

Economic Evaluation of Projects

A critical comparison of the new World Bank Methodology with the UNIDO Guidelines and the revised Little-Mirrlees approach

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1. The Re-opening of Discussion about Project Evaluation

In the early seventies the discussion about evaluation methodology for development projects seemed to have come to an end. Following Hirschman's retrospective "Development Projects Observed" (1967)¹⁾, Little and Mirrlees made an attempt to formulate the OECD "Manual of Industrial Project Analysis" (1969)²⁾ which on account of its limited practicability failed to win general acceptance³⁾ and was one of the reasons for the publication of the "UNIDO Guidelines of Project Evaluation" (1972)⁴⁾, the latter being written with a knowledge of the real situation in developing countries and basically a book for practical use. In addition, especially the works by Kulp (1970), Solomon (1970), Mishan (1971), Gittinger (1972) and Musto (1972) have to be mentioned⁵⁾. Surprisingly the discussion has revived. Following the revised

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- 1) *A.O. Hirschman*, Development Projects Observed, Washington, D.C. 1967.
- 2) *I.M.D. Little, J.A. Mirrlees*, Manual of Industrial Project Analysis in Developing Countries, Vol. II: Social Cost Benefit Analysis, OECD, Paris 1969 (subsequently quoted as LM I).
- 3) See in particular: Symposium on the Little-Mirrlees Manual of Industrial Project Analysis in Developing Countries, Bulletin of the Oxford University Institute of Economics and Statistics, Vol. 34 (1972). *W. Hammel, H.-R. Hemmer*, Grundlagen der Cost-Benefit Analyse bei Projekten in Entwicklungsländern, Kreditanstalt für Wiederaufbau, Frankfurt 1970.
- 4) *P. Dasgupta, S. Marglin, A. Sen*, Guidelines for Project Evaluation, UNIDO, New York 1972 (subsequently quoted as UNIDO).
- 5) *E.M. Kulp*, Rural Development Planning, Systems Analysis and Working Method, New York, Washington, London 1970. *M.J. Solomon*, Analysis of Projects for Economic Growth, New York, Washington, London 1970. *E.J. Mishan*, Cost-Benefit Analysis, London 1971. *J.P. Gittinger*, Economic Analysis of Agricultural

version of the OECD Manual by Little and Mirrlees (1974)⁶⁾, new method approaches were being developed last year within the World Bank⁷⁾. At the root of this were increasing needs for more differentiated and at the same time more standardized tools for project evaluation, especially with regard to distribution effects on the poorest three fifths of the populations, who by twenty years of development strategies and aid policies have hardly being affected.⁸⁾

The following reflections will concentrate on these new approaches in the *World Bank* by Bruce, Van der Tak and Squire (1975) - subsequently denoted as BTS, the revised *OECD* approach by Little/Mirrlees (1974) - subsequently denoted as LM II, and the *UNIDO* Guidelines by Dasgupta, Marglin and Sen - subsequently denoted as UNIDO. After a comparison of the underlying three theoretical concepts, their practical implications will be demonstrated in a case study, a dam project in Nepal. The paper will conclude with a critique of the three approaches from the viewpoint of the sophisticated practitioner.

2. Three Theoretical Approaches to Evaluation Compared: UNIDO, LM II, and BTS

All three approaches have cost-benefit analysis as their methodological base.⁹⁾ Benefits are usually defined in terms of their effects on the objectives, and costs in terms of the benefits foregone of an alternative, second-best use of resources, i. e. as the opportunity costs with regard to the objectives. The crucial

Projects, IBRD, Baltimore, London 1972. S.A. Musto, Evaluierung sozialer Entwicklungsprojekte, GDI Berlin 1972.

- 6) I.M.D. Little, J.A. Mirrlees, Project Appraisal and Planning for Developing Countries, London 1974 (subsequently quoted as LM II).
- 7) C. Bruce, Social Cost-Benefit Analysis: A Guide for Country and Economists to the Derivation and Application of Social Accounting Prices, World Bank Staff Working Paper No. 239, Washington D.C. 1976. H. van der Tak, L. Squire, Economic Analysis of Projects, IBRD, Baltimore, London 1975.
- 8) Cf. inter alia: I. Adelman, C.T. Morris, Economic Growth and Social Equity in Developing Countries, Stanford 1973. J.H. Adler, Entwicklung und Einkommensverteilung, Finanzierung und Entwicklung, No.3 (1973), pp. 2. Eörgens, Zur These der Beeinträchtigung des Wirtschaftswachstums in unterentwickelten Ländern durch Entwicklungshilfe, Konjunkturpolitik, Vol. 21 (1975), p. 201. World Bank Atlas 1974, Washington D.C. 1974, p. 6.
- 9) See the critique by H. Schuster, Der soziale Überschuß und das Problem der externen Renteneffekte, Zeitschrift für Nationalökonomie, (1972), p. 258. H. Schuster, Der soziale Überschuß als Kriterium wirtschaftspolitischer Maßnahmen im mikroökonomischen Bereich, Schmollers Jahrbuch (1970), p. 131.

question of each evaluation is: evaluation with regard to which objectives and whose objectives? Complex political power structures have necessarily multidimensional and potentially conflicting goals. This reflects the unsolved and, given the existing power structures, often unsolvable opposition of interests. This situation certainly is seen in the three approaches. Nonetheless, at the same time, the range of objectives is reduced to only a *single* scale of evaluation, in all three approaches, i.e. the so-called numéraire, and all aspects of evaluation are referred to and are expressed only in terms of this numéraire.

In the *UNIDO approach*, aggregate consumption is taken as the objective, and consequently as the criterion for evaluation. Aggregate consumption is defined as the amount of all goods and services made additionally available through a project (being denoted in what follows simply as "goods"), i.e. the net-output, which is discounted at current values.¹¹⁾ On the other hand, the *LM II* approach takes for its scale of evaluation the "uncommitted government income measured in terms of foreign exchange", as converted into internal currency at the official exchange rate and discounted at current values,¹²⁾ mainly for the sake of national investment programmes. This is based on two premises: firstly that on an optimal factor allocation via the world market, from which comes the demand of LM for evaluating inputs and outputs as far as is possible at world market prices, because they reflect the 'correct' opportunity

10) With regard to the discussion on the definition of costs and benefits, and the problem of the "second-best alternative" see *D. Weiss*, *Kosten-Nutzen-Analyse, Programmbudget und die Rationalisierung öffentlicher Investitionsentscheidungen*, *Zeitschrift für Wirtschaft und Sozialwissenschaft*, Vol. 93(1973), pp. 79-82.

11) The authors admit that "aggregate consumption is an inherently slippery concept" (*UNIDO*, p. 39). "The basic problem involved in calculating the aggregate consumption benefits of a project is to measure the consumers "willingness to pay" for the net output" of the project, we mean the goods and services made available to the economy that would not have been available in the absence of the project"; *ibid.*, pp. 40-41. with regard to the consumption benefits of producer goods the authors elaborate: "The ultimate increase in consumption made possible by the increased availability of the producer good may be stages of production removed from the project output, and this tends to make the problem of measurement more complex... The value of the steel from the point of view of the aggregate-consumption objective is the final consumers' willingness to pay for all the ultimate consumption attributable for the steel"; *ibid.*, pp. 45-46. With regard to the theoretical problems involved, see pp. 39. f. In their case studies, the authors simply use market prices; *ibid.*, p. 263.

12) See *LM II*, p. 72. The definition is not operational, cf. *LM II*, pp. 145-151. in particular the authors remain vague with regard to the real meaning of the term "uncommitted" and its empirical measurement.

costs¹³⁾; and secondly the premise that the rate of investment in most developing countries is too low and must be raised via the formulation of corresponding criteria for selecting projects. As higher taxation meets political-administrative resistance, a higher rate of investment must be attained by favouring projects with relatively high re-investible surpluses, and by disfavouring those with relatively high employment effects and thereby with relatively high consumption effects.

The *BTS approach* adopts the same criterion: "uncommitted public income measured in terms of convertible currency"¹⁴⁾ as converted into local currency at the official exchange rate, and discounted at current values.

The evaluation of costs and benefits in all three approaches is based on shadow prices. Shadow prices are social accounting prices reflecting the interaction of the policy objectives and the resource availabilities. It may be an objective to restrain consumption in favour of higher investment. As regards the resources, real scarcities should be taken into account, i.e. the social opportunity costs represented by the foregone benefit of the best available alternative that needs to be sacrificed which through imperfect market mechanisms, will not be reflected correctly in market prices. A social accounting system of this kind shall lead, within the calculation framework of cost-benefit analysis, to corresponding evaluation results for competing projects.

The basic significance of the numéraire in the three approaches becomes clear when looking more closely at their shadow price systems. The three most important shadow prices are those for unskilled labour, capital, and foreign exchange, for it is here that social opportunity costs normally deviate most from market prices. In what follows, the basic structure of the three shadow price systems will be treated in a strongly summarized form, firstly that of the UNIDO approach, then that of the LM II and BTS approaches.

2.1. The UNIDO Approach

2.1.1. Shadow Price of Investment

UNIDO gives the following definition: "The shadow price of investment is

13) See the critical comments by V. Joshi, *The Rationale and Relevance of the Little-Mirrless Criterion*, Symposium on the Little-Mirrless Manual, op. cit., p.

14. H. Joshi, *World Prices as Shadow Prices: A Critique*, ibid., pp. 53. F. Stewart, P. Streeten, *Little-Mirrless Methods and Project Appraisal*, ibid., p. 81.

14) H. van der Tak, L. Squire, op. cit., a. 67. Similar to LM II, however, it remains unclear how in practice it can be identified whether or not "the public income generated by a particular project may be earmarked" (i.e. "uncommitted"), especially if the public sector profits flow back into the public budget. C. Bruce (op. cit., pp. 2-4) therefore simplifies the expression for the numéraire into 'government income'.

the present value of the additional consumption that a unit of investment would generate¹⁵⁾. In the simplest case (2)¹⁶⁾, the investment funds come from a *single* sacrifice of consumption for the sake of the project with the size of investment K_0 in year t_0 . Then, according to equation (U1), in which "U" signifies UNIDO, the net return B is the summed up stream of returns B_t , discounted at current values, less the sacrificed consumption K_0 .

$$B = \sum_{t=1}^{\infty} \frac{B_t}{(1+i)^t} - K_0 \quad (\text{U1})$$

Case (b) is more realistic, where part of the investment funds for a project must be supplied by sacrificing alternative investments, and thus by doing without the entailed consumption returns¹⁷⁾.

In equation (U2), the expression K_0 of equation (U1) is thus replaced by the stream of returns qK_0 , where q signifies the marginal productivity of capital. Summed up and discounted, this gives $\frac{q}{i} K_0$. Thus $\frac{q}{i} = p^{inv}$ is the shadow price of investment according to the assumptions of case (b).

$$\sum_{t=1}^{\infty} \frac{qK_0}{(1+i)^t} = \frac{q}{i} K_0; \text{ where } \frac{q}{i} = p^{inv} \quad (\text{U2})$$

Thus from equation (U2) we arrive at equation (U3), in which the second term K_0 is made up for by $p^{inv} K_0$.

$$B = \sum_{t=1}^{\infty} \frac{B_t}{(1+i)^t} - p^{inv} K_0 \quad (\text{U3})$$

Case (c) introduces the splitting of the stream of returns q into a consumed part $(1-s)q$ and a saved and reinvested part sq ¹⁸⁾; s being the marginal rate of savings. Then the annual value of consumption B_t is made up by the share which is actually consumed plus the consumption value of the reinvested part sq , i.e. $p^{inv}sq$, where p^{inv} is by definition the consumption value of investments (cf. equation (U4)).

$$B_t = (1-s)p + p^{inv}sq \quad (\text{U4})$$

As the shadow price of investment p^{inv} equals by definition the discounted consumption returns this gives for p^{inv} the expression of equation (U4), but summed up and discounted. Thus, we obtain the discounted expression of equation (U5); in the numerator being the non-saved, immediately consumed stream of returns, and in the denominator an expression which can be thought

15) UNIDO, p. 150.

16) Ibid, p. 173.

17) Ibid, pp. 174-175.

18) UNIDO, pp. 175-179

of as an artificial rate of discount¹⁹⁾ i.e. the social rate of discount i less a correction for the reinvestment sq .

$$\begin{aligned}
 p^{inv} &= \sum_{t=1}^{\infty} \frac{(1-s)q + p^{inv} sq}{(1+i)^t} \\
 &= \frac{(1-s)q + p^{inv} sq}{i} \\
 &= \frac{(1-s)q}{i - sq} \quad (U5)
 \end{aligned}$$

Summary of the symbols used:

B = total consumption stream from an investment

B_t = additional consumption from an investment in year t

K_0 = investment in year t_0

i = social rate of discount

q = marginal productivity of capital

s = marginal rate of savings

p^{inv} = shadow price of investment

2.1.2. Shadow Price of Foreign Exchange

As a rule, the currencies of developing countries are overvalued. The real price of foreign exchange lies consequently above the official rate of exchange lies consequently above the official rate of exchange. Equation (U6) defines the shadow price for foreign exchange as the relation of the internal price P_i^D to the world-market prices p_i^{cif} and p_i^{fob} for imported or exported goods, weighted with the shares f_i and x_i of the respective goods in the country's foreign trade, and summed up for all import and export goods²⁰⁾.

$$P_U^F = \sum_{i=1}^n f_i \frac{p_i^D}{p_i^{cif}} + \sum_{i=n+1}^{n+h} x_i \frac{p_i^D}{p_i^{fob}} \quad (U6)$$

where

P_U^F = shadow price for foreign exchange in the UNIDO approach

P_i^D = domestic price

p_i^{fob} = export price

p_i^{cif} = import price

$\sum_{i=1}^n f_i$ = share of import goods in external trade

19) Ibid., p. 177.

20) UNIDO, pp. 213-220.

$$\sum_{i=n+1}^{n+h} x_i = \text{share of export goods in external trade}$$

$$\sum_{i=1}^n f_i + \sum_{i=n+1}^{n+h} x_i = 1$$

2.1.3. Shadow Price of Unskilled Labour

According to the UNIDO approach, the shadow price depends on two factors: " (1) the output forgone by moving workers from their previous employment to public-sector jobs and (2) the shift in the composition of output from investment to consumption by the expansion of public-sector employment"²¹⁾. The definition covers two elements, firstly the output forgone from previous employment i.e. the marginal product of labour, which mostly lies far below market wages when labour is withdrawn from traditional agriculture. The marginal product should nonetheless not without further consideration be taken as equal to zero, as is done frequently in economic theory. Secondly, there is taken into account the shift in the use of output from investment to consumption as a result of increased employment assuming that wages are almost fully consumed. This shift tends to reduce investment and thus, in accordance with section 2.1.1. the future consumption stream from the investment, namely to the extent of the amount of investment foregone multiplied by the consumption value of investment p^{inv} .

These considerations are all brought together in equation (U7). The shadow wage stems firstly from the opportunity costs of unskilled labour and secondly from the change in the use of output from investment to consumption. UNIDO, with much simplification of the problem, assumes that public sector employment programmes are financed by taxation of capital owners. These in turn, consume and invest in the ratio of $(1-s^F)$ to s^F . Now, however, on account of taxation to the amount of wages w , their consumption and investment must lessen. Thus, in the second expression of equation (U7) for the changed use of output, we have three elements:

UNIDO

1. Shadow Price of Investment

Def.: "The shadow price of investment is the present value of the additional consumption that a unit of investment would generate".

21) UNIDO, p. 152.

a) Investment funds from a single sacrifice of consumption KK_0 at t_0 :

$$B = \sum_{t=1}^{\infty} \frac{B_t}{(1+i)^t} - K_0 \quad (U1)$$

b) Investment funds from a sacrifice of alternative projects (=consumption forgone from alternative later benefits): in stead of K_0 .

$$\text{we can write } \sum_{t=1}^{\infty} \frac{qK_0}{(1+i)^t} = \frac{q}{i} K_0 : P^{inv} = \frac{q}{i} \quad (U2)$$

$$B = \sum_{t=1}^{\infty} \frac{B_t}{(1+i)^t} - P^{inv} K_0 \quad (U3)$$

c) If a fraction sq is reinvested, the annual consumption value of an investment of 1 is

$$B_t = (1-s)q + P^{inv}sq \quad (U4)$$

Since the shadow price P^{inv} is equal by definition to the present value of the entire stream of consumption, it follows that

$$\begin{aligned} P^{inv} &= \sum_{t=1}^{\infty} \frac{(1-s)q + P^{inv}sq}{(1+i)^t} = \frac{(1-s)q + P^{inv}sq}{i} \\ &= \frac{(1-s)q}{i-sq} \end{aligned} \quad (U5)$$

where

B = total consumption stream from an investment

B_t = additional consumption from an investment in year t

K_0 = investment in year t_0

i = social rate of discount

q = marginal productivity of capital

s = marginal rate of savings

P^{inv} = shadow price of investment

II. Shadow Price of Foreign Exchange

The shadow price of foreign exchange is

$$P^{fu} = \sum_{i=1}^n f_i \frac{P_i^D}{P_i^{cif}} + \sum_{i=n+1}^{n+h} x_i \frac{P_i^D}{P_i^{fob}} \quad (U6)$$

where P^D = domestic price, P^{fob} = export price, P^{cif} = import price, the shares of export and import goods $i \dots n \dots h$ adding up to 100%.

III. Shadow Price of Unskilled Labour

Def.: "The shadow wage depends on two factors: (1) the output forgone

by moving workers from their previous employment to public-sector jobs and (2) the shift in the composition of output from investment to consumption by the expansion of public-sector employment."

$$SWR_U = m + [(1 - S^K)w + S^K P^{inv}w - w] \quad (U7)$$

consump-	consump-	consump-
tion	tion	tion owing
forgone	forgone	to expansion
of capi-	from	of employment
tal own-	in invest-	
ers	ment	

where

m = opportunity costs of unskilled labour

w = market wage

P^{inv} = shadow price of investment (cf. U S)

s^K = rate of savings of tax-payers (much simplified: the investing capital owners K)

The first expression m is the direct output forgone. The three last terms of (U7) are the indirect effects according to the above definition which simplifies to

$$SWR_U = m + s^K (P^{inv} - 1)w \quad (U8)$$

IV. Discounting

Discounting is done with the social rate of discount i , which is interpreted as a political value judgement.

LM II

I. Shadow Price of Investment

Def.: s_o = "present value of a unit of investment relative to one current consumption generated by industrial employment".

$$s_o = \frac{1}{1+i_1} (c_1 - m_1) n_1$$

$$+ \frac{1+r_1}{(1+i_1)(1+i_2)} (c_2 - m_2) n_2$$

$$+ \frac{(1+r_1)(1+r_2)}{(1+i_1)(1+i_2)(1+i_3)} (c_3 - m_3) n_3 \quad (L1)$$

where

r_i = rate of return on public investment, fully reinvested

i_i = social rate of discount

c_i = consumption per employee

m_i = marginal productivity of labour in traditional agriculture

n_i = number of newly employed unskilled labour forces

Taking $(c-m)n$, r and i as constant and $i > r$, it follows that

$$\begin{aligned} s_o &= \frac{1}{1+h} (c-m)n + \frac{1+r}{(1+i)^2} (c-m)n + \frac{(1+r)^2}{(1+i)^3} (c-m)n + \dots \\ &= \frac{1}{1+i} \left[1 - \frac{1+r}{1+i} \right]^{-1} (c-m)n = \frac{(c-m)n}{i-r} \end{aligned} \quad (L2)$$

II. Shadow Price of Foreign Exchange

The greatest possible avoidance of a shadow exchange rate, in stead of which the inputs "non-traded goods" shall be split up into their input shares of traded goods and unskilled labour, the former being evaluated at border prices and the latter at the shadow price of unskilled labour.

III. Shadow Price of Unskilled Labour

Def. to (L3): "The first term is the marginal product of labour: the second is the cost which is associated with providing the consumption level w but does not form part of that consumption level (transport costs from country to town, and urban overheads): and the last term is the cost of having an extra amount $w-m$ committed to consumption (since 1 is the value of a unit of resources uncommitted, and $1/s_o$ the value when committed)".

$$SWR_L = m + (c' - w) + \left(1 - \frac{1}{s_o}\right) (w - m) \quad (L3)$$

where

m = opportunity costs of unskilled labour

w = market wage

s_o = value of investment, expressed in value of consumption (see def. to (L1))

$1/s_o$ = value of consumption, expressed in value of investment, i.e. LM II's evaluation criterion

c' = w plus additional transport and urbanization costs

In abbreviated form:

$$SWR_L = c' - \frac{1}{s_o} (w - m) \quad (L4)$$

i.e. the total consumption c is counted as costs, as in LM II a loss of public investment funds. Nonetheless minus a share of the additional consumption of the labour forces come from traditional agriculture, which consumption is viewed as desirable (trade-off between urgent investment needs and a rise in

consumption which is not valued as wholly negative.

N. Discounting

Discounting is done with the Accounting Rate of Interest (ARI), which has the nature of a target rate of return.

Def.: "The proper discount rate to use (the ARI) is the expected rate of fall, as seen from the present, of the value of the numéraire...The ARI also acts as a cut off, rationing the amount of investment to the funds available... The best guide to the proper choice of the ARI is experience. If more projects look acceptable, than there are investible funds available, the ARI should be adjusted upwards; and if too little looks promising, the adjustment should go the other way. In the case of this accounting price, as with most others, such adjustment should be done gradually: the ARI is supposed to reflect long-run possibilities, not to achieve a perfect investment/savings balance week by week".

BTS

I. Shadow Price of investment

Def.: "The social value of private consumption ω is the value of a marginal increase in private consumption (measured at domestic prices) in terms of the value of public income (measured at border prices)".

$$\omega = \frac{w(c)}{w(g)} = \frac{d}{v} \quad (B1)$$

$$\text{where } d = \frac{w(c)}{w(\bar{c})} = \left[\frac{\bar{c}}{c} \right]^\eta \text{ distribution parameter} \quad (B2)$$

$$v = w(g)/w(\bar{c}) \quad \text{valuation of public income vs. consumption}$$

where

$w(c)$ = value of a unit of private consumption c

$w(\bar{c})$ = value of a unit of consumption at the average consumption level \bar{c}

$w(g)$ = value of public income

η = elasticity of marginal utility of consumption with regard to changes in per capita consumption

when a unit of public income is invested and a return q is produced, it follows that

$$v = \sum_{i=0}^{\infty} \frac{q}{(1+i)^i \beta} = \frac{q}{i\beta} \quad (B3)$$

which can be interpreted as a shadow price of public investment, where β is the conversion factor (border prices: domestic prices):

$$\beta = \frac{M+X}{M(1+t_m) + (X(1-t_x))} \quad (B4)$$

in which M =imports, X =exports, t_m and t_x corresponding import and export duties.

II. Shadow price of Foreign Exchange

Conversion factors in the generalization of (B4) i.e. official exchange rate. What are sought for are specific conversion factors for single groups of goods with typically different input shares with regard to traded goods.

III. Shadow Price of Unskilled Labour

Similar to LM II:

$$SWR_B = m\alpha + \left(\beta - \frac{w(c)}{w(g)}\right)(w-m) \quad (B5)$$

where

m = opportunity costs of unskilled labour

w = market wage

β = conversion factor "border prices to domestic prices" (see (B4)) for consumption goods

$\frac{w(c)}{w(g)}$ = value of consumption against the value of public income, corresponds to $1/s_o$ in LM II (L3)

α = conversion factor for output forgone, evaluated at shadow prices (approx. $=\beta$)

As in the LM II approach, the shadow wage consists of output forgone and additional consumption, though minus a part of additional consumption which is seen as desirable: $(w-m)[w(c)/w(g)]$

IV. Discounting

Discounting is done with the Accounting Rate of Interest (ARI)

$$ARI = CRI + \Delta V \quad (B6)$$

where

$$CRI = \eta g + e \quad (B7)$$

or defined as

$$ARI = sq + (1-s) \frac{q}{v\beta} \quad (B8)$$

where

g = growth rate of average per capita consumption

ρ = rate of pure time preference

η = elasticity of marginal utility of consumption

Def. "The purpose of ARI is to allocate public investment funds among

competing uses in the socially desirable way. The ARI can therefore be regarded as a budgetary weapon. If the ARI is set too high initially, too few projects will pass the test of having a positive NPV (net present value, author): if it is set too low, too many projects will have a positive NPV. It follows that the ARI is the internal social rate of return on the marginal project in the public sector."

- a) The loss in consumption of capital owners $(1-s^k)w$
- b) The drop in investment of capital owners $s^k p^{inv} w$, where multiplication with p^{inv} gives the consumption stream foregone from this loss in investment
- c) The opposing factor of *growth* in consumption, owing to fresh employment, to the level of this wage bill $w^{22)}$

$$SWR_v = m + [(1-s^k)w + s^k p^{inv} w - w] \quad (U7)$$

i.e. the three elements give the total net consumption loss owing to the shift of output from investment to consumption. Equation (U7) thus describes the overall direct and indirect loss of consumption arising from the withdrawal of labour from traditional sectors and their employment in the modern ones. Since rise in consumption is the evaluation criterion in the UNIDO approach, loss of consumption is put down as a cost factor. In condensed form, we have equation (U8).

$$SWR_v = m + s^k (p^{inv} - 1)w \quad (U8)$$

where

- SWR_v = shadow price of unskilled labour in the UNIDO approach
- m = opportunity costs of unskilled labour
- w = market wage
- p^{inv} = shadow price of investment (cf. U5)
- s^k = rate of savings of tax-payers (much simplified: the investing capital owners K)

2.2. The LM II Approach

2.2.1. Shadow Price of Investment

The evaluation criterion of the LM II approach is the foreign exchange in the hands of the government with the aim of increasing the public investment budget. What is thus of interest is not the value of investment expressed in terms of the consumption stream thereby attainable as in the UNIDO approach, but the value of consumption in terms of investment, i.e. the cost of consumption with regard to the related loss in available investment funds²³⁾.

22) Cf. *UNIDO*, pp. 201-212.

23) Cf. *P. Dasgupta*, A Comparative Analysis of the UNIDO Guidelines and the

The definition s_o in equation (L1), where L stands for the LM II approach, corresponds roughly to that for the shadow price of investment given in the UNIDO approach: "The present value of a unit of investment relative to the current consumption generated by industrial employment, a ratio which we shall call s_o , is given by the following tedious, but essentially simple, expression"²⁴⁾.

$$\begin{aligned}
 s_o = & \frac{1}{1+i_1} (c_1 - m_1) n_1 \\
 & + \frac{1+r_1}{(1+i_1)(1+i_2)} (c_2 - m_2) n_2 \\
 & + \frac{(1+r_1)(1+r_2)}{(1+i_1)(1+i_2)(1+i_3)} (c_3 - m_3) n_3 \\
 & + \dots
 \end{aligned} \tag{L1}$$

where

r_i = returns from a public investment, all of which are assumed to be re-invested²⁵⁾

i_i = social rate of discount²⁶⁾

c_i = consumption per wage-earner, arising out of wage-payments

mt = marginal productivity of the unskilled labour in agriculture

n_i = number of newly employed unskilled workers

s_o is thus equivalent to a unit of investment relative to the consumption generated by employment effects, likewise discounted at present value. The stream of returns r from the public investment, which is assumed to be fully reinvested, corresponds to the expression sq in equation (U5). $(c-m)$ is the additional consumption per capita in excess of the earlier marginal productivity of labour in the traditional sector, and is multiplied by the number of employed. If one assumes in extreme simplification that $(c-m)$, i , r and $(i-r)$ are constant over time, and also that $i > r$ ²⁷⁾, the expression for s_o in the LM II approach may now be written in the same way as the shadow price of investment in the UNIDO approach (cf. U5), s_o is not, in the LM II approach, used as the shadow price of investment, but as an element for formulating the

OECD Manual, Symposium on the Little-Mirrlees Manual, op. cit., p.42. LM II, p. 358.

24) Ibid, p. 252.

25) See, on the problems connected with this factor LM II, pp. 250-254.

26) Understood as "consumption rate of interest, which we define specifically as the rate at which the social value of employment-generated consumption declines": ibid, p. 251.

27) See on the questionable nature of these assumptions, but at the same time the difficulty of making statements without them, LM II, pp 252-254.

shadow price of unskilled labour.

$$\begin{aligned}
 s_0 &= \frac{1}{1+i} (c-m)^n + \frac{1+r}{(1+i)^2} (c-m)^n + \frac{(1+r)^2}{(1+i)^3} (c-m)^n + \dots \\
 &= \frac{1}{1+i} \left[1 - \frac{1+r}{1+i} \right]^{-1} (c-m)^n \\
 &= \frac{(c-m)^n}{i-r} \quad (L2)
 \end{aligned}$$

2.2.2. Shadow Price of Foreign Exchange

The problem of valuation of foreign exchange poses itself in LM II in a different form to in UNIDO, as free foreign exchange of the evaluation of LM II. Generally the prices of all goods are, as far as possible, expressed in world market prices²⁸⁾. Goods are split up into three groups:

- a) Socalled "traded" goods, which are evaluated in terms of c.i.f. or f.o. b. prices²⁹⁾
- b) Socalled "non-traded" goods³⁰⁾, e.g. goods with high transport cost, most of construction work, transport services, and electrical energy. These groups of good are evaluated in terms of their marginal social cost or their marginal social benefit or an average of both³¹⁾.
- c) Unskilled labour, which is evaluated with the shadow price of unskilled labour.

28) *LM II*, p. 68, argues for this as follows: "If a country produces and trades to its own best to its own best advantage, then the relative internal prices of traded goods (near a port) will be equal to the relative border prices. Consequently border prices can be used as accounting prices for all traded goods, because they represent the correct social opportunity costs or benefits of using or producing a traded good". For critical comments on this see: V. Joshi, op. cit., H. Joshi, op. cit., F. Stewart; P. Streeten, op. cit.

29) If the world market supply and demand curves are not perfectly elastic, it is suggested that marginal import cost or marginal export revenue should be used in place of the c.i.f. or f.o.b. prices: *LM II*, op. cit., pp. 68 and 158 et seq. A correction is made for the transport and trade cost between harbour and inland site. Ibid. pp. 157 and 208.

30) The authors admit that in practice a sharp distinction cannot be made between traded and non-traded goods. Some goods are partly traded and partly non-traded. For reasons of practicability and time-saving, they suggest that all goods which are partly traded, i.e. exported or imported, should be taken as traded, and all the remaining goods as non-traded. Ibid., pp. 154-155.

31) See for details *LM II*, p. 162 et seq. The authors reveal a considerable neglect of practical evaluation problems, as for example on p. 167, first paragraph. See also D. Lal, *Methods of Project Analysis: A Review*, Baltimore, London 1974, p. 3 et seq. A clarifying contribution to this field has been made by W. Voss, *Praktischer Leitfaden zur volkswirtschaftlichen Bewertung von Inputs und Outputs im Rahmen der Cost-Benefit-Analyse*, Kreditanstalt für Wiederaufbau, Frankfurt 1973.

The group of non-traded goods shall be split up into its inputs of traded goods and unskilled labour; and inputs of non-traded goods shall be likewise further split up so that finally each good can be broken down into its traded goods and unskilled labour components³²⁾. The use of conversion factors specific to each group of goods is suggested for shortening the procedure, e.g. for construction work, electrical energy, and transport services³³⁾. Where even this procedure is much too troublesome, the authors bring forward an average "standard conversion factor": the relation of world market prices to domestic prices³⁴⁾, which corresponds to the reciprocal value of the shadow prices of foreign exchange in the UNIDO approach (equation U6). The multiplication of the market price of a non-traded good with the relevant conversion factor gives the (generally lower) accounting price.

The authors stress that the simplified procedure of using the standard conversion factor, i.e. the reciprocal value of the shadow exchange rate, should be avoided as far as can be³⁵⁾. What is wanted is an exact as possible direct splitting up of the inputs of non-traded goods into their inputs of traded goods, calculated at world market prices, and of unskilled labour, calculated at the shadow price of unskilled work.

2.2.3. Shadow Price of Unskilled Labour

The shadow price of unskilled labour according to LM II is arrived at from similar considerations, as to its opportunity costs in the traditional sector and the importance of getting a rise in the investment rate by means of choosing the right projects as in UNIDO. But since the evaluation criterion is free foreign exchange and not consumption, as in UNIDO, rises in consumption owing to employment effects are basically viewed as *cost*, with the exception of a particular share $\frac{1}{s_o}$, to which a *positive* value is given.

$$SWR_L = m + (c' - w) + \left(1 - \frac{1}{s_o}\right)(w - m) \quad (L3)$$

where

32) LM II, pp. 70-71.

33) For example, the conversion factor for construction work was worked according to the proposal of the authors by analyzing a fairly representative construction project as follows: raw materials, converted to accounting prices; labour costs, measured at the shadow wage rate, etc. The sum of these items is an estimate of the *social* construction work, is divided by construction costs at market prices, the result being the conversion factor for construction work. Ibid., p. 214.

34) See for details., p. 218.

35) Ibid.

SWR_L = shadow price of unskilled labour in the LM II approach

m = opportunity cost of unskilled labour

w = market wage

s_o = value of investment, expressed in the value of consumption made possible through its employment effects (cf. L1)

$\frac{1}{s_o}$ = value of consumption, expressed in the value of investment (i.e. the evaluation criterion of value of LM II)³⁶⁾

c' = w plus additional transport and urbanization costs of transferring the work forces from the traditional sector to modern employment³⁷⁾

Equation (L3) signifies that costs are firstly the opportunity costs m , secondly the transport and urbanization costs $(c' - w)$, and thirdly the excess consumption $(w - m)$, minus the share $(w - m) \frac{1}{s_o}$. s_o was the value of investment, expressed in the consumption stream made possible by it (cf. equation L1). The reciprocal value $\frac{1}{s_o}$ gives consequently the value of consumption in terms of investments forgone.

In summarized notation, this gives equation (L4): in the shadow wage are included all elements of consumption (c'), minus the share $\frac{1}{s_o}$ of the additional consumption $(c - m)$ of the labour force transferred from traditional agriculture which is viewed as wholly negative by the policy-makers.

$$SWR_L = c' - \frac{1}{s_o}(w - m) \quad (L4)$$

2.2. The BTS Approach

2.3.1. Shadow Price of Investment

The starting is equation (B1). A relation is established between the overall economic value of a marginal rise in consumption $W(c)$ and the overall economic value of foreign exchange earnings of the government $W(g)$ (the evaluation criterion of the BTS approach): "The social value of private consumption is the value of a marginal increase in private consumption (measured at domestic prices) in terms of the value of public income (measured at border prices)"³⁸⁾.

36) What the authors actually mean is not clear from their definition alone: "We use the notation s for the value of uncommitted government income, measured in terms of consumption committed through employment. Consequently, $1/s$ is the social value of a unit of consumption so committed (in terms of the numéraire)". *LM II*, p. 270.

37) c' , c and m are calculated at accounting prices. *Ibid.*, p. 271.

38) *C. Bruce*, op.cit., p. 21. See *H. van der Tak*, *L. Squire*, op. cit., p. 60 et seq.

$$W = \frac{W(c)}{W(\bar{c})} = \frac{d}{v} \quad (\text{B1})$$

where

$W(c)$ = the value of a unit of private consumption

$W(\bar{c})$ = the value of a unit of consumption at the average income \bar{c}

$W(g)$ = the value of public income

$d = W(c)/W(\bar{c})$ = distribution parameter relating to per capita income levels of social groups affected by the project and the average income of the developing country

$v = W(g)/W(\bar{c})$ = valuation of public earnings vs. consumption of social groups at the average income \bar{c} .

For determining ω , there is proposed a procedure in two stages.

- a) The distribution parameter d gives the relation of the welfare levels of population groups at the consumption level c and the average level \bar{c} . This relation can be set as unity if the political leadership has no interest in a more equal distribution of income. It is larger than unity if the output of a project is aiming at benefiting poorer social groups at an income level lower than the average level \bar{c} .

$$d = \frac{W(c)}{W(\bar{c})} = \left[\frac{\bar{c}}{c} \right]^\eta \quad (\text{B2})$$

In equation (B2) η gives the elasticity of the marginal utility of additional consumption, which likewise embodies a political value judgement, and according to the authors of the BTS approach may lie somewhere between 0 and 2³⁹. The significance of η will be clear from the following numerical example. It is taken that the level of average per capita consumption lies at \$200, but that the level of consumption c of a population group supposed to benefit from the project lies only at \$100. It follows that the value of $d = (200/100)^\eta$:

$$\frac{\eta}{d} \left| \begin{array}{cccc} 0 & 0.5 & 1 & 2 \\ 1 & 1.4 & 2 & 4 \end{array} \right.$$

i.e. given a government with no interest in raising the incomes of the poorer groups at the level of \$100, the following political value judgement is implied: $\eta=0$: $d=1$. On the other hand, given a strong concern for income distribution, we may get the value judgement: $\eta=2$: $d=4$. In other words, the additional income effect due to a project for an underprivileged population

39) *H. van der Tak, L. Squire*, op. cit., pp. 63-66. *C. Bruce* Social Cost-Benefit Analysis, op. cit., p. 30. Thus a utility function $U_c = c^{-\eta}$ is assumed, where the marginal utility U_c decreases when the level of consumption grows. Then $d = U_c/U_{\bar{c}} = (\bar{c}/c)^\eta$.

group would be given the weight of 4, as opposed to the weight of 1 where a government's attitude to income distribution is indifferent. The weight increases therefore firstly with the income gap between c and \bar{c} , and secondly with the elasticity of marginal utility η .

- b) ω depends secondly on how public investment funds are valued in relation to rising consumption, i.e. on v which can be interpreted as the shadow price of public investment. v corresponds, as in the UNIDO and LM II approaches, to the current value of the returns q on the investment (cf. equation (U2) with $P^{inv}=q/i$).

$$v = \sum_{i=0}^{\infty} \frac{q}{(1+i)^i \beta} = \frac{q}{i\beta} \quad (\text{B3})$$

β presents an exchange rate correction factor against the price distorting influence of trade restrictions⁴⁰⁾. Equation (B 4) gives the relation of world market prices to domestic prices, of which the latter are normally the higher.

$$\beta = \frac{M+X}{M(1+t_m)+X(1-t_x)} \quad (\text{B4})$$

where

M = c.i.f. value of imports in the marginal consumption bundle

X = f.o.b. value of exports in the marginal consumption bundle

t_m = average tax on imports

t_x = average tax on exports.

Thus the system of weighting factors in the BTS approach is aimed at a standardized and differentiated procedure for choosing projects with regard to fundamental development objectives. A high shadow price of public investment v favours projects with higher government earnings. A heavier stress on distribution goals d favours the choice of projects benefiting the poorer population strata.

2.3.2. Shadow Price of Foreign Exchange

Here, the BTS approach goes in for a more pragmatic and more easily applicable procedure than does the LM II approach. It makes the same breakdown into traded goods and unskilled work, likewise with the aim of evaluating them as far as is possible at world market prices. For the group of non-traded goods, there is however, only *one* breakdown into traded goods and unskilled work proposed, and all remaining stock is converted by means of conversion factors specific to groups of goods, as in equation (B4), or by means of a standard conversion factor (official exchange rate to shadow exchange rate),

40) *H. van der Tak, L. Squire*, op. cit., p. 59, cf. *C. Bruce*, op. cit., p. 11.

to world market price equivalents⁴¹⁾.

2.3.3. Shadow Price of Unskilled Labour

The valuation of unskilled labour in the BTS approach is almost the same as that in the LM II approach (equation (B5))⁴²⁾.

$$SWR_B = m\alpha + \beta - \frac{W(c)}{W(g)}(w - m) \quad (B5)$$

where

m = opportunity costs of unskilled labour evaluated at domestic prices

w = market wage

β = conversion factor (world market prices to domestic prices) for consumption goods in accordance with equation (B4)

α = conversion factor for output forgone for converting from domestic to world market prices (approximately $\alpha = \beta$)

$\frac{W(c)}{W(g)}$ = ratio of the value of consumption to that of public investment,

corresponding to $\frac{1}{s_0}$ in the LM II approach (equation L3).

The first term of equation (B5) again shows the opportunity costs: in the second term, $W(c)/W(g)$ corresponds to the expression $\frac{1}{s_0}$ of the LM II approach. Thus when $\beta=1$, the last term of equation (B5) is equal to the last term of equation (L3).

2.4. The Valuation by the Three Approaches of Future Costs and Benefits

The cost and benefit streams are then in accordance with conventional rules of cost-benefit-analysis to be discounted⁴³⁾ and summed up in one evaluation figure. The discount rate expresses the relative value of cost and benefits as defined in terms of the chosen objective function (and the evaluation criterion derived from it), which occur at different times⁴⁴⁾. In the UNIDO approach, the evaluation criterion is "consumption" and it is discounted with the social discounting rate i (so-called Consumption Rate of Interest, CRI), which gives

41) *H. van der Tak, L. Squire*, op. cit., p. 33 et seq. and p. 93 et seq. See also *C. Bruce*, op. cit., pp. 10-12.

42) *H. van der Tak, L. Squire*, op. cit., p. 29 et seq. and p. 78 et seq. See also *C. Bruce*, op. cit., p. 34.

43) See as critique there of *D. Weiss*, *Infrastrukturplanung, Ziele, Kriterien und Bewertung von Alternativen*, GDI, Berlin 1971, pp. 42-48, 120-123,

44) See for the extensive discussion, *D. Weiss*, *Infrastrukturplanung...*, op. cit., p. 123 et seq. and *G. Kirsch, B. Rürup*, *Die Notwendigkeit einer empirischen Theorie der Diskontierung in der Kosten-Nutzen-Analyse öffentlicher Projekte*, *Zeitschrift für die gesamte Staatswissenschaft*, Vol. 127, 1971, p. 432 et seq.

the present as opposed to future social valuation of consumption and is understood as a political value judgement⁴⁵: whereby it is evident that the political process is not able to express this value judgement explicitly and quantitatively. Thus the UNIDO approach proposes that this political value judgement should be arrived at through a dialogue between project planners and political decision-makers over alternative cost-benefit calculations using different discounting rates, i.e. over the choices made by political decision-makers when faced by actual project decisions ("bottom-up procedure").

In the LM II and the BTS approaches, the evaluation criterion is foreign exchange earnings of the government. This poses the problem of formulating a discounting rate for the valuation of future as against present government income, the so-called Accounting Rate of Interest (ARI). According to the notion of the authors, this can be seen as a function, firstly of the Consumption Rate of Interest ($CRI=i$, i.e. the social discounting rate for future consumer benefits, which in the UNIDO approach is taken as the only discounting rate) in so far as government consumption is concerned, secondly of possible changes in the valuation of government income as against private consumption, and thirdly of opportunity costs of capital in so far as the government invests. According to the BTS approach, the ARI should be estimated through the following equation⁴⁶.

$$ARI = CRI + \Delta V \quad (B6)$$

with

$$CRI = \eta g + \rho \quad (B7)$$

and

η = elasticity of the marginal utility of consumption with regard to changes in per capita income

g = growth rate of average per capita consumption

ρ = rate of pure time preference⁴⁷.

Both equations entail massive value judgements both with regard to their elements and to the form of their mathematical relations⁴⁸ (the latter being unconsidered by the authors). In the numerical examples given by the World

45) UNIDO, pp. 164-172, 248 et seq.

46) C. Bruce, op. cit., pp. 37-38. LM II, p. 283 et seq., and pp. 291-297.

47) In the LM II approach, this parameter does not occur; the CRI being defined as $CRI = \eta g$, ibid., p. 266.

48) See for the implicit value judgements in the choice of mathematical formulations K.J. Arrow, Social Choice and Individual Values, New York, London, Sydney, 1963, pp. 4-5. This point will be taken up again in the concluding critique of the approaches.

Bank authors, the following values are used: $\eta=1$ to 2; $s=0$ to 3 per cent⁴⁹⁾.

The second term in equation (B6) shows the possible changes in valuation of government income as against private consumption in the course of time⁵⁰⁾, cf. (B1). The usefulness of equation (B6) is, inter alia, obviously limited by the difficulty of estimating Δv (to the problems of determining the CRI we have already referred). This difficulty leads the authors to an alternative method for determining the ARI: "A more promising approach hinges upon the purpose of the ARI, which is to allocate public investment funds to their socially most desirable uses. If the ARI is set too low, demand for public investment resources will exceed supply, since too many projects will have a positive net present value. If the ARI is set too high, too few projects will pass the test of a positive net present value, and there will be an excess supply of public investment funds. In principle, the ARI should be chosen such that the demand for public investment resources just exhausts the available supply. It follows that the ARI is the internal social rate of return on the marginal project in the public sector"⁵¹⁾.

Thus we have as an alternative equation⁵²⁾

49) *H. van der Tak, L. Squire*, op. cit., p. 70. For example, for $\eta=1$, $g=0.03$, and $s=0.03$, a value for i is given of $1 \times 0.03 + 0.03 = 0.06$.

50) "The parameter Δv is the rate of fall over time in the ratio of the marginal utility of government income to the marginal utility of income in the hands of those at the average level of consumption. If there were no premium on government income (if v were equal to one), income in the hands of the government income (if v were equal to one), income in the hands of the private sector would be equal... The factor Δv will also be equal to zero if the present sub-optimal allocation of resources between the public and private sectors is predicted to continue unchanged into the future". *C. Bruce*, op. cit., pp. 38-39.

51) *H. van der Tak, L. Squire*, op. cit., p. 76.

52) Cf. *H. van der Tak, L. Squire*, op. cit., p. 114: "Another estimate of the ARI can also be derived by recalling that the ARI is that rate of discount which balances the supply of and demand for public investible resources. As such, the ARI should equal the internal social rate of return on the marginally acceptable project. In principle, this can be obtained only by an overall analysis of the investment budget, but, in practice, the following formula might be used as a rough guide to the true value of the ARI: $ARI = q \cdot h$, where h adjusts for the distributional impact of public investment on private sector consumption. We have already discussed q : h may be derived as follows: given that s is the proportion of q that accrues to the public sector (and private sector savings), it follows that $(1-s)q$ units of foreign exchange accrue to private sector consumption. If this increment augments the consumption of those at the average level of consumption, then:

$$h = (1-s)q(1-1/v\beta) \text{ and}$$

$$ARI = sq + (1-s)q/v\beta."$$

C. Bruce (op. cit., p. 41) adds the explanation: "what equation (41) (=B8) does is to break up the marginal product of capital into its private consumption and sa-

$$ARI = sq + (1-s) \frac{q}{v\beta} \quad (B8)$$

where

q = marginal productivity of capital

s = marginal rate of savings

v = valuation of public income vs private consumption, cf. definitions to equation (B1)

β = conversion factor for the conversion of q from domestic to world market prices, cf. equation (B4).

Thus in practice, in the BTS approach, the discounting is dealt with by a target rate of return on public investment. The reflections are an attempt to develop further and to operationalize the concepts of Little and Mirrlees, who developed the idea of discounting by means of the ARI, however, without useful instructions for practical project evaluation as how to determine the ARI⁵³). The basic concept of this approach put forward by LM and simplified by BTS will be questioned in the final section of this paper.

vings elements and to revalue its consumption element in terms of public income by dividing by v , the social value of public income. One can then go back to equation (36) (=B6) and, subtracting the CRI obtained in equation (34) (=B7) from the ARI obtained in equation (41) (=B8), obtain a derived estimate of v , and see whether it looks implausible. In the final analysis, though, since the purpose of ARI is to allocate public funds among competing uses in a socially desirable way, ARI can be looked on as a budgetary weapon which can be varied according to experience" (numbers prefaced by B refer to the equations as given in this paper). The questionable basic idea which goes back to Little and Mirrlees (*LM II*, pp. 291-297) is that of burdening the discounting rate with the additional budgetary weapon function, giving it thereby the character of a target rate of return on public investment and thus obscuring the problem of weighting present against future events. Cf. as critique there of also *D. Weiss*, *Infrastukturplanung* op. cit., pp. 121-124. Equation (B8) corresponds to equation (U4) of the UNIDO approach for $P^{inv}=1$ and $v=1$.

- 53) Firstly in *LM I*, p. 181 et seq., then in *LM II*, pp. 291-297. The diction of the authors is, here too, fairly remote from practical necessities, e.g. on p. 296: "The best guide to the proper choice of the ARI is experience. If more projects look acceptable, than there are investible funds available, the ARI should be adjusted upwards: and if too little looks promising, the adjustment should go the other way...It is also possible to estimate the ARI by more sophisticated methods based on input-output tables and other data about the economy's performance and possibilities. If economic models of this kind are to give results that project planners could rely on, or even use as initials estimates, they must include trade possibilities as well as domestic production possibilities. Models of linear programming type have often expressed trade possibilities in a very crude and arbitrary way, by imposing constraints, many of them pure guesses, which have a large effect on the accounting prices estimated. If these difficulties can be circumvented, it should be possible to indicate the sectors that deserve most emphasis in the economy's development, and deduce the ARI that is implied".