an alternate source of financing, because we wanted to give it "first refusal". The Mexicans, especially, had no interest in bringing UN's Resources and Transport Division into the picture. They were not even keen on involving UNDP.

Mr. Shipman makes the recommendations:

1. On UNDP water resource projects it would be desirable that IBRD leave execution to other agencies of the UN family unless very particular reason exists to take on this responsibility. Where the country specifically asks for our help, IBRD cannot ignore this request.

March 7, 1974

This recommendation has some similarity to the existing Bank policy set out in paragraph 6 of OPM 4.00. That policy has been in existence for many years, and I recommend that the language of the OPM, rather than the language of Mr. Shipman's recommendation be our guide. In fact, it might be appropriate for Mr. Shipman to bring the language of the OPM to the attention of those who raised the question with him.

2. Where the Bank accepts to act as Executing Agency on UNDP projects, it should attempt to bring the appropriate specialized agencies into the study as far as possible. This should include subcontracting of those portions of the study to those agencies wherever feasible and, at least, consultation, to let those agencies know we are not bypassing and ignoring them.

While I can agree with the general underlying idea here expressed, I question the practicality of the specifics. UNDP normally consults other "competent" agencies in the course of its project appraisal and makes their views known to us. Otherwise, I find little disposition in the Bank to tolerate the delay inherent in consulting with other agencies and very little feeling that (with rare exceptions) much would be gained. Given the Bank's formally expressed preference for sub-contracting projects, usually in their entirety, to consulting firms, the idea of subcontracting portions of a study to agencies "wherever feasible", seems particularly impractical.

In this connection I might note that Mr. Shipman also mentions that UN raised the question of other agencies being "associated" with Bank-executed projects. The idea of one agency wanting to be designated "associated agency" for projects being executed by another, used to be a particularly virulent plague when project proposals were considered by IACB. The Bank always opposed it, vigorously - and successfully. We never asked to be "associated" with anyone else's projects and never agreed to their being "associated" with ours. The main reason is that those arrangements produce divided responsibility for the project, major coordination problems, and prolonged delay in implementation. The end of IACB consideration of individual UNDP projects has meant that "Associated Agency" status is now less in vogue.

The Bank, however, still says no to the idea whenever it is raised (although we did agree to be "associated" with a UNOIC-executed Statistics project in Indonesia when the Bank staff's desire to be designated executing agency was blocked).

cc: Mr. Shipman (Public Utilities Projects Dept.)
Mr. Franco-Holguin (International Relations Dept.)

VJRiley/eb

~~Mr. Thao~~

~~OP. GOP Appraisal & Preparative of Report~~

~~Wm. Yon~~

~~Is this of any value to this Division?~~

~~SFB~~

~~10/17~~

~~Little value to our work
Jaw~~

THE OPERATIONAL SIGNIFICANCE
OF THE
DRAFT O.M. ON THE
ECONOMIC ANALYSIS OF PROJECTS

(Incorporating Case Studies on the Philippines and Malaysia)

by

Colin Bruce

Asia Projects Department
October 12, 1973

Acknowledgements

This paper would not have been possible without the willing help of many officials in the Philippines, Malaysia, Thailand and Bangladesh, and I am grateful for their assistance.

I benefitted much from a discussion on part of this paper with Deepak Lal, Lyn Squire and Martin Wolf, and from general comments by and help from John Hansen. They are not responsible for any error of fact or logic.

Notation System

In "A Guide for Country Economists to the Derivation of National Parameters for Economic Project Evaluation", John Hansen and I used a mnemonic notation system. I still think this is desirable, but I now attach greater importance to the standardization of symbols for cost-benefit analysis. However, I would modify the symbols used in the draft O.M. on the Economic Analysis of Projects to conform to the draft revised Little-Mirrlees manual. Because this has not been done and because our Worksheets were printed using our mnemonic notations, I continue to use this system in this paper. In Part IV, however, I have put the corresponding draft O.M. symbols in parenthesis where appropriate.

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THE OPERATIONAL SIGNIFICANCE OF THE DRAFT O.M.

ON THE ECONOMIC ANALYSIS OF PROJECTS

I. INTRODUCTION

1. Following the distribution in two parts of the first version of the Draft O.M. on the "Economic Analysis of Projects", John Hansen and I wrote "A Guide for Country Economists to the Derivation of National Parameters for Economic Project Evaluation" (June 25, 1973), hereinafter called "The Guide". This Guide has a series of Worksheets attached which are intended to help country economists, who would shoulder the main burden of the work if the proposed new social cost-benefit analysis were to be introduced.

2. As part of a Bank-wide program to test the practicability of the Draft O.M., a revised version of which was issued on July 3, 1973, it was agreed that, in cooperation with the country economists concerned, I would assess the operational significance of the Draft O.M. as part of my mission to the Philippines, Malaysia, Thailand^{1/} and Bangladesh. This I proceeded to do. Part IV of my mission report (September 18, 1973) summarized the discussions I had in each country and gave some preliminary conclusions.^{2/}

3. Since the Worksheets for Thailand have not been returned, it cannot yet be given as a case study, but from detailed discussions I had in Bangkok with the relevant authorities, I have no doubt that the information is available to complete most of the Worksheets. Bangladesh is also not given as a case study, but for quite different reasons: due to the separation of Bangladesh from the former Pakistan, the current national income accounts and trade statistics are deficient. The Bangladesh Planning Commission has estimated a set of shadow prices, but these will need to be carefully examined and discussed with the Bangladesh Planning Commission before they can be taken as fairly definitive. So Bangladesh is a special case and cannot be taken as representative of the problems to be encountered in most of our countries. Thus, the testing of the methodology is based on the experience of completing the Worksheets for the Philippines and Malaysia, which are attached as Annex B and C respectively, and on discussions held in these countries and in Thailand.

^{1/} Thailand was not in the original list, but, at my suggestion, copies of the Guide were given by our Resident Mission in Bangkok to the National Economic and Social Development Board (NESDB) and during meetings I had with NESDB and the National Statistical Office (NSO) the Thai officials said that they would attempt to complete the Worksheets themselves.

^{2/} This is attached as Annex A for easy reference.

II. TESTING THE METHODOLOGY

4. It is convenient to break down the tests of practicability into four categories as follows:

- Availability of needed information.
- Is the methodology time consuming?
- Reliability of information.
- How capricious is the methodology?

5. The analysis in the next section follows the order of the Worksheets. (See Annex B and C).

A. Availability of Needed Information

(i) Basic Variables

6. (a) Objective Parameters. The marginal propensities to consume (MPC) and save (MPS) for the country as a whole and in the public sector are either given in country economic reports (CERs) or can be estimated from data in CERs or other documents in the Bank. The marginal propensities to consume (MPC^w) and save (MPS^w) out of wages are not generally available in CERs and have to be estimated from other data that may be available, such as consumer budget and farm budget surveys. Failing this, adjustments to the national variables may have to be applied, which involves elements of judgment and guesswork.

7. The estimated future rate of growth of consumption and of population, and hence of the future rate of growth of per capita consumption (CONGRO), are available in CERs or other available documents. The GINI coefficient of income distribution is not usually available in CERs or in other documents in the Bank or in the country. However, the Development Research Center has estimates for a large number of countries, but it is admitted that they are rough and ready in most instances. Nevertheless, there is probably a fair degree of concentration in LDCs around a mean of about 0.46-0.50. The marginal product of labor (MP^{lab}) is not available in any country, and I comment on this when discussing the formula for estimating the marginal product of capital (MP^{cap}).

8. (b) Subjective Parameters. None of the subjective parameters -- elasticity of marginal utility with respect to consumption (MU^e), pure time preference (PTP) and the number of years until government income is optimum (T^{opt}) -- are given in CERs or in any other documents as might be expected. All are value judgments which I discuss later on in this paper.

(ii) Conversion Factors

9. I deal first of all with the factors for converting benefits and costs expressed in domestic values into border prices (foreign exchange equivalents). There is no problem in those countries where quantitative restrictions and

smuggling are relatively unimportant. The estimation of the standard conversion factor (SCF) according to the simple equation given in the Draft O.M. presents no problems. The values of total merchandise imports and exports and total taxes (subsidies) on imports and exports are readily available. Import and export elasticities are not generally available. The breakdown of the SCF into conversion factors for capital goods (CF^{cap}) and consumption (CF^{con}) is more difficult in some countries in that the breakdown of import duties into duties on capital and consumption goods may not be readily available, but it is a breakdown which Ministries of Finance should desirably have anyway; indeed, they should have a much finer breakdown.^{1/} I was able to obtain the breakdown for both the Philippines and Malaysia and I think it is also available for Thailand.

10. Significant smuggling is generally present where there also are quantitative import/export restrictions. This is not to say that it does not occur in relatively open economies, particularly where taxes are high, but it is probably less prevalent in such economies. Clearly there is an added complication where it is known to be more than marginal and some allowance must be made for it, but in many of our countries we do not have to worry about it.

11. There is a real problem in countries like India and Bangladesh, with relatively closed economies and important quantitative restrictions on imports; quantitative restrictions on exports are probably not so important. Here one has to estimate tariff or import duty equivalents. Since it would be very difficult to do this for all items entering into trade, sample surveys have to be resorted to.

12. The revised Draft O.M. suggests estimating conversion factors for some of the more important non-traded items, such as power, transport and building and construction, and our Worksheets included schedules for estimating such conversion factors. During the short time I was in Manila I was unable to get the relevant information, and the National Economic Development Authority (NEDA) was able to supply only some information about average building costs per square meter at market prices. Further delving would be required to estimate the conversion factors for transport and power. In Malaysia I was able to obtain estimates for all three conversion factors. In Thailand a Bank power mission was able to provide me with cost breakdowns for electricity at market prices from which the social values can be estimated; a Transport Survey is in progress which will provide the data for the CF for Transport; and some data is available for the CF for Building and Construction.

^{1/} The draft O.M. does not break down the SCF (β) into capital and consumption elements. It does, however, use α a conversion factor for valuing the foregone marginal product of labor (viewed as output) at border prices. The estimation of α would run into difficulties similar to those for CF^{cap} and CF^{con} where tax yields are not broken down by classes of imports.

(iii) Accounting Rate of Interest (ARI)

13. (a) Marginal Product of Capital (MP^{cap}). I was able to make an estimate of the MP^{cap} for Malaysia, and NEDA did the same for the Philippines based on the Draft O.M. simple, two factor formula. For reasons given in Paragraph 100-102 of the Guide, I think there are theoretical objections to the simple production function used. It is true that the use of investment gross of depreciation underestimates the value of MP^{cap} and therefore offsets the over estimation of MP^{cap} due to using only two factors of production, but we cannot say a priori that the two tendencies would cancel out. More important, however, are the practical difficulties. In the first place employment statistics are typically poor in most LDCs and the Philippines and Malaysia are no exception. Secondly, output/capital and labor/capital ratios tend to vary considerably from year to year. I am not sure that averaging over a period of years gets over this problem. Third, and perhaps most important of all, the formula requires an estimation of the marginal product of labor (MP^{lab}) for the country as a whole. It is difficult enough to estimate the MP^{lab} for a project within a limited area; how does one set about estimating a national figure? One cannot take the average wage as reflecting the marginal product since labor markets are typically imperfect. In support of the above arguments I refer the reader to the Worksheets for the Philippines and Malaysia attached which show MP^{cap} of 26 percent and 25 percent respectively. To say the least, these figures are intuitively implausible. The revised Draft O.M. does say that "the best guide to q / MP^{cap} ", therefore, is the return which public sector projects are currently earning or which proposed public sector projects are expected to earn". I agree very much, but I doubt whether the simple production function should be used even as a "rough guide" or a cross check. In the Worksheets I estimate MP^{cap} using the simple production function, but use a directly estimated MP^{cap} for estimating the GRI (ARI). (In point of fact, due to time constraints, the direct estimate was guesstimated.)

14. (b) Social Value Parameters - The calculation of the consumption rate of interest (CRI), the social price of investment (SPINV) the social price of public income (SPINC) and the national distribution parameter (DIS) are all straightforward, once the subjective parameters are determined, since no new variables or parameters are involved, and one just inserts values from previous worksheets and does simple arithmetical operations on them.

15. (c) Investment Rate of Interest and Government Income Rate of Interest. The Investment Rate of Interest is a form of the ARI which was put in just for interest to see the differences between the three accounting rates of interest - consumption rate of interest (CRI), the investment rate of interest (IRI) and the Government Income Rate of Interest (GRI). All three are the discount rates appropriate to the three different numeraires -- consumption (as in UNIDO), investment (as in the Little-Mirrlees Manual), and public income (as in the revised Little-Mirrlees Draft) -- and all three measure the rate of fall in the value of the numeraire over time. Like the social value parameters, the worksheets are easy to complete as in them one operates on values derived in earlier worksheets. Calculating SPINC Δ was somewhat more difficult for me because I found my knowledge of using logarithms of numbers less than one somewhat rusty!

(iv) Labor Conversion Factor

16. The estimation of the conversion factor for labor (ratio of the shadow to the market wage rate) uses both nationally determined and project-specific parameters. Since my field work did not involve the application of the van der Tak/Squire methodology to any specific project^{1/} Worksheet IV is incomplete. It would be completed by the project economist for each project.

(v) Conclusion

17. About three quarters of the information required is available on average in CERS and other documents. Most of the remaining information is available in planning organizations and in statistical offices in member countries. An important exception to the above is the difficulty in countries which have quantitative import restrictions of estimating tariff equivalents and hence of estimating the conversion factors for re-valuing non-tradeables. It will take time in those countries to carry out sample surveys of relative foreign/domestic prices.

B. Is the Methodology Time-Consuming?

18. The time it takes to complete the Worksheets varies slightly from country to country and according to the amount of information the Bank Group has readily available in its CERS and other documents. I filled in the Worksheets for the Philippines and Malaysia with about three-quarters of the data required in less than three hours for each country. I obtained the balance of the information for Malaysia in one afternoon's session with the staff of the Department of Statistics and they spent a few more hours to provide me with the remaining information I requested. In the Philippines, NEDA were unable to provide me with quite so much information, but the data which is lacking is that necessary to break down the SCF in various ways, information which is desirable but not necessary. Thus experience shows that in general data collection is not a time consuming process, nor does the completion of the Worksheets and the simple computations involved take much time.

19. Deciding on the values of the subjective parameters does require some careful thought, but no more than the average country economist should, in my judgment, take to think about these problems and discuss them with the policy makers as part of his country economic work, particularly if he is interested in making his country economic work more operationally significant. I take up the question of alleged arbitrariness in the next section of this paper.

20. Thus, experience leads us to the conclusion that the allegation that the proposed new methodology would impose a large, new burden on already

^{1/} But I am working with the project economists concerned to apply it to one or two agricultural development projects in Malaysia.

overworked country economists is without any foundation in fact. In the first place, on the average, the time taken on data collection is small. Secondly, with good working relationships it is possible to get personnel in planning agencies and statistical offices to undertake the more time-consuming delving for data which is not readily available. Lastly, even if the methodology were to involve a fair amount of the country economist's time, consideration of priorities in terms of the Bank Group's objectives would indicate that other parts of the country economist's work should make way so as to improve the Bank's project planning work.

21. It is outside the scope of this paper to consider the detailed application of the van der Tak/Squire methodology to the appraisal of projects, but I do have a general comment. No doubt, presenting the economic and social justification part of any project appraisal in a three-fold analysis -- at market (financial), economic (efficiency) and social prices^{1/}, and making all the conversion factors explicit -- would involve a little more work, but the task of the project economist would be eased considerably by the work of his country economist colleagues in estimating the national variables and parameters.

C. Reliability of Information

22. Since I was not the country economist for any of the countries in which the methodology was tested, I cannot give a definitive answer about the degree of reliability of the data taken from the Bank's own CERs and other documents or of the information given to me by the planning and statistical organizations in the field. My tentative judgment is that, relatively speaking, the data base is very good in Malaysia, good in the Philippines, fair in Thailand and poor in Bangladesh (for reasons already explained). However, my preliminary impressions should be reviewed by the country economists concerned, particularly with respect to such objective variables as the marginal propensities to consume and save. The Working Sheets I have completed should be regarded as a working basis for improvement and refinement. And this brings me to a general point. Many of the critics of the Draft O.M. seem to expect an accuracy of estimation well above that required in the Bank's other economic work and greater than involved in projecting many of the project-specific variables twenty to thirty years ahead.^{2/} Inevitably the first estimates of some of the national accounting prices and conversion factors will be rough and ready to a degree, but it should be possible to improve them over a reasonably short period of time, and apply sensitivity analysis to those variables and parameters considered doubtful.

^{1/} In the revised version of the Draft O.M., it is suggested that the term shadow prices be reserved for the analysis taking into account distribution criteria. I think it would be better if the term "shadow price" were dropped altogether and replaced by "accounting price", but failing this I agree with Bela Balassa that it is unnecessarily restrictive and is rather an odd definition.

^{2/} We need to devote a great deal more thought and work to the projections of prices and costs at constant market values.

D. How Capricious is the Methodology?

23. There has been a fair amount of criticism of the Draft O.M. on the grounds that it involves too much arbitrary guesswork, that it is too subjective and that it depends too much on the capriciousness of individuals. How much validity is there in these criticisms and how fair are they?

24. Abstracting from the perjorative nature of many of these criticisms, let us take a look at the facts. The subjective parameters were deliberately separated from the objective parameters^{1/} in our Worksheets and three are listed: the elasticity of marginal utility with respect to consumption (MU^e), pure time preference (PTP) and the number of years until government income is likely to be optimum (T^{opt}). Taking these in reverse order, the only equation in which T^{opt} appears is that for the estimating of the social or shadow price of investment (SPINV) in its more sophisticated form. Within the relevant range in most LDCs, SPINV is probably not very sensitive to variations in T^{opt} . Moreover, if one thinks that T^{opt} is fairly large, say around 30 years and above, one can for all practical purposes assume that $T^{opt} = \infty$ and use the simpler formula. Thus T^{opt} does not seem to present any insuperable problem. PTP does raise practical problems and there is no doubt that a fairly arbitrary value has to be assigned to it - even if this value = 0 ! There is also, of course, an element of guesswork in estimating MU^e , but by direct or indirect ways one can ask meaningful questions of the policy makers -- both in our countries and within the Bank Group -- which will provide pointers towards a more accurate estimate. Presenting projects to policy makers with alternative assumptions about MU^e may be one way of getting a 'revealed preference' and this would be achieved by giving the analysis in terms of both efficiency and social prices. There can be no doubt, however, that elements of arbitrariness and guesswork are involved, but this is true of all aspects of project planning, whatever method is used.

III. VALUE JUDGMENTS

25. The Draft O.M. takes as axiomatic that one cannot evaluate or appraise projects and be neutral or be indifferent as between the distribution of the net benefits. It is interesting that the Bank has been quite prepared to make explicit value judgments with regard to the distribution of benefits over time - hence its use of discounted cash flow procedures - but has been reluctant to make explicit any judgments with respect to the distribution of consumption as between individuals, groups or regions. Yet, implicitly, the Bank has assumed up to now that $MU^e = 0$. This is a value judgment and one which is much more unrealistically arbitrary than in estimating that in most LDCs the value of MU^e lies between, say, 0.5 and 2.0. Indeed, is there

^{1/} I hope it will be clear to the reader that I am not using objective here in the sense of objective functions. It is the opposite of subjective. In philosophical jargon objective = positive and subjective = normative.

not an element of intellectual dishonesty in our continued assumption that $MU^e = 0$ in the face of: (a) the comments of our President and the Board about income distribution; (b) the fact that most of us do not believe it; and (c) the fact that the policy makers in most of our countries do not believe it either. The attempt by the Bank Group to find an explicit means of trading off efficiency against income distribution criteria was welcomed by the responsible officials I talked to in all our countries, although they recognize the elements of judgment involved. We too should welcome this attempt. Much will depend upon how the analysis is presented. If projects are justified simply on the grounds that the net present worth (NPW) is positive using economic and social prices, with no indication that the NPW is just the tip of an iceberg, our appraisal will degenerate again into an exercise in cosmetics. If, however, it is presented in three ways: as a financial analysis (using market prices), as an economic analysis (using accounting prices) and as a social analysis, side by side with the conversion factors explicitly spelled out and frankly discussed, then I suggest there would be a very distinct improvement in the way projects are justified. Anyone who disagrees with any particular conversion factor can make his own adjustment. In addition, unless the framework of social cost-benefit analysis is used to influence the identification, selection and design of projects, the evaluation of projects also tends to be mere cosmetics. There has to be a concordance between evaluation criteria and selection and design criteria. But first let us agree on the criteria, and hopefully agree quickly.^{1/}

IV. WAYS OF SIMPLIFYING THE METHODOLOGY

26. I suspect that the negative reaction of some people to the Draft O.M. - even in its revised version - is because the draft has been written for two different audiences. On the one hand, it has been written with a view to eventual publication outside the Bank and hence it must be theoretically rigorous and comprehensive and stand up to the scrutiny of academics and the purist equilibrium analysts. On the other hand, it has been written as a guide to country and project economists. There was an obvious danger that it would fall between two stools. This has been avoided at the expense of not being a really down-to-earth practical guide. At the cost of some delay, would it not be wise to produce two separate documents for the two different audiences?

27. Whatever eventual form(s) the Draft O.M. takes, I have two suggestions for simplifying the methodology as it should be applied to the average Bank Group project in the average country. This would not preclude any country economist from using a more sophisticated method if he wanted to, but from a presentational point of view it is preferable to give the simpler forms

^{1/} This does not mean, of course, that any agreed new methodology would be static. On the contrary as we learn the lessons of experience the methodology would be modified, but we must start from some 'Guidelines'.

in the main text, referring the reader to the more sophisticated form, in either a separate paper or a separate part of the same paper. The second version of the Draft O.M. is a great improvement over the first in that the full derivation of the equations is relegated to an appendix. I am suggesting that a similar treatment be given to the method itself, with the simpler method being presented as the one which will be most likely to be used, and the sophisticated one and the derivations of the equations presented elsewhere. This is preferable to allowing the possibility of collapsing some of the equations by inserting values such as 0 or 1. I also discuss a proposal by Little-Mirrlees and Scott to use the "critical consumption level" in place of the "average level" as a reference point in estimating the distribution parameters.

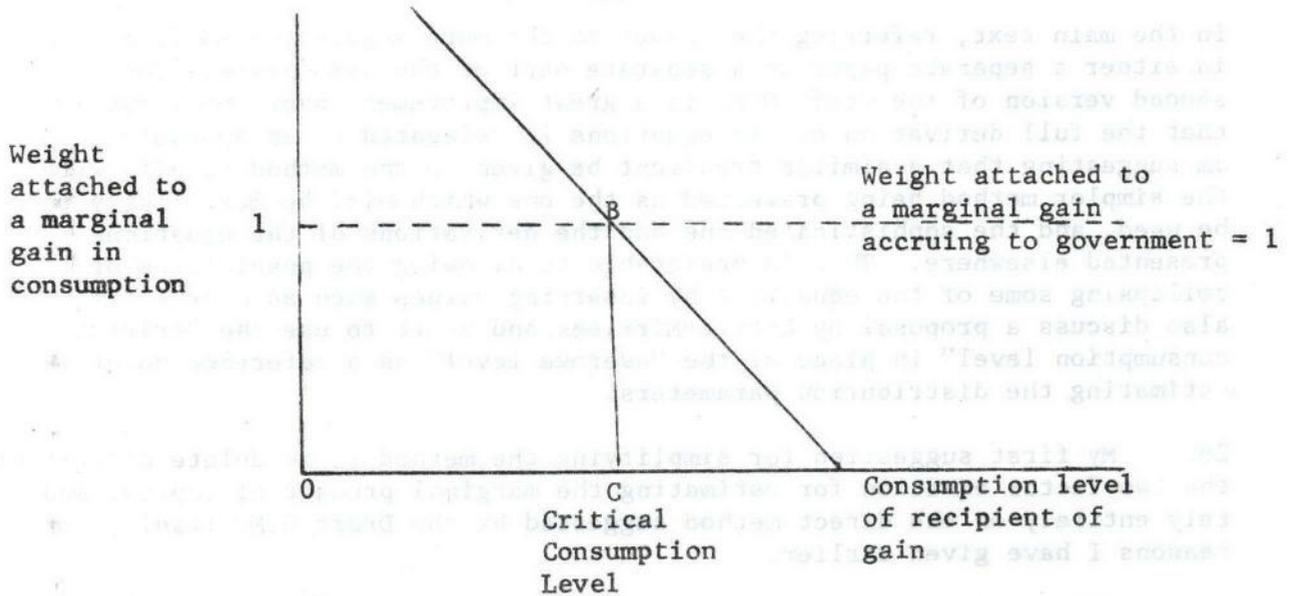
28. My first suggestion for simplifying the method is to delete altogether the two-factor equation for estimating the marginal product of capital and rely entirely on the direct method suggested by the Draft O.M. itself, for reasons I have given earlier.

29. Second, I would suggest that the equation for estimating the social price of public income SPINC (v), be collapsed and replaced by a simple premium on public income, i.e. DIS. I discussed this with Ian Little recently and agree with him that we should not, without strong evidence to the contrary in a particular country, put an added premium on public investment over public consumption if only because some public consumption expenditure (e.g., on teachers and agricultural extension service) is as developmental, if not more so, than much public investment (e.g., on defense and public buildings).^{1/} One could of course meet this objection by reclassifying the items of expenditure or by having finer divisions and more differential weights, but I suggest that this would be too complicated and impractical.

30. I turn now to the suggestion of Little and Scott that the distribution parameter for labor DIS^W (d) be replaced by a weighting system related to what Little and Scott call the "critical income level". This is the level at which the government considers that a rupee in the hands of a citizen and in its hands are equally valuable. The weight would be greater than 1 for those with incomes below this level and less than 1 for incomes above this level. Intuitively, the critical income level seems to make more sense because it is empirically determined and provides the analyst with a kind of 'revealed preference' than some average income level, but we need to know how the weight varies with income level, and, as we shall see later, there are problems. The diagram below illustrates the idea.^{2/}

1/ For a fuller discussion of this see my memorandum to Herman van der Tak, dated September 10, 1973, entitled: "Some comments of Little-Mirrlees-Scott on the Bank's Proposed New Evaluation Methodology".

2/ See "What Shadow Prices" by Maurice Scott, October 2, 1972, p. 21.



31. $BC = 1$ = the weight attached to a marginal gain accruing to the government. At the critical level of consumption, OC , the weight also equals 1. At incomes less than OC the weights would be greater than 1 and at incomes greater than OC the weights would be less than 1. The slope of the diagonal line passing through B is determined by the elasticity of marginal utility with respect to consumption, $MU^e(\eta)$, and this value judgment we have already discussed. Maurice Scott suggests^{1/} two possible methods of estimating the critical income (consumption) level; one can either look at the direct tax system and see the maximum level of income at which taxes are not paid or one can look at the Social Security System - in Mauritius Maurice Scott tried to estimate the critical consumption level (OC in the diagram) "by referring to the government's policies in supplementing the incomes of sick people, in which a mean test is involved."^{2/}

32. Conceptually the Little-Scott proposal is similar to the van der Tak/Squire one, but, if the tax or social security system does not change from year to year, the critical income level does not change and the value of our numeraire, public income, in terms of consumption at the critical level of income is constant over time. And this means that the GRI (Government Income Rate of Interest or Accounting Rate of Interest in L-M terminology) and the CRI are equal. Moreover, the GRI now refers to the rate of fall over time in the value of consumption at the critical level of income and not the average level. Hence if the critical level remains constant, then the GRI equals the rate of pure time preference. In point of fact it is highly unlikely that the critical level will remain constant over any length of

^{1/} Ibid pp. 17 and 18.

^{2/} Ibid p. 17. The reference in this paper is to "Estimates of Accounting Prices for Mauritius, Nuffield College, Oxford, April 1972, particularly Appendix II.

time, but the tax or social security system may not change, which is another way of saying that one cannot necessarily rely on estimating the critical level by reference to the cut-off direct tax point or the minimum social security level. Moreover, in many countries one would probably not want to infer the critical income level from the direct tax system anyway - even less would one want to infer the whole range of weights from the direct tax system, as has been suggested elsewhere. Not many LDCs have social security systems, but, where they have, there is a problem of choosing the direct tax or social security system for estimating the critical income level and, as in Mauritius, there can be (large) differences. Which does one take? While I personally find the idea of the critical income level intuitively appealing I think it can probably be used only as a cross check on the van der Tak/Squire method in some countries.

33. Adoption of the two recommendations above would simplify the methodology without sacrificing its essentials and make it more acceptable within the Bank. I would begin to think that there really was something wrong with the method if every economist in the Bank were to agree with it! But I do think it is very worthwhile making every effort to meet the doubts and fears of some of our colleagues, particularly those on whom most of the work will fall.

34. It may be wrong to generalize my findings, but I believe the experience in testing the methodology in a few of the Asia Region countries demonstrates that the doubts and fears are largely illusory. The proposed new methodology, particularly if it is simplified along the lines suggested above, is indeed an operational or practical one.^{1/} The next step is to apply it to a number of projects and show that the application is both practical and an improvement. Concurrently with the hoped-for adoption of the proposed new methodology, it is even more important to move back down the project planning cycle and ensure that projects are identified, selected and designed in accordance with the evaluation criteria. Hopefully we can devote our energies to this task in the near future.

^{1/} This confirms the experience I had as a Bank-seconded adviser on project planning to the Ethiopian Planning Commission. We incorporated a simplified version of the L-M methodology into "A Guide to Project Planning in Ethiopia", applied it and taught it to the Planning Commission's own staff and the staff in the Planning and Programming units in the operating ministries and agencies.

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Mr. Mervyn L. Weiner

-13-

September 18, 1973

IV. THE OPERATIONAL SIGNIFICANCE OF THE BANK'S
PROPOSED NEW EVALUATION METHODOLOGY

41. I give below brief notes on my work on testing the practicality and operational significance of the Bank's proposed new evaluation methodology in the Philippines, Malaysia, Thailand and Bangladesh. This is then followed by my general, preliminary conclusions. As stated in the Introduction, I am preparing a separate, more detailed report on this subject, which will include a commentary on the July 3 revision of Herman van der Tak's paper: "Economic Analysis of Projects". Also in a separate memorandum to Herman I am reporting on some discussions I had with Ian Little and James Mirrlees in Oxford, England.

The Philippines

42. Because the country economist was away on home leave, I did the "dry run" on the Philippines' worksheets myself from the Bank's economic report - on the airplane travelling from San Francisco to Tokyo! This showed up gaps with respect to: (a) the breakdown of the standard conversion factors (SCF) into conversion factors for capital and consumption goods; (b) the conversion factors for transport, electricity and building and construction; and (c) average wages in the rural and urban areas and the marginal product of labor. NEDA had hoped to provide me with the information in (a) and (b) before I left but were unable to do so. However, they promised to send it to me in Washington, and this promise has been kept. With respect to (c) it was fortunate that a large ILO employment mission was in Manila while I was there and I was able to obtain what data they had on rural and urban wages and their views about the marginal project of labor. I shall be submitting the Philippines' worksheets as an appendix to my full report.

43. Apart from having a very general discussion with Dr. Sicat about the subjective parameters, I did not attempt to obtain any government views in this respect. Dr. Sicat did however promise to read the papers I left with him and send me his views and any comments or criticisms.

Malaysia

44. With respect to testing out the Bank's proposed new methodology in Malaysia, using the work done by Messrs. Pellegrini and Reif, I had completed our worksheets as far as I could from Bank data. With the help of Mr. Nair, the Deputy Government Statistician, and his colleagues, I was able to fill in the gaps from their own detailed worksheets and to revise some of Mr. Pellegrini's estimates. I shall attach the completed worksheets from Malaysia to my separate report on this subject as a case study. I had quite a long and interesting discussion with Dr. Robless, the Deputy Director of Planning in the EPU about the proposed new methodology. He had not had time to read either the original van der Tak/Squire paper or our own guide, but he welcomed the attempt to estimate shadow prices and to find a means of trading off efficiency and income distribution criteria. He promised to read both documents and to send me any comments or criticisms he had. This also applies to a Mr. Thillinathan of the Department of Economics in the University of Malaya, who gives a project

evaluation course at the University. I also had an interesting discussion with him about the demand and supply situation for labor in Malaysia in relation to the racial problem. He is leaving shortly to attend the London University to take his PhD, but will be coming back during vacations to Malaysia to do practical research into the Muda River Irrigation Project for his dissertation.

Thailand

45. Thailand was not one of the original countries selected in the Asia Region to test out the proposed new Bank evaluation methodology. Consequently, I did not attempt a dry run on Thailand using the data from the Bank's Economic Report. However, Manfred Blobel had given copies of the van der Tak/Squire paper and our own guide to NESDB, and I also gave a copy to the National Statistical Office. After I had explained the proposed new methodology in some detail to NESDB and to the National Statistical Office staff and had gone through the worksheets with the National Statistical Office, it was agreed that NESDB, working closely with the National Statistical Office, would attempt to complete the worksheets and send them to me via Bernard Schmutz of our Bangkok Office.^{1/} The NSO is tied up with some work on the national income accounts and so cannot start on the worksheets until some time this month. Hence, I don't suppose I shall receive the worksheets completed as far as they can be until the end of September. All that I can say at this stage is it appears from the discussion we had with the NSO and NESDB that most of the data is available to estimate the national parameters for Thailand.

Bangladesh

46. I knew before coming to Bangladesh that the prospects for testing the proposed new evaluation methodology were poor because the data base is so bad. Drs. Khan and Hassan Iman of the Planning Commission, with whom I discussed this problem, made the interesting observation that, while the current statistics are unreliable, the national income accounts and their knowledge of the Bangladesh economy were good prior to the war, and they hoped to get back soon to this position. It is only the current position which is poor. Dr. Khan agreed it will be very difficult to complete our worksheets. He disagreed with some of the information put on the draft worksheets given to him by our Dacca Office, which had been prepared by our Bangladesh Program Division, but said that the Planning Commission would shortly issue a supplement to the Project Evaluation Proforma, giving a set of what he called "credit accounting prices". He is a firm believer in the Little-Mirrlees methodology and believes it can be applied in practice - even in Bangladesh. I suspect that the accounting prices are

^{1/} He kindly accompanied me on my visits to NESDB, NSO, the Bureau of the Budget and the Ministry of Agriculture. Dolf Einthoven, also of our Bangkok Office went with me to the Ministry of Communications, and I am grateful to both him and Bernard for their help.

based on data taken from the days when Bangladesh was East Pakistan but modified by Dr. Khan's personal knowledge of the economy. Dr. Khan promised to let me have a copy of this set of accounting prices before I left Dacca but unfortunately it did not appear, so I arranged with our Dacca Office to have it sent to me in Washington, D.C., and this has been done.

Preliminary Conclusions

47. I give now some preliminary conclusions of the separate report I am preparing on the operational significance of the proposed new social cost benefit methodology. These preliminary conclusions are subject to the proviso that the national income, the foreign trade and employment statistics, both those taken from the Bank's own economic reports and those given to me by national statistical offices, are reasonably reliable - with the known exception of Bangladesh, which is a special case. My estimates should in each case be checked by the country economist most familiar with the economies of each of the four countries, but my judgment is that relatively speaking the data base is very good in Malaysia, good in the Philippines, fair in Thailand and very poor for the time being in Bangladesh. Nevertheless, the Bangladesh Planning Commission, which believes strongly in the importance of estimating and using shadow prices along the lines of the revised version of Little-Mirrlees, has estimated a set of conversion factors which it has issued as a supplement to the "Project Evaluation Proforma".

48. Thus, subject to the proviso given above, my preliminary conclusions are:

- (a) In general the methodology is a practical one and can be implemented over a relatively short period of time in most of our countries.
- (b) The time it takes to estimate the conversion factors and discount rates has been grossly over-estimated by some people in the Bank.
- (c) About half to two-thirds of the information required is available in Bank economic reports, other Bank documents and in the published and unpublished reports of our member governments. To this extent it only takes a few hours to complete our worksheets.
- (d) Much of the remaining information required is available in one form or another in the ministries and agencies and can generally be obtained in a few days.
- (e) An important exception to (d) is the difficulty in those countries, like India and Bangladesh, which have considerable quantitative import restrictions, of estimating tariff equivalents and hence of estimating the conversion factors (shadow prices of foreign exchange) for revaluing non-tradeables.

- (f) Another exception is that in some of our countries a breakdown of imports and exports and taxes (subsidies) on imports and exports into capital goods and consumption goods is not readily available and considerable effort may be required to obtain this information.
- (g) Perhaps the most difficult part of our worksheets is the estimation of the subjective parameters, and in all probability we shall have to be fairly arbitrary with respect to these.^{1/}
- (h) While some information is lacking both in the Bank and in our countries, surveys are underway which will fill some of the remaining gaps (e.g. the transport surveys in Bangladesh and Thailand). Over time other surveys could be undertaken to fill the remaining gaps.
- (i) While the concepts of the marginal products of labor and capital are easily understandable, there are practical problems in estimating these. However, the marginal product of labor is only required in one formula -- that for estimating the marginal product of capital -- and this is a dubious one which should in my judgment be abandoned. Any system of social cost benefit analysis has the problem of estimating the marginal product of capital.

49. While there are problems connected with some of the concepts, and while countries differ with respect to the data base available for estimating national parameters, my mission has confirmed the view I had before I left, based on my Ethiopian experience, that the van der Tak/Squire methodology is a sound one and can be implemented, although I believe it has to be further simplified.^{2/}

50. One further conclusion: I think that both our economic and project appraisal missions should pay much more attention to the demand/supply situation for labor in different parts of each country, to migration patterns, if any, and to seasonal variations in unskilled wage rates; in short, we need to analyze labor markets much more thoroughly than in the past.

^{1/} My experience does not support Bela Balassa's contention ("Proposed Operational Memorandum on the Economic Analysis of Projects", dated August 30, 1973) that moving from efficiency to social prices would involve our country economists in a considerable amount of extra work. On the contrary, I would argue from my experience that the time consuming parts of the estimation work lie with efficiency not social prices.

^{2/} Since my return I have read an excellent draft paper by Joe Wood: "Guidelines for Calculation of Economic Rates of Return on DFC Sub-Projects", 7/30/73. I suggest it would be a good idea to generalize what Joe Wood has done for DFCs and prepare a similar Guidelines for use by Project economists.

ESTIMATES FOR THE PHILIPPINES

LIST OF WORKSHEETS

- I. Basic Variables
 - a. Objective Parameters
 - b. Subjective Parameters
- II. Conversion Factors
 - a. Standard Conversion Factor
 - b. Conversion Factor for Capital Goods
 - c. Conversion Factor for Consumption
 - d. Conversion Factor for Transport
 - e. Conversion Factor for Electricity
 - f. Conversion Factor for Building and Construction
- III. Accounting Rate of Interest
 - a. Marginal Product of Capital
 - b. Social Value Parameters
 - (i) Consumption Rate of Interest (CRI)
 - (ii) Social Price of Investment (SPINV)
 - (iii) Social Price of Public Income (SPINC)
 - (iv) National Distribution Parameter (DIS)
 - (v) Investment Rate of Interest (IRI)
 - (vi) Government Income Rate of Interest (GRI)
- IV. Labor Conversion Factor

NOTE: These Worksheets should be checked by the Country Economist, and used as a basis for improvement and refinement over time.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS (ACCOUNTING RATIOS)

I (a) Objective Parameters

The following variables should be obtainable or could be estimated from the latest Bank Economic Report, or from other economic, sector and project information available within the Bank Group, or from the statistical publications and other reports of our countries. The data will, of course, vary in quality from country to country. Where any of the estimated variables are considered unreliable, this should be stated and an attempt made to see to what extent reliable data from countries in similar stages of development could be used.

(i)	Est. national marginal propensity to consume (MPC)	<u>0.886</u>
(ii)	Est. national marginal propensity to save (MPS)	<u>0.114</u>
(iii)	Est. marginal propensity to consume in the public sector (MPC ^g)	<u>0.698</u>
(iv)	Est. marginal propensity to save in the public sector (MPS ^g)	<u>0.302</u>
(v)	Est. marginal propensity to consume out of wages (MPC ^w)	<u>1.000</u>
(vi)	Est. marginal propensity to save out of wages (MPS ^w)	<u>0.0</u>
(vii)	Est. future growth rate of consumption	<u>0.037</u>

(viii)	Est. future growth rate of population	<u>0.029</u>
(ix)	Est. future growth rate of per capita consumption: (v) - (vi) = $\overline{(\text{CONGRO})}$	<u>0.008</u>
(x)	Gini coefficient of income distribu- tion (GINI) <u>1/</u>	<u>0.49</u>
(xi)	Average marginal product of labor (MP ^{lab}) <u>2/</u>	<u>P 959 p.a.</u>

1/ See paras. 42-49 in our "Guide for Country Economists to the Derivation of National Parameters for Economic Project Evaluation" for a discussion of possible means of estimating the Gini coefficient.

2/ See paras. 93-102, op. cit., for a discussion of the problems of estimating MP^{cap}. Similar problem exist with respect to a national MP^{lab}.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS (OR ACCOUNTING RATIOS)

I (b) Subjective Parameters (involving value judgements)

	<u>£</u>
(i) Elasticity of marginal utility with respect to consumption (MU^e) - Probable range: 1.5 - 2.5 ^{1/}	<u>1.5</u>
(ii) Pure time preference - Probable range: 3% - 8%	<u>5.0</u>
(iii) Number of years until government income is optimum	<u>35</u>

^{1/} The worksheets assume that marginal utility diminishes as income rises, i.e. that $MU^e > 0$, and that a unit increase in consumption is more valuable in the hands of a poor person than in the hands of a rich person.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS OR ACCOUNTING RATIOS (SIMPLIFIED METHODOLOGY)

II (a) - STANDARD CONVERSION FACTOR ^{a/}

	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
(1) Value of merchandise imports	<u>1150</u>	<u>1132</u>	<u>1090</u>	<u>1186</u>	<u>1230</u>
(2) Value of merchandise exports	<u>858</u>	<u>855</u>	<u>1062</u>	<u>1136</u>	<u>1106</u>
(3) (1) + (2)	<u>2008</u>	<u>1986</u>	<u>2152</u>	<u>2308</u>	<u>2335</u>
(4) Value of all taxes on imports	<u>249</u>	<u>245</u>	<u>184</u>	<u>222</u>	<u>258</u>
(5) Tariff equivalent of quotas ^{b/}	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
(6) Value of all taxes (subsidies) ^{c/} on exports	<u>-</u>	<u>-</u>	<u>62</u>	<u>85</u>	<u>60</u>
(7) (3) + (4) + (5) - (6)	<u>2256</u>	<u>2231</u>	<u>2274</u>	<u>2444</u>	<u>2533</u>
(8) (3) ÷ (7)	<u>89.0</u>	<u>89.0</u>	<u>94.6</u>	<u>94.4</u>	<u>94.4</u>
Average of (8) over period	<u>91.8</u>				

^{a/} Based on equation (26):

$$SCF = \frac{IMP + EX}{IMP(1 + Tax^{imp} + TQ^{imp}) + EX(1 - Tax^{ex})}$$

^{b/} Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market retail price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

^{c/} If a subsidy is involved, it should be added in with a negative sign. If subsidies exceed total taxes, the value of item (6) will be negative.

II (b) - CONVERSION FACTOR FOR CAPITAL GOODS ^{a/}

	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
(1) Value of capital goods imports	<u>1022</u>	<u>1023</u>	<u>1016</u>	<u>1080</u>	<u>1114</u>
(2) Value of capital goods exports	<u>627</u>	<u>622</u>	<u>734</u>	<u>775</u>	<u>684</u>
(3) (1) + (2)	<u>1649</u>	<u>1645</u>	<u>1749</u>	<u>1854</u>	<u>1798</u>
(4) Value of taxes on capital goods imports	<u>197</u>	<u>202</u>	<u>135</u>	<u>201</u>	<u>204</u>
(5) Tariff equivalent of quotas ^{b/}	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
(6) Value of taxes (subsidies) ^{c/} on capital goods exports	<u>-</u>	<u>-</u>	<u>45</u>	<u>62</u>	<u>43</u>
(7) (3) + (4) + (5) - (6)	<u>1846</u>	<u>1847</u>	<u>1839</u>	<u>1993</u>	<u>1959</u>
(8) (3) ÷ (7)	<u>89.3</u>	<u>89.1</u>	<u>95.1</u>	<u>93.0</u>	<u>91.8</u>

Average of (8) over period 91.7

^{a/} Based on the same type of equation as used for SCF.

^{b/} Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

^{c/} If a subsidy is involved it should be added in with a negative sign. If subsidies exceed taxes, the value of item (6) will be negative.

II (c) - CONVERSION FACTOR FOR CONSUMPTION ^{a/}

	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
(1) Value of merchandise imports	<u>128</u>	<u>109</u>	<u>75</u>	<u>106</u>	<u>115</u>
(2) Value of merchandise exports excluding capital goods	<u>230</u>	<u>233</u>	<u>328</u>	<u>362</u>	<u>422</u>
(3) (1) + (2)	<u>359</u>	<u>342</u>	<u>403</u>	<u>468</u>	<u>537</u>
(4) Value of taxes on imports of goods excluding capital goods	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
(5) Tariff equivalent of quotas ^{b/}	<u>-</u>	<u>-</u>	<u>16</u>	<u>23</u>	<u>17</u>
(6) Value of taxes (subsidies) on exports excluding capital goods ^{c/}	<u>-</u>	<u>-</u>	<u>16</u>	<u>23</u>	<u>17</u>
(7) (3) + (4) + (5) - (6)	<u>409</u>	<u>384</u>	<u>435</u>	<u>466</u>	<u>573</u>
(8) (3) \div (7)	<u>87.8</u>	<u>88.8</u>	<u>92.5</u>	<u>100.5</u>	<u>93.6</u>
Average of (8) over period	<u>92.7</u>				

^{a/} Ideally, one should weight individual imports and exports by their relative shares in an average consumption basket, but such consumption data is typically lacking or deficient in LDCs. This is based on the same type of equation as SCF.

^{b/} Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

^{c/} If a subsidy is involved, it should be added in with a negative sign. If subsidies exceed taxes, the value of item (6) will be negative.

II (d) - CONVERSION FACTOR FOR TRANSPORT

	Cost per ton/km	
	(1) At Market Prices <u>a/</u>	(2) At Social Prices
Direct skilled labor	1.0	
Direct unskilled labor	$\frac{1}{CF^{lab}}$	
Fuel, lubricants, etc.		
Spare parts & other inputs	$\frac{1}{CF^{cap}}$	
Management overheads	1.0	
Maintenance		
Other costs		
Rent		
Depreciation	$\frac{1}{CF^{cap}}$	
Interest		
Profit		
Direct taxes	0.0	-
	<hr/>	<hr/>
Total value	(1)	(2)

$$\text{Conversion factor for transport} = \frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}}$$

a/ The breakdown of total value at market prices can usually be obtained from the latest census of production and distribution and/or sample surveys of unit transport costs by various modes for varying lengths of journeys and types of terrain.

b/ The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CFCap. In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

II (e) - CONVERSION FACTOR FOR ELECTRICITY ^{a/}

	Cost per kwh		
	<u>At Market Prices</u> ^{b/}	<u>Conversion Factor</u> ^{c/}	<u>At Social Prices</u>
Direct skilled labor		1.0	
Direct unskilled labor		$\frac{1}{CF^{lab}}$	
Fuel			
Materials			
Spare parts & other inputs		$\frac{1}{CF^{cap}}$	
Maintenance			
Management overheads		1.0	
Other costs			
Rent			
Depreciation		$\frac{1}{CF^{cap}}$	
Interest			
Profit			
Direct taxes			
	Total value	(1)	(2)

$$\text{Conversion factor for electricity} = \frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}}$$

- ^{a/} It may be necessary to estimate separate conversion factors for peak and off-peak loads and different systems, e.g., different regional systems and different production methods such as hydroelectric and diesel generators.
- ^{b/} The breakdown of total value at market prices can usually be obtained from the latest census of production and/or from the public utility authorities.
- ^{c/} The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CF^{cap} . In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

II (f) - CONVERSION FACTOR FOR BUILDING AND CONSTRUCTION ^{a/}

	Cost per m ²		
	<u>At Market Prices</u>	<u>Conversion Factor</u>	<u>At Social Prices</u>
Direct skilled labor		1.0	
Direct unskilled labor		$[\overline{CF}^{lab}]$	
Materials			
Fuel			
Spare parts & other inputs			
Maintenance			
Other costs			
Management overheads		1.0	
Rent			
Depreciation		$[\overline{CF}^{cap}]$	
Interest			
Profit			
Direct taxes		0.0	
		_____	_____
		_____ (1)	_____ (2)

Conversion factor for building and construction =

$$\frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}}$$

a/ It may be desirable to estimate separate conversion factors for building works and other Civil Engineering works.

b/ The breakdown of total value at market prices can usually be obtained from the latest census of production or from sample surveys.

c/ The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CF^{cap} . In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

WORKSHEETS FOR THE DERIVATION OF
CONVERSION FACTORS (ACCOUNTING RATIOS)^{a/}

III. Accounting Rates of Interest

(a) Marginal Product of Capital (MP^{cap})^{b/}

$$= \frac{\Delta \text{OUT}}{\Delta \text{CAP}} - \text{MP}^{\text{lab}} \times \frac{\Delta \text{LAB}}{\Delta \text{CAP}}$$

As was mentioned in the text, calculating the marginal product of capital on the basis of a simple two-factor production function is subject to error from many sources including:

- the unrealistic nature of a two-factor model (capital is not homogeneous, and other factors of production are involved),
- the problems of defining capital stock, and
- the lack of basic data on capital, output, labor and wages.

For these reasons, it was suggested that this approach be used only as a check on other estimates of the marginal productivity of capital derived from the experience of development banks and from observed market rates of interest (paras. 93-96 in text).

Perhaps the meaning of the marginal product of capital should be explained briefly. Although the marginal product of capital has a physical or monetary meaning when calculated -- for example, \$0.15 of net product is produced each year by every \$1.00 invested, all other factors being held constant -- marginal productivity is expressed as the incremental product divided by the incremental

a/ If trends are discernable in ΔOUT , ΔCAP and ΔLAB , projected instead of average values should be used in items (2), (4) and (7) below.

b/ Based on equation (36) from text.

investment, which is considered to be \$1.00. This rate of return, while expressed in percentage form for discursive purposes, must be written in decimal form when used in the equations presented in the text.

It should be apparent that the marginal product of capital is not the same as the perhaps more familiar incremental output capital ratio. Output in this ratio includes the product of labor and other factors in addition to that of capital. It is implicitly assumed in calculating this ratio that all factors are increased in proportion, so the ratio simply notes the increase in capital inputs which is normally associated with a given increase of output.

(1) Δ OUT	1968	<u>2,542</u>	x	SCF _{t-4}	<u>88.9</u>	=	<u>2260</u>
	1969	<u>3,108</u>	x	SCF _{t-3}	<u>89.0</u>	=	<u>2766</u>
	1970	<u>4,807</u>	x	SCF _{t-2}	<u>94.6</u>	=	<u>4547</u>
	1971	<u>6,144</u>	x	SCF _{t-1}	<u>94.4</u>	=	<u>5800</u>
	1972	<u>4,928</u>	x	SCF _t	<u>92.2</u>	=	<u>4544</u>
							<u>19917</u>
(2) Average Δ OUT over 5 years		=	<u>3,983</u>				
(3) Δ CAP	1968	<u>6,654</u>	x	CF _{t-4} ^{cap}	<u>89.3</u>	=	<u>5942</u>
	1969	<u>6,893</u>	x	CF _{t-3} ^{cap}	<u>89.1</u>	=	<u>6142</u>
	1970	<u>8,612</u>	x	CF _{t-2} ^{cap}	<u>95.1</u>	=	<u>8190</u>
	1971	<u>10,546</u>	x	CF _{t-1} ^{cap}	<u>93.0</u>	=	<u>9808</u>
	1972	<u>11,052</u>	x	CF _t ^{cap}	<u>91.8</u>	=	<u>10146</u>
							<u>40228</u>
							=====
(4) Average of Δ CAP over 5 years		=	<u>8,046</u>				
(5) $\frac{\Delta$ OUT, (2)}{\DeltaCAP	(2)	÷	(4)	=	<u>0.495</u>		

(6) Δ LAB	19 68	<u> </u>
	19 69	<u> </u>
	19 70	<u> </u>
	19 71	<u>1349</u>
	19 72	<u>633</u>

=====

(7) Average of Δ LAB over 2 years = 991

(8) $\frac{\Delta \text{ LAB}}{\Delta \text{ CAP}}$, (7) \div (4) = .00012

(9) MP_t^{lab} 959 $\left[\text{From I(a)(x)} \right] \times CF^{\text{con}}$.917 $\left[\text{From II(c)} \right] =$ 882

(10) $\Delta \text{ OUT} / \Delta \text{ CAP}$.495 $\left[\text{From (5) above} \right]$

(11) (9) 882 \times (8) .00012 $-$.106

(12) MP^{cap} $-$ $=$ 389

$MP^{\text{cap}} = 38.9\%$
This is implausible. The
worksheets which follow
assume $MP^{\text{cap}} = 0.15$

(b) Social Value Parameters

(i) Consumption Rate of Interest (CRI) ^{a/} = $MU^e \times \overline{CONGRO} + PTP$

(1) Elasticity of marginal utility (MU^e) 1.5 [From I(b) (i)]

(2) Rate of growth of per capita consumption (\overline{CONGRO})..... x .008 [From I(a) (ix)]

(3) $MU^e \times \overline{CONGRO}$ = .012

(4) Rate of pure time preference (PTP) + .050 [From I(b) (ii)]

(5) CRI = .062 CRI = 6.2%

(ii) Social Price of Investment (SPINV) ^{b/} = $\frac{MPC \times MP^{cap}}{CRI - MPS \times MP^{cap}}$

(1) Marginal propensity to consume (MPC) .886 [From I(a) (i)]

(2) Marginal product of capital (MP^{cap}) x .150 [Estimated]

(3) $MPC \times MP^{cap}$ = .133

(4) Marginal propensity to save (MPS) = .114 [From I(a) (ii)]

(5) Marginal product of capital (MP^{cap}) x .015 [Estimated]

(6) $MPS \times MP^{cap} (-1)$ = -.002

(7) Consumption rate of interest (CRI) + .042 [From III(b) (i)(5)]

(8) $CRI - MPS \times MP^{cap}$ = .040

(9) (3) \div (8) = SPINV = 3.325

a/ Based on equation (31) in main text.

b/ This is based on the simplified equation (2) in the main text.

(iii)	<u>Social Price of Public Income (SPINC)</u> ^{a/}	=	MPS ^g x SPINV + MPC ^g $\left(\frac{DIS^g}{SCF}\right)$
(1)	Marginal propensity to save in the public sector (MPS ^g)		<u>.302</u> [From I(a) (iv)]
(2)	SPINV	x	<u>3.325</u> [From III(b) (ii) (9)]
(3)	MPS ^g x SPINV	=	<u>1.004</u>
(4)	Marginal propensity to consume in the public sector (MPC ^g)		<u>.698</u> [From I(a) (iii)]
(5)	Distribution parameter for government [use DIS]	x	<u>1.400</u> [See III(b) (iv)]
(6)	MPC ^g x DIS	=	<u>0.977</u>
(7)	Standard conversion factor (SCF)	÷	<u>.918</u> [From II(a)]
(8)	MPC ^g x (DIS/SCF)	=	<u>1.065</u>
(9)	MPS ^g x SPINV	+	<u>1.004</u> [See (3) above]
(10)	SPINC	=	<u>2.069</u>

(iv)	<u>National Distribution Parameter (DIS)</u> ^{b/}	
(1)	One	1.00
(2)	GINI	+ <u>0.49</u> [From I(a) (x)]
(3)	(1 + GINI)	<u>1.49</u>
(4)	GINI	0.49
(5)	Two	x <u>2.00</u>
(6)	(2 x GINI)	<u>0.98</u>
(7)	CONDIS $\frac{c/}{2} = \frac{1 + GINI}{2 \times GINI} = (3) \div (6)$	<u>1.52</u>

CONDIS	MU ^e				
	0	0.5	1.0	2.0	3.0
1.5	1.0	0.86	1.0	1.8	3.85
2.0	1.0	0.94	1.0	1.3	2.0

(8)	DIS	<u>1.40</u>
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Footnotes

- a/ Based on equation (9) in main text
- b/ Based on equation (10) in main text; because of the complexity of this equation, Table 1 of typical results is used here.
- c/ Based on equation (11) in the text.

(v) Investment Rate of Interest (IRI)^{a/}

$$= MP^{cap} [MPS \times SPINV + MPC (DIS/SCF)]$$

(1) MPS .....	.114	[From I(a) (ii)]
(2) SPINV	x 3.325	[From III(b) (ii) (9)]
(3) MPS x SPINV	= .379	
(4) DIS	1.400	[From III(b) (iv) (11)]
(5) SCF	÷ .918	[From II(a)]
(6) (DIS/SCF)	= 1.525	
(7) MPC	x .886	[From I(a) (i)]
(8) MPC x (DIS/SCF)	= 1.351	
(9) (3) + (8)	= 1.730	
(10) MP ^{cap}	x .150	[Estimated]
(11) IRI	= .260	<u>IRI = 26.0%</u>

(vi) Government Income Rate of Interest (GRI)^{b/}

$$= CRI + SPINC^{\Delta}$$

(1) SPINC ^Δ = alog [{log (1/SPINC)} / T ^{opt}] - 1		
(a) unity	1.0	
(b) SPINC	÷ 2.069	[From III(b) (iii)(10)]
(c) (1/SPINC)	= .4833	
(d) log (1/SPINC)	= 1.6833	
(e) T ^{opt}	÷ 35	[From I(b) (iii)] $\frac{34.6833}{35} - \frac{35}{35}$
(f) log (1/SPINC/T ^{opt}) ...	= 1.9910	
(g) alog of (f)	= 0.9795	
(h) unity	- 1.0	
(i) SPINC ^Δ	= .021	
(2) CRI	0.062	[From III(b) (i) (5)]
(3) SPINC ^Δ	+ .021	[From (i) above]
(4) GRI	= 0.083	<u>GRI = 8.3%</u>

a/ Based on equation (32) in text.
b/ Based on equation (37) in text.

While the above steps will produce the right answer, in practice it is easier to calculate this rate using compound interest tables. Since most of these tables are set up to give compound rates of growth rather than decline, the procedure suggested here first finds the equivalent growth rate based on the value obtained by dividing the value of SPINC in the base year by the value of SPINC in the final year.

This value will always equal SPINC in the base year because SPINC in the year in which the distribution becomes optimal will always equal unity by definition. The next step is to find the compound rate of interest which, given the years until SPINC equals one, will yield the value of SPINC in the base year.

Since this is a compound growth rate and SPINC declines over time, the next step is to find the equivalent rate of decline, which is calculated as

$$\text{SPINC} = \frac{1}{1 + \text{CRG}}$$

where CRG is the compound rate of growth located in the table.

WORKSHEET FOR THE DERIVATION OF
CONVERSION FACTORS (ACCOUNTING RATIOS)

IV - Labor Conversion Factor^{a/}

(a) Forgone Marginal Product at Border Prices

(1) Forgone marginal product of labor

(MP^{lab}) _____ Project-specific

(2) Conversion factor for consumption

(CF^{con}) x .927 From II(c)(8)

(3) (MP^{lab} x CF^{con}) = _____

(b) Distribution Parameter for Wages^{b/}

(1) Average consumption (\overline{CON}) _____ Project-specific

(2) New consumption (CONⁿ) ÷ _____ Project-specific

(3) (\overline{CON}/CON^n) = _____

(4) Old consumption (CON^o) _____ Project-specific

(5) New consumption (CONⁿ) ÷ _____ Project-specific

(6) (CON^o/CONⁿ) = _____

(7) Elasticity of marginal utility (MU^e) .

1.5 From I(b) (i)

(8) Values for DISⁱ given above parameters:

MU ^e	$\frac{\overline{CON}}{CON^n}$	2			1			0.5		
		0.25	0.5	0.75	0.25	0.5	0.75	0.25	0.5	0.25
0		1	1	1	1	1	1	1	1	1
1.0		3.70	2.77	2.33	1.85	1.39	1.15	0.92	0.69	0.57
1.5		7.54	4.69	3.45	2.67	1.66	1.22	0.92	0.59	0.43
2.0		16.00	8.00	5.30	4.00	2.00	1.30	1	0.50	0.33

a/ Based on equation (30) in the main text.

b/ See paras. 52-60 in main text for details.

(c) <u>Social Cost of Increased Consumption</u>		
(1) Average market wage rate (WAG^m)	_____	<u>Project-specific</u>
(2) Forgone marginal product of labor (MP^{lab})	- _____	<u>Project-specific</u>
(3) ($WAG^m - MP^{lab}$)	= _____	
(4) Conversion factor for consumption ...	x <u>.927</u>	<u>From II(c) (8)</u>
(5) ($WAG^m - MP^{lab}$) CF^{con}	= _____	
(6) Distribution parameters for wages (DIS^w)	_____	<u>From IV(b) (8)</u>
(7) Conversion factor for consumption (CF^{con})	÷ <u>.927</u>	<u>From II(c) (8)</u>
(8) (DIS^w/CF^{con})	= _____	
(9) Social price of public income (SPINC)	÷ <u>2.069</u>	<u>From III(b) (iii) (10)</u>
(10) (DIS^w/CF^{con})/SPINC	= _____	
(11) MPC^w	x <u>1.000</u>	<u>From I(a) (v)</u>
(12) $MPC^w [(DIS^w/CF^{con})/SPINC]$	= _____	
(13) Marginal propensity to save (MPS^w) ..	<u>0.000</u>	<u>From I(a) (vi)</u>
(14) Social price of investment (SPINV) ..	x <u>3.325</u>	<u>From III(b) (i) (9)</u>
(15) MPS^w x SPINV	= _____	
(16) Social price of public income (SPINC)	÷ <u>2.069</u>	<u>From III(b) (iii) (10)</u>
(17) (MPS^w x SPINV)/SPINC	= _____	
(18) Unity	<u>1.0</u>	
(19) $MPC^w [(DIS^w/CF^{con})/SPINC]$	- _____	<u>From (12) above</u>
(20) (MPS^w x SPINV)/SPINC	- _____	<u>From (17) above</u>
(21) 18 - 19 - 20	= _____	
(22) ($WAG^m - MP^{lab}$) CF^{con}	x _____	
(23) Social cost of increased consumption	= _____	

(e) Summary Calculation for Conversion Factor for Labor

(1) Forgone marginal product of labor at border prices	_____	∕From IV(a)(3)∕
(2) Social cost of increased consumption	+ _____	∕From IV(c)(23)∕
(3) Shadow wage rate	= _____	
(4) Market wage rate	÷ _____	∕Project-specific∕
(5) Conversion factor for labor	= _____	

ESTIMATES FOR MALAYSIA

LIST OF WORKSHEETS

- I. Basic Variables
 - a. Objective Parameters
 - b. Subjective Parameters
- II. Conversion Factors
 - a. Standard Conversion Factor
 - b. Conversion Factor for Capital Goods
 - c. Conversion Factor for Consumption
 - d. Conversion Factor for Transport
 - e. Conversion Factor for Electricity
 - f. Conversion Factor for Building and Construction
- III. Accounting Rate of Interest
 - a. Marginal Product of Capital
 - b. Social Value Parameters
 - (i) Consumption Rate of Interest (CRI)
 - (ii) Social Price of Investment (SPINV)
 - (iii) Social Price of Public Income (SPINC)
 - (iv) National Distribution Parameter (DIS)
 - (v) Investment Rate of Interest (IRI)
 - (vi) Government Income Rate of Interest (GRI)
- IV. Labor Conversion Factor

NOTE: These Worksheets should be checked by the Country Economist, and used as a basis for improvement and refinement over time.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS (ACCOUNTING RATIOS)

I (a) Objective Parameters

The following variables should be obtainable or could be estimated from the latest Bank Economic Report, or from other economic, sector and project information available within the Bank Group, or from the statistical publications and other reports of our countries. The data will, of course, vary in quality from country to country. Where any of the estimated variables are considered unreliable, this should be stated and an attempt made to see to what extent reliable data from countries in similar stages of development could be used.

(i) Est. national marginal propensity to consume (MPC)	<u>0.82</u>
(ii) Est. national marginal propensity to save (MPS)	<u>0.18</u>
(iii) Est. marginal propensity to consume in the public sector (MPC ^G)	<u> </u>
(iv) Est. marginal propensity to save in the public sector (MPS ^G)	<u> </u>
(v) Est. marginal propensity to consume out of wages (MPC ^W)	<u>90-95%</u>
(vi) Est. marginal propensity to save out of wages (MPS ^W)	<u>5-10%</u>
(vii) Est. future growth rate of consumption	<u>5.5</u>

(viii)	Est. future growth rate of population	<u>0.080</u>
(ix)	Est. future growth rate of per capita consumption: (v) - (vi) = (CONGRO)	<u>0.027</u>
(x)	Gini coefficient of income distribu- tion (GINI) <u>1/</u>	<u>0.480</u>
(xi)	Average marginal product of labor (MP ^{lab}) <u>2/</u>	<u>825 MS\$ per year.</u>

1/ See paras. 42-49 in our "Guide for Country Economists to the Derivation of National Parameters for Economic Project Evaluation" for a discussion of possible means of estimating the Gini coefficient.

2/ See paras. 93-102, op. cit., for a discussion of the problems of estimating MP^{cap}. Similar problem exist with respect to a national MP^{lab}. The figure of MS\$825 is the average rural wage rate, but this is not necessarily the marginal product of labor because of imperfections in the labor market.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS (OR ACCOUNTING RATIOS)

I (b) Subjective Parameters (involving value judgements)

	<u>%</u>
(i) Elasticity of marginal utility with respect to consumption (MU^e) - Probable range: 0.5 - 2.0 ^{1/}	<u>1.0</u>
(ii) Pure time preference - Probable range: 2% - 5%	<u>3.0</u>
(iii) Number of years until government income is optimum	<u>35</u>

^{1/} The worksheets assume that marginal utility diminishes as income rises, i.e. that $MU^e > 0$, and that a unit increase in consumption is more valuable in the hands of a poor person than in the hands of a rich person. $MU^e = 1$ means that, say, a 10% increase in consumption has the same utility for rich and poor, eg. an increase in consumption of \$10 on a base of \$100 has the same utility as an increase of \$100 on a base of \$1000. Thus putting $MU^e = 1$ is giving a considerable weight on the utility of poor people's consumption.

WORKSHEETS FOR THE DERIVATION OF CONVERSION
FACTORS OR ACCOUNTING RATIOS (SIMPLIFIED METHODOLOGY)

II (a) - STANDARD CONVERSION FACTOR^{a/}

	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>
(1) Value of merchandise retained imports	—	<u>3182</u>	<u>3237</u>	<u>3935</u>	<u>3960</u>	
(2) Value of merchandise exports	—	<u>4122</u>	<u>5052</u>	<u>5163</u>	<u>5009</u>	
(3) (1) + (2)	—	<u>7304</u>	<u>8289</u>	<u>9098</u>	<u>8969</u>	
(4) Value of all taxes on imports	—	<u>372.22</u>	<u>389.39</u>	<u>417.43</u>	<u>364.89</u>	<u>358.34</u>
(5) Tariff equivalent of quotas ^{b/}	—	—	—	—	—	
(6) Value of all taxes on exports ^{c/}	<u>189.29</u>	<u>192.59</u>	<u>268.77</u>	<u>250.32</u>	<u>228.10</u>	<u>263.80</u>
(7) (3) + (4) + (5) - (6)	—	<u>7868.8</u>	<u>8847.2</u>	<u>9765.8</u>	<u>9562.0</u>	
(8) (3) ÷ (7)	—	<u>.93</u>	<u>.94</u>	<u>.93</u>	<u>.94</u>	
Average of (8) over period		<u>0.935</u>				

a/ Based on equation (26):

$$SCF = \frac{IMP + EX}{IMP (1 + Tax^{imp} + TQ^{imp}) + EX (1 - Tax^{ex})}$$

b/ Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market retail price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

c/ If a subsidy is involved, it should be added in with a negative sign. If subsidies exceed total taxes, the value of item (6) will be negative.

II (b) - CONVERSION FACTOR FOR CAPITAL GOODS ^{a/}

	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971 72</u>
(1) Value of capital goods imports	_____	<u>750</u>	<u>742</u>	<u>1151</u>	<u>1269</u>
(2) Value of capital goods exports	_____	<u>73.5</u>	<u>84</u>	<u>84.1</u>	<u>82.1</u>
(3) (1) + (2)	_____	<u>823.5</u>	<u>826</u>	<u>1235.1</u>	<u>1351.1</u>
(4) Value of taxes on capital goods imports	_____	<u>23.93</u>	<u>14.91</u>	<u>19.97</u>	<u>20.46</u> 1997
(5) Tariff equivalent of quotas ^{b/}	_____	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
(6) Value of taxes (subsidies) ^{c/} on capital goods exports	_____	<u>-</u>	<u>-</u>	<u>-</u>	<u>-</u>
(7) (3) + (4) + (5) - (6)	_____	<u>847.4</u>	<u>840.9</u>	<u>1255.0</u>	<u>1371.5</u>
(8) (3) ÷ (7)	_____	<u>.97</u>	<u>.98</u>	<u>.85</u>	<u>.86</u>

Average of (8) over period 0.91

^{a/} Based on the same type of equation as used for SCF.

^{b/} Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

^{c/} If a subsidy is involved it should be added in with a negative sign. If subsidies exceed taxes, the value of item (6) will be negative.

II (c) - CONVERSION FACTOR FOR CONSUMPTION ^{a/}

	<u>MS\$Million</u>				
	<u>1967</u>	<u>1968</u>	<u>1969</u>	<u>1970</u>	<u>1971</u>
(1) Value of merchandise imports	—	<u>1275</u>	<u>1139</u>	<u>1212</u>	<u>1127</u>
(2) Value of merchandise exports excluding capital goods	—	<u>263</u>	<u>286</u>	<u>349</u>	<u>386</u>
(3) (1) + (2)	—	<u>1538</u>	<u>1425</u>	<u>1561</u>	<u>1513</u>
(4) Value of taxes on imports of goods excluding capital goods	—	<u>348.3</u>	<u>374.5</u>	<u>397.4</u>	<u>344.4</u>
(5) Tariff equivalent of quotas ^{b/}	—	—	—	—	—
(6) Value of taxes (subsidies) on exports excluding capital goods ^{c/}	<u>189.3</u>	<u>192.6</u>	<u>268.8</u>	<u>250.3</u>	<u>228.1</u>
(7) (3) + (4) + (5) - (6)	—	<u>1978.9</u>	<u>2068.3</u>	<u>2208.7</u>	<u>2085.5</u>
(8) (3) ÷ (7)	—	<u>77.8</u>	<u>68.9</u>	<u>70.6</u>	<u>72.5</u>
Average of (8) over period	—	<u>0.72</u>			

^{a/} Ideally, one should weight individual imports and exports by their relative shares in an average consumption basket, but such consumption data is typically lacking or deficient in LDCs. This is based on the same type of equation as SCF.

^{b/} Where there is a quota but no tariff, or a complete ban on imports, a tariff-equivalent should be estimated by expressing the border price of each good subject to the quota or ban as a percentage of the domestic market price, less an average transport/marketing mark-up. If a large number of goods are subject to quotas, it is suggested that a short-cut be employed by selecting a small representative sample of such goods and averaging the results by using rough weights according to their relative importance in the trade of the goods subject to quota.

^{c/} If a subsidy is involved, it should be added in with a negative sign. If subsidies exceed taxes, the value of item (6) will be negative.

II (d) - CONVERSION FACTOR FOR TRANSPORT

	Cost per ton/km								
	(1)			Conversion Factor <u>b/</u>	(2)				
	At Market Prices <u>a/</u>				At Social Prices				
	<u>Land</u>	<u>Rail</u>	<u>Ports</u>		<u>Land</u>	<u>Rail</u>	<u>Ports</u>		
Direct skilled labor				1.0					
Management overheads	97.6	32.2	21.7	1.0	0.8	78.1	25.8	17.4	
Direct unskilled labor				0.75					
Fuel, lubricants, etc.	34.6	4.2	1.7	.935		32.4	3.9	1.6	
Spare parts & other inputs	52.1	5.2	2.7	.91		47.4	4.7	2.5	
Maintenance	7.8	24.0	6.0	.935		7.3	22.9	5.3	
Other costs	34.5	0.6	0.3	.935		32.3	0.5	0.3	
Rent	-	1.2	-	1.0		-	1.2	-	
Depreciation	23.2	8.2	6.1	.91		21.1	7.4	5.9	
Interest	23.2	8.2	6.1			21.1	7.4	5.9	
Profit)									
Direct taxes)	41.2	-8.4	11.2	.935		38.5	-7.9	10.5	
				0.0		-	-	-	
Total value	291.0	67.2	49.7	(1)		257.7	58.5	43.5	(2)

Conversion factor for transport = $\frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}}$ $\frac{88.6/87.1/87.5}{87.1/87.5}$

a/ The breakdown of total value at market prices can usually be obtained from the latest census of production and distribution and/or sample surveys of unit transport costs by various modes for varying lengths of journeys and types of terrain.

b/ The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CF^{cap}. In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

II (e) - CONVERSION FACTOR FOR ELECTRICITY ^{a/}

	Cost per kwh		
	<u>At Market Prices</u> ^{b/}	<u>Conversion Factor</u> ^{c/}	<u>At Social Prices</u>
Direct skilled labor	41.4	1.0	33.1
Management overheads		1.0	
Direct unskilled labor		0.75	
Fuel	35.0	.935	32.7
Materials	27.4 (of which 17.0 rep. purchases of electricity from amongst themselves)	.935	25.3
Spare parts & other inputs		.935	16.2
Maintenance	17.3		
Other costs			
Rent			
Depreciation	35.6	.91	32.4
Interest			
Profit	85.0	.935	79.5
Direct taxes			
	<u>241.7</u>	(1)	<u>219.2</u>

$$\text{Conversion factor for electricity} = \frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}} = 0.91$$

^{a/} It may be necessary to estimate separate conversion factors for peak and off-peak loads and different systems, e.g., different regional systems and different production methods such as hydroelectric and diesel generators.

^{b/} The breakdown of total value at market prices can usually be obtained from the latest census of production and/or from the public utility authorities.

^{c/} The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CF^{cap} . In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

II (f) - CONVERSION FACTOR FOR BUILDING AND CONSTRUCTION ^{a/}

	M\$Million		Cost per m ²
	1970 At Market Prices	Conversion Factor	At Social Prices
Direct skilled labor	54.8	1.0	54.8
Direct unskilled labor	40.9	$\frac{0.75}{[CF^{lab}]}$	30.7
Materials	279.5	.935	261.3
Fuel	6.3	.935	5.9
Spare parts & other inputs	21.3	.91	19.4
Maintenance	8.6	.935	8.0
Other costs	49.5	.935	46.3
Management overheads	14.6	1.0	14.6
Rent	1.2	1.0	1.2
Depreciation	9.5	$\frac{.91}{[CF^{cap}]}$	8.6
Interest	3.5	.935	3.3
Profit)	4.7	.935	4.4
Taxes=45%)		0.0	
Direct taxes)			
	494.4	(1)	458.5
Total value			

Conversion factor for building and construction =

$$\frac{\text{Total at Social Prices (2)}}{\text{Total at Market Prices (1)}}$$

0.93

- a/ It may be desirable to estimate separate conversion factors for building works and other Civil Engineering works.
- b/ The breakdown of total value at market prices can usually be obtained from the latest census of production or from sample surveys.
- c/ The conversion factor for fully traded goods is the ratio of unit border prices to unit domestic prices. For non-traded goods, the conversion factor is the SCF or the CF^{cap}. In general, indirect taxes on constituent cost elements should be taken out by setting the conversion factor equal to zero.

WORKSHEETS FOR THE DERIVATION OF
CONVERSION FACTORS (ACCOUNTING RATIOS)^{a/}

III. Accounting Rates of Interest

(a) Marginal Product of Capital (MP^{cap})^{b/}

$$= \frac{\Delta \text{OUT}}{\Delta \text{CAP}} - \text{MP}^{\text{lab}} \times \frac{\Delta \text{LAB}}{\Delta \text{CAP}}$$

As was mentioned in the text, calculating the marginal product of capital on the basis of a simple two-factor production function is subject to error from many sources including:

- the unrealistic nature of a two-factor model (capital is not homogeneous, and other factors of production are involved),
- the problems of defining capital stock, and
- the lack of basic data on capital, output, labor and wages.

For these reasons, it was suggested that this approach be used only as a check on other estimates of the marginal productivity of capital derived from the experience of development banks and from observed market rates of interest (paras. 93-96 in text).

Perhaps the meaning of the marginal product of capital should be explained briefly. Although the marginal product of capital has a physical or monetary meaning when calculated -- for example, \$0.15 of net product is produced each year by every \$1.00 invested, all other factors being held constant -- marginal productivity is expressed as the incremental product divided by the incremental

a/ If trends are discernable in ΔOUT , ΔCAP and ΔLAB , projected instead of average values should be used in items (2), (4) and (7) below.

b/ Based on equation (36) from text.

investment, which is considered to be \$1.00. This rate of return, while expressed in percentage form for discursive purposes, must be written in decimal form when used in the equations presented in the text.

It should be apparent that the marginal product of capital is not the same as the perhaps more familiar incremental output capital ratio. Output in this ratio includes the product of labor and other factors in addition to that of capital. It is implicitly assumed in calculating this ratio that all factors are increased in proportion, so the ratio simply notes the increase in capital inputs which is normally associated with a given increase of output.

(1) Δ OUT	1968	<u>314</u>	x	SCF_{t-4}	<u>0.96</u>	=	<u>301</u>
	1969	<u>944</u>	x	SCF_{t-3}	<u>0.96</u>	=	<u>906</u>
GDP at current factor cost.	1970	<u>460</u>	x	SCF_{t-2}	<u>0.96</u>	=	<u>442</u>
	1971	<u>467</u>	x	SCF_{t-1}	<u>0.96</u>	=	<u>448</u>
	1972	<u>697</u>	x	SCF_t	<u>0.96</u>	=	<u>669</u>
							<u>2766</u> =====

(2) Average Δ OUT over 5 years = 553

(3) Δ CAP	1968	<u>1548</u>	x	CF_{t-4}^{cap}	<u>0.91</u>	=	<u>1409</u>
	1969	<u>1559</u>	x	CF_{t-3}^{cap}	<u>0.91</u>	=	<u>1419</u>
	1970	<u>1874</u>	x	CF_{t-2}^{cap}	<u>0.91</u>	=	<u>1705</u>
	1971	<u>2089</u>	x	CF_{t-1}^{cap}	<u>0.91</u>	=	<u>1901</u>
	1972	<u>2470</u>	x	CF_t^{cap}	<u>0.91</u>	=	<u>2248</u>
							<u>8682</u> =====

(4) Average of Δ CAP over 5 years = 1,736

(5) $\frac{\Delta OUT}{\Delta CAP}$, (2) \div (4) = 0.32

Δ Output \div Capital in t-1
1968 .21
1969 .61
1970 .29
1971 .25
1972 .33
Av. <u>.34</u> x SCF (0.76) = 32.6

(b) Social Value Parameters

(i)	<u>Consumption Rate of Interest (CRI)</u>	^{a/}	$= MU^e \times \overline{CONGRO} + PTP$
	(1) Elasticity of marginal utility (MU^e)	<u>1.000</u>	[From I(b) (i)]
	(2) Rate of growth of per capita consumption (\overline{CONGRO})	<u>0.027</u>	[From I(a) (ix)]
	(3) $MU^e \times \overline{CONGRO}$	<u>0.027</u>	
	(4) Rate of pure time preference (PTP)	<u>0.030</u>	[From I(b) (ii)]
	(5) CRI	<u>0.057</u>	<u>CRI = 5.7%</u>
(ii)	<u>Social Price of Investment (SPINV)</u>	^{b/}	$= \frac{MPC \times MP^{cap}}{CRI - MPS \times MP^{cap}}$
	(1) Marginal propensity to consume (MPC)	<u>0.82</u>	[From I(a) (i)]
	(2) Marginal product of capital (MP^{cap})	<u>0.15</u>	[Estimated]
	(3) $MPC \times MP^{cap}$	<u>0.123</u>	
	(4) Marginal propensity to save (MPS)	<u>0.18</u>	[From I(a) (ii)]
	(5) Marginal product of capital (MP^{cap})	<u>0.15</u>	[Estimated]
	(6) $(MPS \times MP^{cap})^{-1}$	<u>0.027</u>	
	(7) Consumption rate of interest (CRI)	<u>0.057</u>	[From III(b) (i) (5)]
	(8) $CRI - MPS \times MP^{cap}$ (7) - (6)	<u>0.030</u>	
	(9) (3) \div (8) = SPINV	<u>4.10</u>	

a/ Based on equation (31) in main text.

b/ This is based on the simplified equation (2) in the main text.

- (iii) Social Price of Public Income (SPINC) ^{a/} = $MPS^g \times SPINV + MPC^g \left(\frac{DIS^g}{SCF} \right)$
- (1) Marginal propensity to save in the public sector (MPS^g) (Use MPS)... 0.18 [From I(a) (ii)]
 - (2) SPINV x 4.10 [From III(b) (ii) (9)]
 - (3) $MPS^g \times SPINV$ = 0.74
 - (4) Marginal propensity to consume in the public sector (MPC^g) (Use MPC) 0.82 [From I(a) (i)]
 - (5) Distribution parameter for government [use DIS] x 1.00 [See III(b) (iv)]
 - (6) $MPC^g \times DIS$ = 1.82
 - (7) Standard conversion factor (SCF) \div 0.94 [From II(a)]
 - (8) $MPC^g \times (DIS/SCF)$ = 1.94
 - (9) $MPS^g \times SPINV$ + 0.74 [See (3) above]
 - (10) SPINC = 2.68

(iv) National Distribution Parameter (DIS) ^{b/}

- (1) One 1.00
- (2) GINI + 0.48 [From I(a) (x)]
- (3) (1 + GINI) 1.48
- (4) GINI 0.48 [From I(a) (x)]
- (5) Two x 2.00
- (6) (2 x GINI) 0.96
- (7) $CONDIS \frac{c/}{2 \times GINI} = \frac{1 + GINI}{2 \times GINI} = (3) \div (6)$ = 1.54

CONDIS	MU ^e				
	0	0.5	1.0	2.0	3.0
1.5	1.0	0.86	1.0	1.8	3.85
2.0	1.0	0.94	1.0	1.3	2.0

- (8) DIS = 1.00

(v) Investment Rate of Interest (IRI)^{a/}

$$= MP^{cap} [MPS \times SPINV + MPC (DIS/SCF)]$$

(1) MPS	<u>0.18</u>	[From I(a) (ii)]
(2) SPINV	x <u>4.10</u>	[From III(b) (ii) (9)]
(3) MPS x SPINV	= <u>0.74</u>	
(4) MPC	<u>0.82</u>	[From I(a) (i)]
(5) DIS	x <u>1.00</u>	[From III(b) (iv) (ii)]
(6) MPC x DIS	= <u>0.82</u>	
(7) SCF	÷ <u>0.94</u>	[From II(a)]
(8) MPC x (DIS/SCF)	= <u>0.87</u>	
(9) (3) + (8)	= <u>1.61</u>	
(10) MP ^{cap}	x <u>0.15</u>	[Estimated]
(11) IRI	= <u>0.24</u>	<u>IRI = 24.0%</u>

(vi) Government Income Rate of Interest (GRI)^{b/}

$$= CRI + SPINC^{\Delta}$$

(1) SPINC ^Δ = $\text{alog} [\{\log (1/SPINC)\} / T^{opt}] - 1$		
(a) unity	<u>1.00</u>	
(b) SPINC	÷ <u>2.68</u>	[From III(b) (iii) (10)]
(c) (1/SPINC)	= <u>0.37</u>	
(d) log (1/SPINC)	= <u>1.5717</u>	$\frac{34.5717}{35} - \frac{35}{35}$
(e) T ^{opt}	÷ <u>35</u>	[From I(b) (IV)]
(f) log (1/SPINC)/T ^{opt} ..	= <u>1.9878</u>	
(g) alog of (f)	= <u>0.9723</u>	
(h) unity	- <u>1.0</u>	
(i) SPINC ^Δ	= <u>0.0277</u>	
(2) CRI	<u>0.057</u>	[From III(b) (i) (5)]
(3) SPINC ^Δ	+ <u>0.0277</u>	[From (i) above]
(4) GRI	= <u>.085</u>	<u>GRI = 8.5%</u>

a/ Based on equation (32) in text.
b/ Based on equation (37) in text.

Footnotes to Sheet III (c).

a/ Based on equation (9) in main text

b/ Based on equation (10) in main text; because of the complexity of this equation, Table 1 of typical results is used here.

c/ Based on equation (11) in the text.

While the above steps will produce the right answer, in practice it is easier to calculate this rate using compound interest tables. Since most of these tables are set up to give compound rates of growth rather than decline, the procedure suggested here first finds the equivalent growth rate based on the value obtained by dividing the value of SPINC in the base year by the value of SPINC in the final year.

This value will always equal SPINC in the base year because SPINC in the year in which the distribution becomes optimal will always equal unity by definition. The next step is to find the compound rate of interest which, given the years until SPINC equals one, will yield the value of SPINC in the base year.

Since this is a compound growth rate and SPINC declines over time, the next step is to find the equivalent rate of decline, which is calculated as

$$\text{SPINC} = \frac{1}{1 + \text{CRG}}$$

where CRG is the compound rate of growth located in the table.

(c) <u>Social Cost of Increased Consumption</u>		
(1) Average market wage rate (WAG^m)	_____	<u>Project-specific</u>
(2) Forgone marginal product of labor (MP^{lab})	- _____	<u>Project-specific</u>
(3) ($WAG^m - MP^{lab}$)	= _____	
(4) Conversion factor for consumption ...	x 0.72	<u>From II(c) (8)</u>
(5) ($WAG^m - MP^{lab}$) CF^{con}	= _____	
(6) Distribution parameters for wages (DIS^w)	_____	<u>From IV(b) (8)</u>
(7) Conversion factor for consumption (CF^{con})	÷ 0.72	<u>From II(c) (8)</u>
(8) (DIS^w/CF^{con})	= _____	
(9) Social price of public income (SPINC)	÷ 2.04	<u>From III(b)(iii) (10)</u>
(10) (DIS^w/CF^{con})/SPINC	= _____	
(11) MPC^w	x 0.95	<u>From I(a)(v)</u>
(12) MPC^w <u>(DIS^w/CF^{con})/SPINC</u>	= _____	
(13) Marginal propensity to save (MPS^w) ..	0.05	<u>From I(a)(vi)</u>
(14) Social price of investment (SPINV) ..	x 4.08	<u>From III(b)(ii) (9)</u>
(15) MPS^w x SPINV	= 0.20	
(16) Social price of public income (SPINC)	÷ 2.04	<u>From III(b)(iii) (10)</u>
(17) (MPS^w x SPINV)/SPINC	= 0.098	
(18) Unity	1.0	
(19) MPC^w <u>(DIS^w/CF^{con})/SPINC</u>	- _____	<u>From (12) above</u>
(20) (MPS^w x SPINV)/SPINC	- _____	<u>From (17) above</u>
(21) 18 - 19 - 20	= _____	
(22) ($WAG^m - MP^{lab}$) CF^{con}	x _____	
(23) Social cost of increased consumption	= _____	

(e) Summary Calculation for Conversion Factor for Labor

(1) Forgone marginal product of labor at border prices	_____	[From IV(a)(3)]
(2) Social cost of increased consumption	+ _____	[From IV(c)(23)]
(3) Shadow wage rate	= _____	
(4) Market wage rate	÷ _____	[Project-specific]
(5) Conversion factor for labor	= _____	

at. General Op of File
Policy - Appraisal
& Preparation
of Projects

OFFICE MEMORANDUM

TO: Mr. L. Squire, CPS

DATE: May 18, 1973

FROM: Brian Shields, LCPTB

SUBJECT: Economic Analysis of Projects -
Annex - Derivation of Shadow Prices

1. Mr. Knox has requested me to send you comments made by members of the LAC Projects Department on the Annex distributed under cover of Mr. van der Tak's memo of April 25, 1973. I make some general comments below and then attach comments and questions on details which you may wish to consider when revising the Annex. We may have further comments when staff, now on missions, have had a chance to read the Annex.
2. The Annex will be a very useful guide to those endeavoring to improve on present practice in project evaluation. It will be interesting to follow the initial studies in the pilot countries and pilot projects selected. We do make efforts in this Department, varying in thoroughness in accordance with the nature of the data, the availability of staff and the state of preparation of the project, to use shadow pricing where it appears that the divergences between market and economic prices are wide enough to affect decisions significantly.
3. We continue, however, to have doubts on the questions raised by Mr. Knox in his memo of February 13, 1973. First, what is the practical value of carrying out all the subtle calculations proposed in the Annex, bearing in mind that many assumptions and values attributed to the parameters will be intuitive and crude, as acknowledged frequently in the Annex? Will the various simplifications which the Annex admits likely to be required not result in exercises resembling present Bank practice? The first few pilot studies will no doubt help answer this question. And experience should also answer the related question about the implications of the suggested procedures for time and staff required to prepare and appraise projects. Any additional staff involvement can then be weighed against the perceived difference between results from present and proposed procedures. We note that Mr. Anand's recent Malaysia exercise took longer than the normal appraisal and that, in spite of being set up to conduct a shadow pricing exercise, did not tackle the income distribution aspect for lack of time. We note from this exercise also that the rates of return obtained from the two approaches did not differ significantly. Our limited knowledge of other investigations, of tea roads in Kenya and of major highway works in Israel, for example, similarly indicates that because of offsetting factors on both cost and benefit sides of the balance, the investment decision is not affected. The Kreditinstaldt fur Wiederaufban regards the Little Mirlees method as of more use for industrial than for infrastructure type projects. It may be worth contacting this institution, since it has undertaken several dozen evaluations with this method.

4. In spite of the desire to measure all variables as objectively as possible, the Annex acknowledges that the estimation of some parameters will rely very much on subjective judgment - so much in fact, that the valuation is likely to be arbitrary. Maybe the practice will demonstrate that the range of values for any parameter is not so great - but prima facie we have the feeling that a clever economist can prepare a justification for almost any project. For example, the exogenous variable n is a very crucial parameter in estimating CIR, d, dw, de, D and therefore, AIR and SWR. Yet the guide to the estimation of n (para. 46) is not rigorous, and cannot be. What will happen in the event of a conflict between Bank and Government in the attempted quantification of Government or country preferences? Or if there is disagreement between project staff and country program economists? The same argument may apply to the manner in which other variables, such as α , accounting ratio for non-tradeables, are to be valued (paras. 17, 64, 65 for α and 47 and 48 for other parameters). In para. 29 the shadow wage rate varies from $0.45W$ to $0.81W$, depending on the equation used to compute it. Perhaps a model can be devised in the Bank which will calculate the range of values of the main coefficients for shadow pricing on the basis of different values for the subjectively estimated parameters. This would help to ascertain how critical to useful decision making the values are.

5. We would like you to consider the implications of the more extensive use of shadow pricing in project evaluation for another aspect of the Bank's work - supervision of the project, including, for example, selection of contractors and equipment suppliers. Will we receive guidelines on how we are to reconcile justification of projects on the basis of lower estimated shadow price of domestically supplied inputs, such as labor, with a bid evaluation using prices quoted by the contenders in open international competitive bidding? We may have a project designed from the early stages on the assumption of a particular method of construction but with a low financial bid from a contractor who intends to use another method. Is it proposed to approach management with a view to changing our procurement policies to bring them into line with economic evaluation practices?

6. I attach a comment by Mr. Stout on an exercise using Colombian data to ascertain the incremental capital-output ratio (Annex I); a comment on an attempt made by Mr. Chatelin to find the shadow price of capital in Mexico using the basic equation proposed in Appendix 2 (Annex II); and detailed comments, raised mainly by Mr. Lee, consultant to LCP Education Projects Division (Annex III).

BShields:lg

CC: Messrs. van der Tak, VPSVP; Knox, LCPDR; Calika, LCPDR; Cheek, LCPED; Geli, LCPTR; Goffin, LCPAG; Renger, LCPDF; Sheehan, LCPPB; Chatelin, LCPTR; Stout, LCPDF, McGarry, LCPAG; Koulourianos, LCPED; K.W. Lee, Consultant

OFFICE MEMORANDUM

TO: Mr. B. Shields, LCPTR

DATE: May 15, 1973

FROM: D. E. Stout, LCPDF *MS*SUBJECT: Economic Analysis of Projects -
Annex: Derivation of Shadow Prices

1. I continue to have reservations about the data base constraints and judgmental elements which will unavoidably enter into the estimation of shadow prices. The approach of the Annex is sensible in using shortcuts to compromise between the ideal and the attainable; but the more such shortcuts have to be relied upon, the more ambiguous must be the results. I should like to illustrate this for one specific exogenous variable, k (the incremental output/capital ratio), which is fundamental for the calculation of q (the marginal product of capital).

2. The Annex (paragraph 13) notes that both investment and output should be measured at accounting prices and be averaged over, say, five years in order to remove the effects of short-term fluctuations. Estimates of k for Colombia, based on market prices, show no stability even for 5-year averages. Instead, the year-to-year fluctuations are so great as to call into question the value of the exercise. It seems unlikely that the use of accounting prices for output and for investment would remove the instability. The basic problem undoubtedly is the nature of the data. The rolling 5-year average of k shows the following year-to-year percentage increases (decreases):

1956	0	1961	8.3	1966	5.0
1957	(17.7)	1962	13.9	1967	(2.9)
1958	(10.2)	1963	3.8	1968	9.7
1959	19.8	1964	(5.3)	1969	0.7
1960	8.0	1965	0.2	1970	8.6

3. Since q enters into several of the shadow prices and the shadow prices are sensitive to q , I suppose that the country economists in this case would have to refine the data base. This could be a formidable task, but perhaps that is what country program economists should be doing.

4. I am not questioning the desirability of shadow pricing. I am only suggesting that it will be interesting to learn (a) what are the manpower implications of this approach and (b) whether shadow pricing in practice will lead to different accept-reject decisions than at present. For example, the LCPDF division already is beginning to experiment with economic rate-of-return calculations for sub-projects in Colombia and Ecuador, using much more simplified shadow-pricing techniques than those in the Annex. When shadow prices from the country program department become available, it will be instructive to compare the results.

DESTout:yir

cc: Messrs. Renger; Mirski; Hyde

By using the basic equation proposed in Appendix 2 of the methodology to compute shadow prices for Mexico. We found V (shadow prices of capital) negative because s_q is higher than i . We have:

$$s = 0.2 \quad q = 0.31$$

$$i = nG = 5.25 \text{ percent and } n = 1.5$$

In this case as is mentioned in para. 41 we have to use another equation to compute i , the new equation is:

$$i = nG + \rho \quad (\rho = \text{rate of pure time preference})$$

The number of countries where nG is less than s_q should be quite large and the proposed methodology should be more explicit in this case and give more emphasis on how to compute ρ . If ρ in addition to n, ρ etc. is a subjective value, the computation of shadow prices will be too much subjective to have a concrete applicability.

Detailed Para. by Para. Comments

Para. 3

Certainly, public income in foreign exchange is convenient as the numeraire for measuring costs and benefits. Yet, is it universal enough to measure all plausible costs and benefits generated by the project being dealt (or which will be dealt) by the Bank?

Para. 10

The first line should start with "If $r \approx CRI$," adding an equality sign. Do you consider that it is realistic to assume that the shadow prices for private and public investment are equal?

Para. 11

"Equation (3)" in the first line should also be changed to "equation (5)."

Para. 13

Notations for equation (9) should read as "where k = output/capital ratio, l = labor/capital ratio, and m is the marginal product of labor."

Because if the production function is linear and homogeneous:

$$F(\lambda k, \lambda L) = \lambda F(K, L) \quad \text{for all } \lambda > 0, \text{ where } K \text{ and } L$$

are two inputs, capital and labor. It then follows, by Euler's Theorem, that:

$0 = qK + rL$ for all K and L, where q and r are marginal products of K and L, respectively. By dividing each side by K and rearranging terms, we get equation (9):

$$q = \frac{0}{K} - r \frac{L}{K}$$

To make the estimation procedure consistent throughout the paper, estimation of m should be made considering the situation of the relevant labor market as classified in paras. 17 to 20. In few countries, with which the Bank deals, the marginal product of labor would be equal to average labor earnings because the equality implies that the labor market is perfectly competitive and efficient, which is not a general situation in LDC's. Alternatively, as suggested for the estimates of k and l, one may well exclude the subsistence agricultural sectors from the estimate of m.

para. 15

By adopting different assumptions and formulas, as shown in the example, one has different estimate of ARI. Therefore, it is crucial to classify an economy especially into either B or C (see para. 9). Yet the basis of judgments (para. 12) are not always clear or discernible.

The statement, "In general, v is more sensitive to change in i or T than r or \bar{r} ," is not clear enough to understand. After all, v is not dependent on the value of r or \bar{r} . Rather, r and \bar{r} is affected by the value of v (see equation (1)).

para. 18

To be consistent, output foregone by the "excess urban migrants" should be measured in general not by the market wage rate but by marginal product of those excess migrants in rural employment, which in turn might be estimated by the market wage rate in view of the degree of competitiveness of the relevant labor market.

paras. 35 - 39

By using a specific marginal utility function of consumption, the Annex invariably assigns different weights to increased consumptions depending on the ratio of new and old levels of consumption of the beneficiary and the ratio of the new level of consumption and the average level of consumption in the economy. Would not it be reasonable to make the weights to increased consumption flexible from economy to economy also depending on the level of average consumption in an economy, even though the two ratios are same between the economies? For instance, using the example in para. 39, would it be reasonable to maintain $d = 2.77$ irrespective of the average levels of consumption of different countries (suppose average consumption level is \$100 in one country and \$500 in another country), all the other parameters of the two country being equal?

para. 45

Guides to making judgments about n are too elusive and abstract to reach an objective estimate. This would be more serious if we considered the fact that all the other endogenous variables are very sensitive to different values of n .

paras. 64 - 65. 67 - 68

It appears the Annex argues that the need to use average accounting ratios is caused by distortions in output prices due only to trade tariffs or taxes because it considers the nature of α and β only in this context. Certainly, there are a great number of other causes for distortions which make it necessary to use accounting ratios to convert market prices into equivalent social value. These other causes should also be taken into account in refining the estimating procedure of α and β .

Mr. Jim Jennings

January 8, 1973

K. Bengt O. Holmgren *BH*

Format of Financial Annexes in Appraisal Reports -
Comments and Draft for Telecom Companies

1. Enclosed is a draft set of statements showing the format of financial annexes in appraisal reports for telecommunication companies which has been based on the set you made for power companies. Significant differences are commented on below. Agreement on the format of financial statements should be reached before we proceed with major changes of FIN-PRO as being discussed.

2. Treatment of Cash. Instead of having the cash position as a residual item, the level of cash necessary for the projected level of operations and development should be projected explicitly. In the balance sheet schedule--analysis of current assets and liabilities, the residual should be entered under the entry "Short-term Investments and Borrowings" and cash under the entry "Cash and Bank Deposits". In the cash flow statement, the last three entries have been eliminated (cash increase for year, cash at beginning of year and cash at end of year) and the corresponding figure included under "changes in net current assets". The advantages of these changes are:

- The cash flow statement will focus on what is most important, i.e., requirements of external finance and the way it is covered. The cash position should normally not be of particular interest.
- The residual will be shown explicitly as "Short-term Investments and Borrowing", which will facilitate reading of the statements.
- More effort will go into assessing the appropriate cash level.

3. Income Statement. I have incorporated an entry for non-operating revenues and expenses as "Other - Net" (Annex 1). Furthermore, to make the income statement universal and easier to read, I have removed all items which pertain to the sector (like energy sales, etc.) which, in any case, will form part of the revenue analysis schedule.

4. Income Statement Schedule - Statistics. Since in telecommunications, many items will affect revenues as well as expenses, these are included in a separate schedule.

5. Indicators. Should we use only US currency to facilitate comparison?

KBOH/jm

Mr. James H. Jennings

January 8, 1973

L. V. Smith

Format of Financial Annexes in Appraisal Reports

Your memorandum to Mr. Weiner dated June 14, 1972 was brought to my attention the other day and having just prepared financial annexes for the Kuala Lumpur Water Supply Project Phase Two, my first project, it seemed as though there might be some benefit in putting down my thoughts on paper while they are still fresh in my mind and at the same time pushing forward the concept of standardization for these annexes for water projects.

I attach my drafts of these annexes as follows:

1. Annex I, IA and IB are particularly for water projects and would need amendment for other types of projects.
2. Annex II is the Cash Flow and could be used for any type of project and only differs in detail to yours.
3. Annex III, IIIA, IIIB and IIIC are designed mainly for water but could be used for other projects with very little modification.

It does seem to me to be desirable to get a standard set of forms for showing these projections as soon as possible and if there is anything that I can contribute to push this forward, please let me know.

Attachments

LVSmitth/cma

cc: Messrs. V. Rajagopalan
M. Mould
B. Holmgren

INCOME STATEMENTS - WATER

	Year	Year	Year
Water Billings			
Other Billings			
Total Billings			
Other Revenues			
Total Revenues			
Cash Operating Expenses			
Income Before Depreciation			
Depreciation			
Income Before Interest			
Interest			
<u>Net Income</u>			

INDICATORS

1. Operating Ratio
2. Average Rate Base
3. Rate of Return

INCOME STATEMENT SCHEDULE - WATER

Revenue Analysis

	Year	Year	Year
Number of Connections with possible Analysis Domestic, Industrial, Commercial, Government, Other			
Water Production			
Water Sales with Analysis			
Water Unaccounted for %			
Average Price per unit billed			
Other Billings and types			
Other Revenues and types			

INDICATORS

1. Increase in Connections
2. Increase in Production
3. Increase in Sales
4. Variation in Losses
5. Increase in Average Price Billed
6. Increase in Other Billings
7. Increase in Other Revenues
8. Increase in Total Revenues
9. Total of Billing per Connection Cash
10. Total of Billing per Connection Water

INCOME STATEMENT SCHEDULE - WATEROperating Cost Analysis

Year Year Year

STATISTICS

Gross Production Capacity
 Miles of Pipeline in Sizes showing Raw and
 Treated Separately
 Miles of Distribution Pipes in Sizes
 Number of Treatment Works and Capacities
 Number of Reservoirs and Capacities
 Number of Pumping Stations and Sizes
 Number of Dams and Capacities
 Number of Meters and Sizes
 Number of Stand Pipes
 Number of Fire Hydrants
 Number of Employees Salaried
 Number of Employees Manual
 Value of Gross Plant in Service (L C)
 Value of Gross Plant in Service (US\$)
 Value of an Appropriate Price Index

OPERATING COSTS

Labor
 Chemicals
 Power
 Repairs and Maintenance
 Administration
 Other

Cash Operating Costs

Depreciation

Total Operating Costs

INDICATORS

1. Average Depreciation Rate
2. Cash Operating Costs+ Gross Plant in Service
3. Cash Operating Costs per 1,000 Gallons Produced
 (or other unit)
4. Cash Operating Costs per Connection
5. Total Operating Costs per 1,000 Gallons Produced
 (or other unit)
6. Number of Employees per IMg Capacity (or other unit)
7. Number of Employees per IMg Sold (or other unit)
8. Number of Employees per US\$ million Gross Plant in Service
9. Number of Connections per Employee
10. Average Annual Cost per Employee (L C)
11. Average Annual Cost per Employee (US\$)

CASH FLOW

<u>REVENUE</u>	Year	Year	Year	Year
<u>Internal Sources of Funds</u>				
Net Operating Income Before Interest				
Depreciation				
Additions to Current Liabilities				
Total				
<u>Subtract</u>				
Additions to Current Assets				
Loan Repayments Principal				
Loan Repayments Interest				
Total				
<u>Balance of Internal Funds Available</u>				
<u>for Investment</u>				
 <u>CAPITAL</u>				
<u>Construction Program</u>				
Bank Project				
Other Works				
Future Project				
Interest During Construction				
Total Construction				
<u>Financed by</u>				
Bank Loan Existing				
Bank Loan Proposed				
Other Borrowing				
Government Contributions				
Consumer Contributions				
Other Capital Sources				
Total Capital Sources				
<u>Balance to be financed from Internal</u>				
<u>Funds of elsewhere</u>				
 <u>CASH POSITION</u>				
Cash Increase (Decrease) in Year				
Cash at Start of Year				
Cash at End of Year				

INDICATORS

1. Debt Service Coverage

BALANCE SHEET

<u>ASSETS</u>	Year	Year	Year	Year
<u>Fixed Assets</u>				
Plant in Service				
Less: Depreciation				
Net Plant in Service				
Working Progress				
Net Plant				
Investments Long-Term				
Sub-Total				
<u>Current Assets</u>				
Inventories				
Accounts Receivable				
Investments Short-Term				
Cash				
Other				
Sub-Total				
Other Assets				
TOTAL ASSETS				
<u>EQUITY AND LIABILITIES</u>				
<u>Equity</u>				
Accumulated Surplus				
Contribution				
Sub-Total				
<u>Debt</u>				
Long-Term Debt Gross				
Less: Current Maturities				
Long-Term Debt Net				
<u>Current Liabilities</u>				
Accounts Payable				
Deposits				
Current Maturities				
Sub-Total				
TOTAL EQUITY AND LIABILITIES				

INDICATORS

1. Gross Long-Term Debt as % of Net Plant
2. Current Ratio
3. Receivables/Revenue
4. Fixed Asset Growth
5. Cash and Short-Term Investments as % of
Cash Operating Costs and Construction Costs
6. Debt/Equity Ratio

BALANCE SHEET SCHEDULEAnalysis of Working Capital and Changes

	Year 1	Year 2	Year 3
	Amount	Change +	Amount
		(-)	Change +
			(-)
	Amount		Change +
			(-)
<u>CURRENT ASSETS</u>			
Inventories			
Accounts Receivable (Analysed)			
Investments Short-Term			
Cash			
Other			

Sub-Total	_____		
<u>CURRENT LIABILITIES</u>			
Accounts Payable			
Deposits Consumer			
Deposits Contractor			
Deposits Work			

Sub-Total	_____		
<u>INDICATORS</u>			
1. Accounts Payable Operations/ Cash Operating Expenses			
2. Accounts Payable Construction/ Construction Program			
3. Accounts Receivable to Total Revenues Analysed			

