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Accounting Prices as a Tool of Development Planning

by

Peter Eckstein

February 1968

Center for Research on Economic Development
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ACCOUNTING PRICES AS A TOOL OF DEVELOPMENT PLANNING[1/]

by

Peter Eckstein

The postwar resurgence of interest in the problems of economic development has been marked by the proliferation of theories geared to the distinctive problems of underdeveloped economies. Among those most widely advocated is the technique of basing development plans on "accounting prices" or "shadow prices" for labor and capital rather than on the prices which actually prevail in the market. The argument of this paper is that most discussions of this technique are based on a seriously inadequate definition of the problem and prescribe policies which will be inimical to economic development.

We begin by describing the general theory under the assumptions of a closed economy. We then examine some constraints on the policy which the accounting price theorists consider inadequately but which indicate that their policy recommendations can lead to a serious misallocation of resources. In particular, we argue that, even for countries with significant amounts of unemployed labor, a zero shadow price for labor is not — in theory or in practice — an appropriate tool of development policy.

1/ This is a revised version of a memorandum circulated by the Project for Quantitative Research in Economic Development in March, 1967, which, in turn, was an extensive revision of a paper presented to the Seminar on Quantitative Analysis and Developmental Planning at Harvard in May, 1965.

Although this paper takes issue with a few of the many writings of Professors Tinbergen and Chenery, I am grateful to both of them for the helpful criticisms and encouragement which they provided at earlier stages of this effort.

While it is possible to modify the accounting price theory to render it somewhat more general, we argue that a fully general approach to developmental planning — based on less rigid assumptions concerning the factor markets — will prescribe policies based on the market prices of factors, though not necessarily those prices which prevail initially. Later sections of the paper deal with special domestic aspects of the theory. Relaxation of the assumption of a closed economy, with a discussion of the applications of the accounting price concept in the markets for foreign exchange and for internationally-traded goods, must be reserved for a later paper.

I. The Theory

The theory of accounting prices has come to take a central place in the current literature on development planning. The policy has been recommended in publications of the United Nations Secretariat, by the UN Economic Commission for Asia and the Far East, and by individuals in the publications of the UN Economic Commission for Latin America and the United States Agency for International Development. [47, 48, 16, 18, 9, 34] The idea is at the heart of two semi-popular introductions to planning, issued under the respective auspices of the World Bank and the Carnegie Endowment for Peace [46, 33] and several recent articles have studied particular problems in the application of the theory. [6, 11] The most extensive theoretical defense of the approach, and that to which most other writers defer, has been made by Professor Jan Tinbergen in his small book Design of

Development [46][2/], and elaborated mathematically by his student Qayum. [36] We will, therefore, use their writings as the basis for our discussion of the accounting price theory, considering the work of others only insofar as they introduce important variations on the theme.

It is a commonplace of modern static welfare economics that, given adequate aggregate demand and the absence of indivisibilities, externalities and constraints on income redistribution, an economic optimum may be realized when firms act as profit maximizers under conditions of perfect competition. Tinbergen objects, however, that in underdeveloped economies:

> a better test for application by policy-makers would be the increase in total national income .... The contribution made to national income by a project may be very much more important than private profits of the investors might indicate. ([45], p. 179)

The two criteria will not coincide in a number of underdeveloped economies, Tinbergen contends, because of a divergence between the market prices of capital, labor and foreign exchange and their "intrinsic values." The major reason for this divergence is the "fundamental disequilibria" which exists in the markets of many underdeveloped economies:

> The most important is the widespread unemployment — open and disguised.... The basic reason in all probability is the lack of complementary means of production, i.e., land and capital. Very probably the equilibrium level of wage rates will be considerably less than market wages. On the other

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2/ But also described in [45]. Unless otherwise noted, all references to Tinbergen are to [46].

> hand, equilibrium interest rates probably are much higher than market rates. (p. 39)

Accounting prices, as Tinbergen defines them, are

> technical instruments to assure the full use, and no more than the full use, of the scarce factors of production available.... They are the prices at which supply is just sufficient to satisfy demand; they represent the value of the marginal product to be obtained with their aid, since projects showing no surplus above the cost, at accounting prices, of the factors used, will be on the margin between acceptance and rejection. (pp. 39-40)

There are two ways in which the scope of the accounting price policy may be defined. 1) Such prices may be used by planners in designing and establishing priorities among possible government investment projects, so that a public investment may be undertaken "even if it does not pay financially," provided it is expected to contribute more to national income than the accounting cost of the resources it will employ. 2) Accounting prices can also be made real to private investors through a system of subsidies and taxes "tending to stimulate the use of abundant, and to discourage the use of scarce, factors" (p. 41). Tinbergen describes both approaches, although he maintains a distinction, presumably valid under either approach, between the "program sectors," in which accounting prices would be applied, and "the rest of the economy" (p. 81).

The kind of underdeveloped economy Tinbergen describes is one in which the scarce factors of production are land, capital and "a number of types of skilled labor." Only unskilled labor is plentiful, and its marginal productivity – and hence the "equilibrium level of wage rates" – is low (p. 35). At the same time, there is a higher-than-

equilibrium wage rate imposed on the labor market — by trade union pressure or (as Qayum suggests) by minimum wage or other labor legislation — and the result is that the supply of unskilled labor at that wage is substantially greater than the demand for it. The basic strategy is to utilize as many of the unemployed workers as will make a positive contribution to output, inducing producers to hire them by offering a subsidy which makes up the difference between the wage cost and the marginal product of labor.

Even if we accept the accounting price theorists' description of the unemployment problem, we must recognize that subsidization of employment is not the only way to deal with it. For example, Tinbergen ignores the possibility of labor training, which could be a highly productive means of reducing at least some of the excess supply of unskilled labor. He does consider the alternative possibility of lowering the market wage to the equilibrium level, but he objects that it is impossible because it "would mean imposing on the workers a level substantially lower than presently prevails and having the revolution right now" (p. 40). In addition, if wages are close to subsistence levels, lowering them could reduce labor productivity, and wages in accordance with the very low "intrinsic value of labor" often "would mean starvation." (p. 77)

For the sake of theoretical argument we shall accept these objections and assume in what follows that we are dealing with an economy in which reduction of the real wage — e.g. through wage control, the repeal of minimum wage laws, higher taxation or the denial of money wage increases in the face of general price inflation — would

have prohibitive economic or political consequences. It should be borne in mind, however, that the extent to which this is so is an empirical question. Unless the assumption is valid in the case at hand, the whole accounting price policy of working around the market wage is unnecessary.[3/]

II. The Problem of Cost[4/]

A) The Definition of the Problem

The selection of an optimal technology in underdeveloped economies reduces — like most economic questions — to a problem of maximization under constraint. Before evaluating any development policy, then, it is necessary to define exactly both the maximand and the constraints within which a solution must be found.

All the accounting price theorists pose the problem as one of finding the technological process or processes

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3/ This conclusion is further supported by our argument in section III that the accounting price theorists do not establish the institutional rigidity of the price of capital.

4/ Since the earliest version of this paper was written two other discussions of the accounting price policy have independently raised several of the criticisms leveled in this chapter. Stolper [42] has strongly rejected the applicability of the approach to Nigerian planning — for many of the empirical reasons cited in section II-E of this paper — but remains respectful of the underlying theory. In an unpublished paper Marglin [27] has developed an alternative definition of accounting prices which is based on several of the principles that, it is argued in this section, have been inadequately considered by "the accounting price theorists." Before preparing the current draft I heard a lengthy exposition of Marglin's approach, and I have profited from it, particularly from his use of consumption as a criterion. Our approaches remain quite different, however, and I have made no effort here to compare his assumptions and conclusions with my own.

which will maximize output. Tinbergen, Chenery and Qayum employ models which explicitly aim to maximize current output or the flow of output from current investment.[5/]

They all see the maximization as subject to certain specified conditions of demand for output and to the quantities of factors of production which are available. (Capital and labor are the only factors usually explicitly included in a model for a closed economy.) All state or imply strongly that the stocks of these factors are fixed or exogenously given — labor by some concept of full employment of the available workers, capital by a given level of saving in the economy. These constraints and the production function itself are sufficient to determine the optimal factor proportions and the maximum level of current output for the system. So long as there is a positive marginal rate of substitution between labor and capital — i.e., factor proportions are still flexible and the marginal productivity of labor (and hence its accounting price) is positive — maximization of output will require the utilization of labor up to the full employment limit.[6/]

5/ See [45], p. 265; [11], p. 33; [9], pp. 60-62; [36], pp. 31-32, p. 53. Elsewhere [46], p. 63, Tinbergen urges a more sophisticated approach — that the output flows of different periods be rendered comparable by maximizing "the discounted 'present value' of all future income (or, alternatively, consumption)" — but his conclusions, as we shall see, appear to be based on the logic of the maximization of current output.

6/ This is presumably the sense in which we are to interpret Tinbergen's insistence on the "full use of scarce factors" rather than taking him to argue that labor should be employed even when its marginal product is negative. The association of positive accounting

The most striking aspect of this formulation of the theory is the absence of any tangible concern about possible financial cost. The UN Manual on Economic Development Projects puts the argument quite simply:

> If ... a road is to be constructed and there is unemployed labor which can be utilized without involving a reduction of output in other sectors of the economy, the price which must be paid for such labor employed on the road does not represent a social cost. ([47], p. 205)

Or, as Tinbergen puts it, "The intrinsic value to the country of a man who would otherwise have been unemployed is very low" (p. 38).

It is because market costs are seen as unrelated to social costs that the level of operation of the accounting price system can be completely determined once the production function, factor stocks and demand conditions are known. For example, Chenery [9] offers a single-period programming model for development planning and solves it with hypothetical data without ever calculating the financial cost of the program being recommended.

Tinbergen confesses some uneasiness over the issue. After advocating the widespread subsidization of labor-intensive techniques — carried to the extent that "cottage industries" may "become more attractive than large-scale plants" he injects a note of hesitation:

> Many may doubt the practical possibility of such a far-reaching measure. One of the doubts would

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prices and full employment of labor appears, for example, in the linear programming model of Chenery [9] and the continuous production function model of Qayum [36]. In his linear programming model Qayum shows by example that when one factor has a negative shadow price optimal utilization of factors does not imply full employment.

> be based on budgetary considerations. In fact this measure, if applied to all enterprises, would charge the government budget with enormous amounts that would have to be financed out of taxes. It may be that certain government investments would thus become impossible. To the extent that this applied, it should be taken account of as a disadvantage, to be set off against the advantages (p. 53).

He concedes that when a low accounting price for labor is applied, "the execution of projects does absorb actual tax revenue. This sets a limit to either development at large or to the execution of 'accounting price projects'." (p. 78)

Thus, what Tinbergen introduced as a clear-cut criterion for investment decisions has become in the end no criterion at all. Far from being able to use accounting prices to select those projects which will make a net contribution to development, planners may in the end be forced to choose between "the execution of 'accounting price projects'" on the one hand and "development at large" on the other. The design of projects along accounting price lines is not necessarily to be seen as a means to development but in the end may actually represent an antithetical goal. To assist planners in making a choice between these two goals the accounting price theory ultimately offers no sharper instrument than the rather unhelpful suggestion that the "advantages" be set off against the "disadvantages."

B) <u>A Redefinition of the Problem</u>

We would argue that the accounting price theorists overlook or grapple indeterminantly with the issue of financial cost because they have misstated the maximization problem. They seek to maximize the output of a

particular period subject to the labor (or some share of it) available in that period and to the capital stock made available by the investment of previous periods, the quantity of which is assumed to be exogenous. This formulation fails to take adequate account of limitations on the government's ability to incur the costs of subsidization, limitations which arise both from the fact of underdevelopment and from the goal of development. These limitations are not merely possible complications to be considered after an optimal solution has been discovered.[7/] Rather they are elements which must be included in the statement of maximization problem itself and are likely to determine its solution.

7/ This is the way several accounting price theorists deal with the problem. For example, Qayum [36] devotes several chapters to an attempt to demonstrate that a cost constraint is not likely to be operative (see Appendix B), but he devotes not a word to the implications for the theory if he is wrong. Papanek and Qureshi [34] recognize what they call the "financial problem" – that an inability to raise taxes for widespread subsidies would open the way "for inflation which may distort prices seriously" – but they dismiss this as a "short-run" problem not fully comparable to the "long-run" problem of development (p. 105). Chenery [9] notes in passing that planners may wish to test "the inconsistency of the result with some established criterion – such as desirable income distribution or the allowable rate of inflation" – but he says nothing more than that such consistency "can only be tested in a more qualitative fashion" (p. 61). The difficulty with all these comments is that they are essentially obiter dicta, interesting points which may be worth keeping in mind but which are not offered for any systematic relationship they may bear to the solution of the problem.

In the first place, one of the most important problems of an underdeveloped economy – more difficult in countries where the administrative machinery is also underdeveloped – is a severe limitation on the resources that the government can raise for developmental purposes. Tinbergen himself suggests this when he describes "the upper limit of investment" for the public sector as "the total of (i) government revenue after current expenditure, (ii) domestic borrowing, (iii) admissible deficit financing, (iv) foreign assistance" (p. 35). But a system of accounting prices, if it is to be successful in influencing factor proportions in the economy, will necessarily involve a net subsidy to producers.[8/] This amount will represent a financial cost to the government and, insofar as newly-employed workers increase their consumption, a real cost to the economy. If, as all the accounting price theorists assume, funds for capital investment are scarce, then subsidization funds are also scarce. As Tinbergen himself casually observes in an obscure footnote to one of his annexes, subsidies "paid by government ...to further labor-intensive activities may reduce government investment itself" (p. 89). This implies that the limit he describes for public sector investment is

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8/ This follows directly if we assume that for any set of market prices there is a unique set of factor proportions at which profits are maximized and which the firm will choose to adopt. If there were a set of taxes and subsidies for factor use which enabled a firm to earn as much or more with new factor proportions as it did previously, and if the net effect were not a subsidy to the firm, then the firm had not previously been maximizing profits. Any set of taxes and subsidies which the government could levy on a firm without a net subsidy the firm could levy on itself so as to increase its profits. For a mathematical treatment, see appendix A.

better seen as a limit on the total both of subsidization to increase current output and investment to increase future output.

In the second place, the reduction of investment is obviously a significant part of the problem, because the very idea of development entails concern for future as well as current income. Tinbergen acknowledges this concern — even if his policy recommendations do not reflect it — when he contends that the objective of a development program is the maximization of "the discounted 'present value' of a stream of income or consumption." If we adopt this criterion, we can agree that such maximization will necessarily be constrained by the production function, by the supply of labor available in each period, and by the amount and form of capital available before the initiation of a development program. The important point, however, is that it is not possible to treat the amounts of capital available during the program as exogenous. Rather, when some constraint on the ability of the government to raise funds for all developmental purposes is formally introduced, the amount of capital available for new investment in each period will not be an independent constraint but will be a function of the way those funds are allocated.

In the perspective of a particular year, the maximization of current output through subsidization may be seen as subject to the use of available funds to increase output in future years. The most obvious such use is the provision of physical capital for new investment projects, including vital social overhead projects which the private sector cannot be expected to build. But there are many other possible uses which will also increase future

output, including efforts to train unskilled workers and entrepreneurs and programs of exploration of natural resources, technical education, and agricultural and community development. A government cannot rationally determine how much it should commit for the subsidization of projects – nor can it measure the "social cost" of such subsidization – until it has compared its costs and benefits with those of all other categories of developmental expenditure. If long-range development is the goal, then, even if the opportunity cost of unskilled labor is "very low" or zero, the cost of devoting resources to the subsidization of employment in one period may be very high. Indeed, that cost may be the abandonment of investment projects needed to increase both output and employment in future periods.

C) A Framework for Analysis

A more systematic analysis of the problem may help to define the cost constraint more fully. For this purpose we will temporarily accept the assumptions of the models of the accounting price theorists: that there are only two, homogeneous factors of production, capital (K) and unskilled labor (L); that the existing stock of capital in any period is given by past investment; that projects are run according to the principles of profit maximization under perfect competition; and that, in the face of a fixed real wage prevailing in the market, a considerable number of unskilled workers will be left unemployed. Together these assumptions imply that, once the quantity of capital has been determined, output in projects can only be increased through the hiring of additional numbers of unemployed workers, with a net subsidy required to induce the employment of each.

It is also convenient to assume:

i) that each project in the economy can sell varying amounts of a homogeneous output (X) at a fixed market price;

ii) that units of current output may be devoted either to current consumption or to investment in the projects originating in the current year;

iii) that each project at its inception faces the same production function, $X = X(K,L)$, describing a range of technologies from among which one may be selected;

iv) that the production function is characterized by a) constant returns to scale; b) marginal productivities for each factor of production which are initially positive but diminishing; and c) complementarity between the two factors for all ranges of positive marginal products; and that its characteristics are perfectly known by both government and producers.

v) that a project, once established, embodies a fixed capacity and fixed factor proportions as determined by the technology selected;

vi) that the technology of projects originating in the ith year is selected by project managers on the basis of factor prices (assumed to be constant over the life of the projects), the production function, and the government's irrevocable commitment to subsidize project operations by an equal amount in each of the years ($i + 1$ through $i + N$) in which they will operate.

vii) that each project begins production one year after the investment occurs, and that it produces at undiminished efficiency for N years, after which its capital has no salvage value. This implies that the gross return to capital must include an annual depreciation allowance equal to $1/N$ the value of the initial

capital;

viii) that private recipients of income from capital and labor each save (voluntarily or through taxes) different fixed shares of their respective net incomes, and that neither will accept a lower level of real income or consumption per person than that realized in the absence of an accounting price policy;[9/]

ix) that government is able to realize for itself the full gross return (depreciation and interest or profit) on its capital investments, whether these are made directly in the public sector or indirectly through loans to the private sector;

x) that all government borrowings, gross earnings from government capital and tax revenues — beyond those funds required for a given level of non-developmental expenditures — comprise income for the Development Budget, a fund which is allocated between two forms of expenditure: subsidization of projects <u>operating</u> in the current period and investment in projects <u>originating</u> in the current period;

9/ If, as Tinbergen argues, lowering the money wage would mean "having the revolution right now," then attempts to lower the real wage through increased rates of taxation or through price inflation induced by increased spending without taxation may have equally revolutionary implications — or may simply be defeated through compensatory increases in the money wage.

The assumption in the text merely explicitly extends this reasoning on labor income to the income of capitalists, who are often very powerful politically. The assumption is consistent with the form of the policy advocated by Tinbergen and Qayum. Both prescribe accounting prices for labor and capital based on marginal products under subsidized techniques. Since the higher marginal product of capital that results from greater labor intensity is all taxed away, private capital income is unaffected by the policy.

xi) that the Development budget may be augmented by new tax revenues or by private savings which permit noninflationary borrowing but that it may still remain insufficient to permit government to finance an optimum level of either subsidization or investment;

xii) that the ultimate criterion for decisions as to the allocation of the Development Budget is their effect on a welfare function which, as Tinbergen suggests, assigns greater weight at the margin to benefits realized earlier. Specifically, we shall assume that the contribution in each year is discounted to the present according to a rate of social time preference which remains constant so long as any significant unemployment of labor persists.[10/] In the present section we shall use consumption rather than output as the basis of the welfare function.

It follows from these assumptions that total saving (and hence investment in our closed economy) consists of private net saving and depreciation allowances plus that part of the Developmental Budget not devoted to subsidizing output. Since accounting prices are designed so as to maintain the return on capital, private capital income does not vary with the degree of subsidization. So long as recipients of that income save a constant share of it, their total savings will not vary either.

10/ This term is used to mean the rate of time discount preferred by the government as a basis for its development plans. As such it is inherently a value concept, although one which, when applied to marginal decisions between present and future consumption, is necessarily influenced by the absolute levels being compared and the persistence of unemployment among the workers affected.

It is not necessary, then, to assume that they save all – or any other particular share – of their incomes. Even without such an assumption, national savings may be seen to be an inverse function of the labor-intensity of projects (beyond the intensity indicated by profit maximization at market prices). This is simply because it is the degree of subsidization (and hence non-investment of developmental funds) which determines how labor-intensive projects can become.[11/]

So long as the privately-realized return on capital does not increase, the present and future consumption of recipients of capital income is fixed by the constraint on taxes and the assumption of fixed shares of income saved. So long as depreciation allowances are reinvested, the workers already employed at the fixed market wage will continue to be employed. The maximization of

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11/ This is an important difference between the model employed here and those used in many discussions of the "factor-proportions problem." For example, while Sen [40] put much of the earlier discussion in a clearer perspective, his contention that savings decline as labor-intensity increases depends on the assumption that all of capital income is saved. The assumptions used here are also less restrictive than those of Galenson and Leibenstein [21] who ascribe high reinvestment characteristics to capital-intensive projects regardless of their relationship to the factor proportions which will maximize profits. In the analysis of Otto Eckstein [15], the "reinvestment coefficient" of a project is not systematically related to factor proportions or otherwise explained.

By describing the policy tools required to affect factor proportions in investment projects, the accounting price theorists have at least opened the way to analysis of a more systematic relationship between factor intensity and savings.

welfare thus reduces to a problem of maximizing the discounted stream of income or consumption of the originally-unemployed workers. (Worker consumption will vary directly with income if savings shares are fixed.) At any given time during an investment program the income of these workers will be a function both of current levels of subsidization and of past levels of investment, the latter being equivalent to past subsidization foregone. The allocation of scarce developmental funds between subsidization and investment may thus be seen to be the real problem of development policy in the context of significant amounts of labor unemployment, but it is a problem to which the accounting price theorists do not seriously address themselves.

D. A Diagramatic Representation

The elements of the maximization problem may be better understood by considering the operation in some j^{th} year (which we shall call "current") of the projects designed and initiated in some previous i^{th} year. Figure 1 describes the operation of these projects at levels of employment beyond the point at which the marginal product of labor, as determined by the production function and the previously-given amount of capital, equals the market wage (O-W_m). Marginal product is shown as gradually declining until, as the accounting price theorists suggest, it falls to zero at some finite level of employment (O-L_0). If the total amount of unemployed labor available for these projects is given by O-L_5, then the unconstrained accounting wage would be O-W_a. The gross labor subsidy would be the number of additional workers hired times the difference between the market

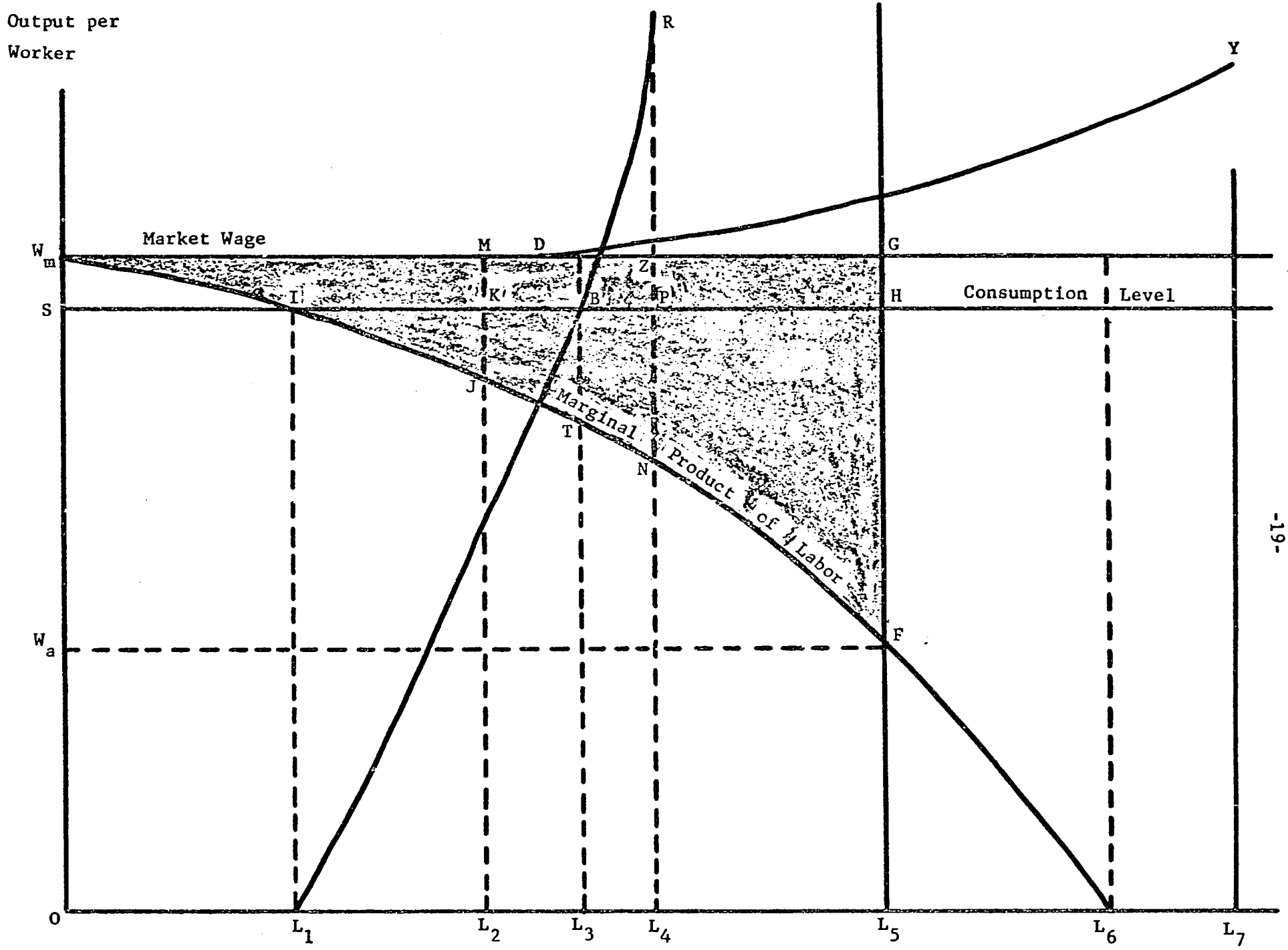
Output per
Worker
R
Y
Market Wage
W_m
M
D
G
Z
S
I
K
B
P
H
Consumption
Level
J
Marginal
T
N
Product of Labor
W_a
F
O
L_1
L_2
L_3
L_4
L_5
L_6
L_7
Number of Additional Workers.

FIGURE 1

wage and the accounting wage, i.e., the rectangular area W_m-W_a-F-G. With constant returns to scale the marginal products of the two factors will absorb total product, so that the three-sided area W_m-W_a-F — the amount of additional product not allocated to labor at the accounting wage — represents a "producers' surplus" attributable to capital, or the change in the marginal product of capital times its fixed amount. A capital tax would absorb exactly this much surplus, leaving total income from capital unaffected. The net subsidy would thus be represented by the three-sided area between the market wage line and the marginal product of labor curve, i.e., the shaded area W_m-F-G. The net cost of a program, in other words, is the difference between the uniform wage paid to each worker and the declining contribution which each makes to production.[12/]

It was the promise of subsidization in the current year (and in others) which induced producers to design projects so as to be able to expand current output beyond the levels indicated by market prices. At the same time, the realization of that higher output might increase the ability of the government to pay the promised subsidy. The additional workers hired will pay some existing taxes for which their new income and consumption make them eligible and will do some saving, both of which will permit equivalent increases in governmental developmental expenditure without inflationary effects.[13/] Since each

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12/ The general formula for the amount of the net subsidy is presented in Appendix A.

13/ Special taxes applied to newly-employed workers would be equivalent to lowering the real wage, something which Tinbergen specifically rules out (p. 40). Recall that if it were possible to lower the real wage in the first place no system of accounting prices would be needed.

additional worker is hired at a standard wage, the proportion of tax payments and savings in the income of the average previously-unemployed worker should be relatively constant. This proportion — representing the contribution of each worker to the capacity of government to subsidize his own employment — is indicated in the figure by the ratio of the amount saved and taxed, the distance $S\text{-}W_m$, to the real wage, the distance $O\text{-}W_m$.

From the standpoint of the Development Budget it is always desirable to increase employment so long as the savings and taxes generated by a marginal increase in employment are greater than the amount of subsidization required to achieve that increase. Thus, the employment of at least $O\text{-}L_1$ additional workers should clearly be induced, since at this level the net contribution to the Development Budget generated by the subsidization is at a maximum (at the amount $W_m\text{-}S\text{-}I$). For any further expansion the marginal worker will require more subsidization than he will contribute to the Development Budget.[14/] Once employment has been raised to the level $O\text{-}L_1$ the surplus funds which have been generated are available either for the subsidization of additional current output or for investment in projects which will increase production in future years. The problem is to

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14/ The net contribution of subsidized workers to the budget is exhausted when employment is carried to the level $O\text{-}L_2$, where the total budgetary contribution ($W_m\text{-}S\text{-}K\text{-}M$) just equals the size of the subsidization burden ($W_m\text{-}J\text{-}M$). Whether the government actually should extend employment all the way to the point at which the created capacity is exhausted — or possibly even beyond it — is another question.

determine which use at the margin would contribute more to welfare over time.

It is possible to use Figure 1 to suggest the basis for determining an optimal level of subsidization. As a first approximation, let us assume that after the government has met its operating budget commitments and hypothetically increased employment to L_1 so as to maximize net revenues, there would remain a fixed Development Budget applicable to these projects. It might be equal to the area I-N-P, including the area I-J-K (equals W_m-S-I) created by the expansion of employment. If this amount were allocated entirely to subsidization it could induce the hiring of L_1-L_4 additional workers, whose additional consumption would be the area L_1-I-P-L_4. To suggest the alternative allocation, let us take a curve such as R-L_1 to depict the current-consumption equivalent of the marginal contribution to future welfare of these funds invested in the most efficient ways.[15/] The

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15/ The current-consumption equivalent of future returns is obtained by discounting their potential for consumption back to the present at the social rate of time preference. The curve R-L_1 will decline from right to left for at least two reasons: because each point represents the effect of a smaller amount of investment (since the height of the area I-N-P declines - ultimately to zero) and because the marginal efficiency of investment falls off. The curve might also decline if some of the fruits of the investment were to be realized only after the attainment of full employment and if the marginal utility of additional consumption per worker were declining.

Since future returns on investment will be realized as government revenue, to their nominal value must be added some premium for revenue in each of the relevant years — reflecting the potential leverage of subsidization in inducing consumption. Thus, unless we make the extreme assumption that all future returns

intersection of this curve with the consumption line at the point B indicates an optimal level of investment from these funds of B-T-N-P and an optimal net outlay on subsidization of current output of I-T-B, inducing as it would a total additional employment of O-L_3 workers.

E) Elements of the Constraint

The analysis above explicitly assumes that the cost constraint, rather than the labor force constraint, determines the solution and that at the indicated level of employment the marginal product of labor is still close to the market wage.[16/] There are several reasons, most of them originating in the fact of underdevelopment itself, why these assumptions are likely to be valid.

1) The subsidization of the projects originating in a particular, earlier year must compete for scarce developmental funds not only with current investment projects but also with the subsidization needs of the projects which originated in all of the N previous years and are still currently operating. The share of current funds allocated to the projects of any one year must necessarily be rather small.

from current investment should be immediately and directly consumed, we must know any budgetary constraints operative in the years when returns will be realized before we can solve for the optimal levels of current subsidization and investment. It is, then, strictly speaking, not possible to substitute a single period analysis for a full solution of a multi-period problem. (For a more rigorous discussion, in which the assumption of a fixed Development Budget is relaxed, see subsection H. below.)

16/ Qayum's book can be seen as an effort to disprove this assumption. For a specific analysis of his argument, see Appendix B.

ii) Projects which contribute only to output in general must compete for current subsidization funds with projects which are marked by specific external economies. Subsidization of such projects (which would include many social overhead and educational facilities) may confer significant economic or social benefits which cannot be recovered financially, due to their wide diffusion in the economy or to the limited taxing power of the government.

iii) In economies which, as the accounting price theorists describe them, are poor in capital and have very low average labor incomes, the wages of unskilled workers will be too close to subsistence to permit them to do either much saving or much taxpaying.[17/] The contribution of each newly employed worker to the Development Budget, then, is likely to be very low.

iv) The overhead cost borne by the government when additional workers are employed — what Tinbergen calls the "displacement cost" and recognizes should be taken into account (p. 83) — can be substantial. If employment entails the urbanization of persons previously in the agricultural sector, government may be required to provide new transportation facilities, police protection,

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17/ Although employment ordinarily brings a substantially larger income, it will also bring a higher consumption aspiration level and increased consumption needs. As Rosenstein-Rodan pointed out long ago, workers moving from agriculture to industry require higher incomes "because they need more foodstuffs than they had in their agrarian semi-unemployed existence, because these food stuffs have to be transported to towns, and because the workers have to pay for housing accommodation." ([37], p. 249.)

and other city services. Such costs could easily be sufficient to offset the effect on government revenues of worker taxes and saving, so that the market wage would in fact understate the impact of additional employment on current consumption.

v) The "full employment" labor constraint applicable in a particular year is not, as Qayum and others have attempted to define it, some small portion of the existing amount of unemployment. Rather it is close to the total amount of unemployment plus the natural increment to the labor force.

vi) Initial subsidization, when the difference between the marginal product of labor and the market wage is very small, will have a multiple impact on current output. As more and more workers are subsidized, however, the marginal product will decline rapidly – reaching zero, most of the accounting price theorists contend, for the existing labor force in the economy.[18/] Thus, the financial cost of inducing the employment of an additional worker approaches the full amount of the wage rate, while the contribution of that worker to output approaches zero.

vii) The productivity of investment in a labor-surplus economy is high and can be even higher when a policy of subsidization of employment is being pursued. This productivity sets severe limitations on the amount

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18/ This is not to imply acceptance of the empirical basis of the assumption of zero marginal productivity, which is seriously contested by many economists, most notably Schultz [39]. One purpose of this paper, rather, is to challenge on theoretical grounds the conclusions which the accounting price theorists have drawn from this empirical assumption.

of a given Development Budget that is best devoted to the subsidization of current output.

viii) The marginal costs of taxation – the allocative inefficiencies which concern economists and the popular discontents which concern politicians – are likely to rise rapidly if more or higher taxes are imposed.

ix) It is not useful to attempt to evade the cost constraint on a total program of projects by designing only some projects according to unconstrained accounting prices. Such a procedure would be inefficient both in its use of government funds and in its allocation of capital and labor.

The first four points are perhaps self-explanatory; the fifth is discussed in Appendix Bii; the last four deserve further attention here.

F) Low Marginal Product of Labor

The accounting price theorists explicitly assume that the marginal product of labor is significantly below the market wage; indeed, as we have noted, most of them argue that it approaches zero for the existing labor force. In Tinbergen's words, "Capital may not be sufficient to employ all unskilled labor, even at zero prices" (p. 83). Chakravarty, Papanek and Qureshi, Harberger, Mason and numerous UN agencies and committees have made similar assertions, arguing for the use of a zero accounting price in project planning.[19/]

Figure 1 suggests the staggering financial consequences of inducing employment up to the point at which

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19/ See, for example, [6], p. 50; [33], p. 98; [23], p. 209; [28], p. 53; and [16], No. 2, p. 18.

the accounting wage becomes zero (when additional employment is $O\text{-}L_6$). What Tinbergen and others are saying is that full employment constraint may be even higher (e.g. at $O\text{-}L_7$). As employment approaches the level of a zero accounting wage the net subsidy cost of hiring additional workers approaches the full amount of the market wage (less the small amount taxed or saved), while the contribution of those workers to output approaches zero. At the point at which the accounting wage actually becomes zero, then, and for any expansion of employment beyond that point, the policy becomes exclusively a "Design of Redistribution" with no relevance for development. Indeed, the current redistribution would be effected at considerable cost in future output while making no contribution to current output.

Because capital and labor are complementary factors of production, as the accounting price of labor falls — and thus as the labor-intensity induced by subsidization increases — the marginal productivity of capital also increases. In a two-factor world with constant returns to scale the marginal products of the two factors will account for total output. Thus, as the accounting price (marginal productivity) of labor approaches zero, the marginal product of capital approaches its average product. The gross rate of return to capital then becomes equal to the output-capital ratio under the most labor-intensive techniques available. This could easily be as high as 1/2 (or 2/3) corresponding to gross incremental capital-output ratios

of 2 (or 1.5).[20/] Discounted at 10 per cent over a period of 20 years such a return would have a present value of 4.2 (or 5.6) times the cost of any additional capital; discounted at 4 per cent it would have a present value 6.8 (or 9.1) times that cost.

For a proper comparison with subsidization, we must consider the case of an accounting wage equal to zero in projects originating in both of two successive years. In the second year, when the projects originating in the first year would begin operating, the government would be transferring wages to workers who at the margin would be contributing nothing to production. The (present) value of the resulting increase in consumption would be one. Alternatively, the government could have invested those funds in projects originating in the second year. Even if all the later earnings of such investments were simply transferred to workers (rather than reinvested or used to subsidize more productive employment) the present value of the resulting consumption would be many times one. Thus, assuming some continuity in the accounting prices of different periods, a rational government would support an accounting wage of zero only if its rate of time preference for consumption approached the highest net output-capital ratio which was technologically attainable. For net capital-output ratios of 2 or 1.5 this would

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20/ Tinbergen presents capital-output ratios for both India and Mexico of 1.5. If these were in fact sustainable in the past without significant subsidization of labor intensity, a full-blown program of such subsidization could presumably produce incremental ratios which were even lower.

be the equivalent of preferring one dollar of consumption by unemployed workers in one year to $1.50 or $1.67 of consumption by them in the next year, a fantastic rate of social time preference which the advocates of a zero accounting wage never associate with their proposal.[21/] At any reasonable rate of time preference it is virtually certain that a cost constraint on subsidization – in the form of opportunities for investment which are far more attractive – will prove binding well before the accounting wage reaches zero.

G) The Productivity of Investment

When the accounting price of labor is zero, the marginal productivity of capital – then equal to the output-capital ratio in the most labor-intensive technology possible – is at its upper limit. This does not, however, represent an upper limit to the impact of currently-invested capital on future welfare. Indeed, paradoxical though it may seem, the power of additional investment to induce additional employment and output is highest when the accounting wage is highest (but still lower than the market wage) and reaches a lower limit – albeit a substantial one – at a zero accounting wage. This may be seen by considering that the government retains the option of using the annual earnings of the capital it owns to subsidize the labor-intensity of the projects in which that capital is invested, and as we have noted, the leverage

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21/ As contrasted with these rates of 50 per cent or more, Tinbergen himself suggests that a rate of 10 per cent (evaluated above) may be a good approximation of the accounting price of capital (p. 86).

of subsidization funds is greatest when the marginal product of labor is closest to the market wage.

If unemployed labor were still plentiful and the levels of subsidization in future periods of projects originating in the current period were still constrained by limits on the Development Budget, additional investment in such projects would have three kinds of impact on future labor income and output:

a) The additional capital would permit projects to employ more labor at market prices, even if there were no subsidization; i.e., even if the capital-labor ratio remained constant.

b) Additional capital would normally permit a given amount of subsidization to induce more additional employment than when the capital base of the projects was smaller.

c) The gross earnings of capital in the projects would be an addition to the Development Budget and, as such, could be used to increase the level of subsidization in each of the years in which the projects were to operate.[22/]

It should be remembered that the ability of current investment to effect these increases is not confined to a single period but recurs for each of the years for which the capital in the project survives. By contrast the alternative use of the funds — subsidization — would have had an impact in one period alone. It should be remembered, too, that the use of all of the earnings of the additional capital for future subsidization may not be optimal. The alternative of reinvestment of part or

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22/ These three elements are demonstrated graphically in section i of Appendix C.

all of those earnings may offer even greater possibilities for increasing welfare in the long run. The possible output and employment benefits from using investment earnings for future subsidies should be seen as the minimum to be realized from investing current developmental funds rather than using them for current subsidization.

H) Elements of an Optimal Policy[23/]

The comparison between the subsidization of current output in period i and investment in projects which will operate in periods j ($j = i + 1, i + 2, \ldots, i + N$) can be described algebraically. Let us continue to judge the two alternatives by their impacts on the consumption of otherwise unemployed workers. We will assume this consumption to be equal to some constant, c, times the incomes of workers at the fixed market wage rate, or $c \cdot W_m$.[24/] The net subsidy cost to the government of inducing the employment of an additional worker in period i will be $c \cdot W_m - MPL_{hi}$, where the latter term is the highest marginal product of labor in the projects initiated in any previous period h since the beginning of a program of subsidization and still operating in period i. The leverage of a dollar of current subsidization in generating current worker consumption will be given by the ratio of induced consumption to subsidy costs, or:

23/ The reader may omit this algebraic restatement of the argument without loss of continuity.

24/ Recall that c may not be less than one if the overhead expenses of employment are greater than the savings and taxes of newly-employed workers.

(1) $$\frac{c \cdot W_m}{c \cdot W_m - MPL_{hi}}$$

This expression will be a large multiple of one when the marginal product of labor is close to the consumption rate of labor and will equal one (the pure redistribution value) when that marginal product is zero.[25/]

Were a dollar from the Development Budget of period i to be invested instead in projects originating in that period, it would generate gross earnings on capital in period j which we shall designate as MPK_{ij} and see as a share of that dollar. Marginal investment in period i would have a maximum impact on consumption in period j if its gross earnings were, in effect, devoted to the subsidization of the labor intensity of the projects in which the investment was made. The resulting worker consumption in period j would be approximately equal to MPK_{ij} times the leverage of expenditure in period j on subsidizing the consumption of workers employed in projects originating in period i.[26/] The productivity of current investment funds in generating future consumption may thus be seen as the present value in period i (PV_i) of the stream of these values in all N periods j, or:

(2) $$PV_i \left[\sum_{j=i+1}^{i+N} MPK_{ij} \frac{c \cdot W_m}{c \cdot W_m - MPL_{ij}} \right]$$

25/ The redistribution value may be considered to be greater than one in a more detailed version of the welfare function, but this does not affect the argument presented here, since the expressions will cancel out in a comparison of two years.

26/ This expression is derived more rigorously in Appendix Cii, where it is shown to be an understatement.

The present value of a constant stream can be represented by a number multiplied by the annual size of that stream. That number will be a function only of the discount rate applied and the number of years for which the stream occurs. So long as the rate of social time preference and the expected life of new projects are both constant, they alone will determine the fixed number (which we may also denote as PV_i) to be multiplied by the annual consumption values of investment returns in calculating their present value. Thus subsidization in period i will at the margin be preferable to investment in period i only if the current consumption generated by that subsidization is greater than or equal to the present value of the future consumption stream financed by the earnings of that investment, or if:

$$(3) \qquad \frac{c \cdot W_m}{c \cdot W_m - MPL_{hi}} \geq PV_i \cdot MPK_{ij} \cdot \frac{c \cdot W_m}{c \cdot W_m - MPL_{ij}}$$

In order to facilitate a comparison, we may multiply both expressions by $c \cdot W_m - MPL_{ij}$ and divide them both by $c \cdot W_m$. The marginal contribution to welfare of the two kinds of expenditure in period i may then be seen to be equal when:

$$(4) \qquad \frac{c \cdot W_m - MPL_{ij}}{c \cdot W_m - MPL_{hi}} = PV_i \cdot MPK_{ij}$$

The expression on the left is the ratio of the effective subsidies per worker paid in two different periods, while the expression on the right is the present value of the gross return on investment. Their equality is a condition of welfare maximization so long as unemployment persists.

Only two kinds of patterns are likely to characterize

an optimal policy – constant or falling accounting wages – and both imply severe limits on the degree of subsidization of employment in the early stages of an investment program. Assuming market wages and consumption ratios do not change, if accounting wages are constant, then the subsidies per worker being compared in the expression on the left will be constant over time. Welfare will then be maximized when investment is carried to the point at which the present value of the gross earnings of the marginal investment is equal to one.

The other major possibility is that, if the economy is growing and if the elasticity of government revenues is greater than one, it will be feasible to support a gradually increasing subsidy per worker, i.e., an accounting wage which declines over time. This would imply that current investment should be curtailed before the present value of its marginal earnings has fallen to one. Since labor and capital are complementary, however, the greater degree of subsidization of labor in later years would raise the marginal product of a given amount of investment. Thus, while a higher present value for investment earnings would be required, the size of those earnings would be increased, and optimal investment levels need not be reduced substantially. Of course the very fact that levels of subsidization will be lower in earlier years implies a positive intitial accounting price for labor.

Our purpose in developing the analysis this far is not to propose a definitive and workable alternative investment criterion[27/] but merely to suggest how far short

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27/ Indeed, the criterion suggested here for decisions as between investment and subsidization should be applied only with great caution. It assumes, inter alia, both a

of providing such a criterion the accounting price theorists fall, especially when they recommend an accounting wage of zero. The possibility of subsidization in the future as well as in the present implies that the earnings of present investment can exert a leverage on future consumption comparable to that exerted by present subsidization. Long before the point at which present subsidization carries the marginal product of labor to zero, the present value of the stream of future consumption which could be generated by investment will, at any reasonable rate of time preference, become greater than the consumption deferred because of that investment.

I. The Social Costs of Taxation

An optimal development policy in the face of substantial unemployment implies a high marginal valuation on public revenue, in that the present value of the consumption that can be generated through increased developmental expenditure is greater than the amount of that expenditure. The situation might be characterized by saying that, since the availability of public revenue is seen as a binding constraint in the maximization problem, its accounting price is greater than one, probably substantially greater.

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constant production function and the existence of only two factors of production. Often the returns on project investments have present values less than one not so much because of rapidly diminishing returns to capital have set in as because inadequate supplies of complementary factors (other than unskilled labor) are available. If potential investment is to be reduced in favor of subsidization, it should be based on an estimate of the rate at which future consumption can be generated by all forms of investment — i.e., by any combination of increases in physical capital and improvements in the quality of the factors of production or of the organizing institutions of the economy.

In policy terms this implies that we should not in practice accept as given any a priori limits on the size of the Development Budget of the sort assumed in the discussion of Figure 1. Rather, the leverage of additional developmental expenditures in increasing consumption – through subsidization in the present or through investment and subsidization in the future – may readily justify the effort and sacrifice entailed in increasing government revenues, even if the distributional, allocative and collection costs of additional taxation make its marginal social costs substantially and increasingly greater than its marginal yields. On the other hand, the governments of most undeveloped economies are plagued by political and administrative weaknesses which place severe limits on any revenue increases. These weaknesses imply both a) that governments are unable to select freely among kinds of taxes so as to arrive at that combination which is least burdensome in terms of the efficient allocation of private resources and the equitable distribution of private income and wealth, and b) that for any tax selected the administrative costs of collection – and the allocative distortations of evasion – will at the margin be substantial.[28/] Because it is governments which ultimately must perceive and act upon the private costs of increasing

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28/ For example, politically or administratively weak governments tend to deem systematic income taxation impossible. Instead, they favor highly distorting – though far-from-airtight – taxes like those on international trade, or they resort to deficit financing, the cost of which is distorting domestic inflation or increasingly burdensome international indebtedness. For general discussions of these weaknesses and their policy implications, see Berg [2] and Watson and Dirlam [49].

taxation or accelerating inflation, these costs will inevitably be measured as – or compounded by – their political risks. Thus, a given revenue source can easily be defined as having an infinite marginal social cost if the government feels that tapping that source is certain to result in its own overthrow.

Economists may urge that governments maximize welfare by acquiring revenue to the point at which its increasing marginal social cost just equals the declining marginal social values of each category of expenditure[29/] – in this case of a) developmental investment, b) subsidization, and c) non-developmental expenditure. They should not, however, ignore the very high costs of additional taxation and thus be surprised if quite rational governments – however wasteful some forms of their expenditure may be – reject at the margin opportunities for investment or subsidization the social value of which may be several times their nominal cost.

J. The Scope of the Policy

When accounting prices for the projects originating in a particular period are calculated only on the basis of the capital and labor constraints, they indicate a set of projects with particular technologies and factor proportions. The introduction of a budgetary constraint may make it impossible to implement a full program of such projects As we have seen, the accounting price theorists never realistically face the question of how a development program should be adapted to such a constraint.

29/ For a discussion of the general criterion, attributed to Pigou and Dalton, see Musgrave [31], p. 113, and Morag [30].

Tinbergen comes closest to implying a solution when he says that a possible inability to meet financial costs "sets a limit to either development at large or to the execution of 'accounting price projects'." Unfortunately, defining accounting prices according to the labor constraint and then setting a limit to the number of "accounting price projects" according to the cost constraint – if this is what Tinbergen is implying – is a very inefficient means of dealing with the problem.[30/] It would mean that producers in the "program sector" would be taxed and subsidized according to their factor use, while producers in "the rest of the economy" would not be. Projects which were labor-rich and capital-poor would exist alongside projects which were relatively capital-rich and labor-poor. Such a situation would clearly violate the basic tenet of welfare economics that "between any two variables, the marginal rates of substitution must be...(technically) equal for all alternative processes."[31/]

Consider two sectors with identical production functions, with employment in the first subsidized to a greater extent than employment in the second. In both sectors the marginal productivity of labor falls and the marginal productivity of capital rises as a direct function of labor intensity. The marginal worker in the first sector is thus making a greater contribution to subsidy costs and a smaller contribution to output than the marginal worker in the second.

30/ The same criticism applies to the *de facto* subsidy entailed by a policy of project ranking or selection in which labor is valued at less than its market price in one sector of the economy but not another.

31/ Samuelson [38], p. 38.

Total output could be increased and total subsidy costs reduced by transferring workers from the first sector to the second up to the point at which their factor intensities were equal.[32/] In fact, the production functions are not likely to be identical, because the "program sector" is likely to include all of the government's own social overhead projects, many of which are naturally capital-intensive and subject to rapid declines in the marginal productivity of labor. In this case, the gains from a transfer of labor out of the heavily-subsidized program sector into the formerly non-program sector would be even greater.

The only economically efficient strategy in the face of a binding cost constraint is the subsidization of the widest possible number of projects designed not according to the ideal of full employment but to the reality of limited subsidization funds. Accounting prices calculated without regard to a financial constraint offer absolutely no guide as to how projects should be redesigned. While this conclusion is compatible with the use of some sort of accounting prices, it implies discarding everything the accounting price theorists have written about the full utilization of labor, the "balancing of supply and demand"

32/ Or, alternatively, by shifting capital from the second project to the first.

In his recent book on planning, W. Arthur Lewis argues that because of budgetary and administrative burdens the application of accounting prices "to all employment or investment is simply impracticable." They should, however, be applied to "certain sectors" – including the government, "factories that would compete with handicraft production," and "a few large projects or industries." [26], pp. 64-66. While this approach may reduce the administrative burden of achieving a given level of employment, it can only increase the budgetary burden.

for factors of production, "equilibrium prices," zero accounting wages, and the clear desirability of cottage industries or other highly labor-intensive techniques. If the accounting price framework is to be maintained, the prices of a solution must themselves be seen as potentially dependent on the amount of money which the government is able to commit to the annual subsidization of currently-operating projects as against investment in projects which will increase future employment and output.

III. Alternative Assumptions and Policies

The results of the previous section may be interpreted as an effort to define the basis for a new set of accounting prices for capital and labor in the face of a budgetary constraint. It is not clear, however, that the addition of such a constraint contributes a sufficient dose of realism to the problem or that a system of accounting prices for labor and capital represents an optimal way of stimulating current output. The alternative policy that we will propose is based on different assumptions concerning the supplies of labor and capital than those made by the accounting price theorists, and we turn first to an examination of these.

A) The Supply Schedules of Factors

One consequence of introducing budgetary cost as a possible constraint on the maximization of output is that it is no longer sufficient to define the factor constraints as single quantities of capital and labor whose prices are irrelevant to a solution. Rather, if the full cost implications of any policy are to be understood, it is necessary to describe supply schedules for each factor, specifying

the prices at which different quantities would be available.

i) The Supply of Labor

Implicit in the writings of most of the accounting price theorists — and explicit in those of Qayum (p. 89) and of Papanek and Qureshi (p. 98) — is the assumption of a labor supply schedule like that incorporated in Figure 1. Supply is seen as perfectly elastic (horizontal) at the market wage up to some point of "full employment" (G in the figure), after which it becomes perfectly inelastic (vertical). In reality, however, a large pool of unemployed workers is likely to have some depressing effect on the market wage. As a subsidization policy reduced the level of unemployment the market wage would tend gradually to increase, and the higher wage and greater availability of jobs might draw additional workers into the labor market. A more realistic supply schedule — all of whose points would be potentially relevant to the solution — might be an upward-sloping one like W_m-D-Y in Figure 1.[33/] Both the higher wage and the increased number of workers ultimately available would make the approach to full employment in the later stages of a subsidization program more likely to violate a cost constraint than the rectangular

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33/ For an empirically-oriented defense of the realism of an upward-sloping supply curve in Africa, see Berg [1]. Seeing the labor supply curve as upward sloping has another implication for the approach of the accounting price theorists. Contrary to Tinbergen's assumption, the accounting wage which will entail the "full use" of labor will no longer be the equilibrium wage. An even lower accounting wage will be required to induce producers to hire the additional workers drawn into the labor force by the higher-than-equilibrium market wage.

supply schedule described by the theorists (and incorporated in the assumptions of the previous section) would suggest.

ii) The Supply of Capital

A question with more important policy implications is that of the market and supply schedule for capital. Tinbergen and Qayum both give the impression that one function of an accounting price for capital is to offset the effects of a rigid interest rate which – like the fixed wage – creates a market disequilibrium. All of the accounting price theorists, whether or not they specify a rigid interest rate, make the operating assumption that the supply of capital is fixed in any given period. Papanek and Qureshi make the most explicit defense of the assumption when they argue that it is safe to "ignore the effect of the rate of interest on savings," since the empirical basis for such a relationship is difficult to establish (p. 96). In accordance with these assumptions the accounting price policy would (in most versions) leave the low market interest rate untouched while applying a tax on the use of capital in the subsidized sectors of the economy. Thus, even if in fact the rate of interest were free to vary and the supply of funds to producers were interest-elastic, the policy would discourage producers from acquiring control over additional capital. It is important, then, to examine both premises of the capital tax policy – the rigidity of the interest rate and the inelasticity of the supply of capital.

a) The Rate of Interest and the Capital Market

The accounting price theory treats the two factor markets as parallel, offering a subsidy to offset disequilibrium in the labor market and imposing a tax to offset disequilibrium in the capital market. It is not clear,

however, that the capital market the theorists describe is in disequilibrium in the same sense as is the labor market. A true disequilibrium would require an actual capital shortage — more demanded than is being supplied at the prevailing price — which would be the counterpart of a labor surplus. Yet Tinbergen refers only to the "scarcity" of capital in underdeveloped countries, and no accounting price theorist assumes the existence of usury laws or other imposed ceilings on the interest rate which would be the counterpart of rigid floors beneath the wage rate. Tinbergen says only that in underdeveloped economies it is "probable" that interest rates "on the whole have a downward bias as compared to 'accounting rates'" (p. 77), and the reasons he and Qayum offer for such a bias are not entirely consistent as means of explaining a true "market disequilibrium."

Both Tinbergen and Qayum describe a demand for capital that is not as great as it might be. Tinbergen argues that "the scarcity of entrepreneurs and of capital" would ordinarily make for "extremely high" rates of profit and interest but that these are not realized because of the higher-than-equilibrium wage rates (p. 77). While this implies a low market price for capital, it does not seem to imply any disequilibrium on the capital market. In fact, Qayum seems to suggest that if there were any disequilibrium from these causes it would not be a shortage but a surplus of supply over the small amounts demanded. Financial institutions, he says, "could not maintain lower interest rates if the demand for capital were high enough; due to lack of initiative and enterprise, the demand is very low even for the small amount of capital which is available." (p. 3)

Insofar as inadequate demand is responsible for low interest rates, the most appropriate action might be the

stimulation of the supply of a third factor of production, entrepreneurship, through training and other programs which need have no direct effect on the prices of labor or capital. Indeed, if demand is too low, a tax or increased charge for the use of capital is, to that extent, unnecessary and is, in and of itself, only likely to aggravate the problem.

All the other sources of low interest rates cited by the accounting price theorists are governmental lending policies. Tinbergen describes a "tendency for underdeveloped countries to organize cheap credit facilities for certain types of small enterprises" (p. 77) and implies that funds derived from international loans to governments are often re-lent at the low rates at which they were obtained (p. 39). Qayum describes a tendency for central banks to imitate the low-interest policies of their counterparts in countries where capital is more plentiful (p. 3).

Given the low demand for capital already described, it is not clear that such low-interest policies necessarily create an actual market disequilibrium. Insofar as they do, however, Tinbergen is clearly correct when he contends that "the interest rate to be applied should express the real scarcity of capital" (p. 42). But a disequilibrium directly resulting from the lending policy of the government can be corrected merely by adjusting that policy (which may be all that Tinbergen is advocating). It does not by itself justify an offsetting tax levied on the users of capital of the sort Qayum recommends (pp. 71-72).

There is a definite role for a capital tax within the assumptions of the accounting price policy, a role which both Tinbergen and Qayum recognize. When the employment of labor in a project is subsidized on the basis of a single accounting wage, this increases, as we have seen, the return

to a complementary factor like capital. If the amount of capital is assumed to be fixed, its increased return would constitute a "quasi-rent" that makes no contribution to factor allocation. The role of a tax on such capital is to absorb this windfall gain and make the net cost of the policy much lower than the gross amount of the labor subsidy.

The capital tax, however, has not been shown to be independently justified. The theorists posit no political pressures or institutional rigidities on the interest rate creating a market disequilibrium beyond the reach of conventional policy tools. Demand-responsive interest rates are an alternative way of equilibrating the capital market, serving as they might to alter the relative prices of capital and labor. Development policy has in fact a degree of freedom which the stress on market disequilibrium obscures.

ii) The Elasticity of the Supply of Capital

Let us for the sake of argument, accept the assumption of the accounting price theorists that the interest rate does not affect the gross sum of positive savings in the economy as a whole.[34/] It does not follow, however, that

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34/ There is, however, evidence which suggests that private savings is responsive to higher rates of return. Hirschman, on the basis of his Columbia experience, argues that "additions to savings depend far more on the opening up of investment opportunities and on the removal of various obstacles to investment activity than on increased income." ([24], p. 32.) For a partial statistical confirmation for several Latin American countries, see the savings equations in [12]. Falcon and Gotsch show how opportunities for substantial returns to investment in tubewells elicited unprecedented voluntary savings among Pakistani farmers. ([20], pp. 9-16.) In a recent study of United States data, Wright [50] finds a significant negative influence of interest rates on overall consumption. Tinbergen himself may be implying some elasticity of the total supply of savings when he speaks of the interest rates at which it is possible to "attract additional capital." (p. 39.)

the rate does not affect the availability of capital to the productive sectors of the economy. The subsidization of the productive sectors would increase the marginal product of capital in them and – if the interest rate were allowed to respond freely to market forces – enable them to bid more for capital. This would increase the rate paid not only by producers but by all potential borrowers in the economy. So long as the demand for capital by non-subsidized users was at all interest-elastic, the subsidized users of capital (producers) would be able to obtain a larger share of capital for themselves merely by bidding it away.

The non-subsidized users – whether they be described as "non-productive investors" or "dissavers" – who would be induced to use less capital might include:

a) individuals borrowing for purposes of consumption, including the heavy expenses often associated with traditional ceremonies and celebrations;[35/]

b) individuals and firms borrowing to support the construction of housing units or recreational facilities, either for use or for rental;

c) governmental bodies at all levels borrowing to cover their deficits, whether attributable to expenditures on current account or to long-term projects.[36/]

35/ A clear example of this phenomenon has been called to my attention by Subramaniam Swami. When the Government of India increased the rate of interest on a category of consumer loan commonly used to finance weddings, the standard length of the celebrations – though based on long-standing custom – was reduced by several days.

36/ For quantitative evidence of the importance of the rate of interest in influencing non-productive borrowing we must largely rely on studies of the United States. A significant relationship is best documented for expenditure on

Thus, even with a total stock of funds which is fixed by the level of positive savings in the economy, the presence in the market of these other users of funds means that there may be a significant degree of interest elasticity in the supply of capital to productive users. Allocating more of this capital to such users would mean that funds which might otherwise have been spent for apartment buildings, stadiums, funerals or filing cabinets would be spent instead for factories, bullocks, machinery, and inventory, but the total level of spending in the economy – and hence

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housing; see, for example, Brady [3], who uses interest rates, and Break [4], who uses a composite terms-of-credit variable which includes interest charges. Hamburger [22] finds expenditure both on automobiles and on other consumer durables to be significantly and negatively related to the interest rate, while Suits [43] and others have related automobile demand to more general measures of the availability of credit. Phelps [35] reports that from two to five per cent of construction undertaken by state and local governmental units is shifted to periods of easier credit and that from four to seven per cent of municipal capital expenditures are cut back in response to tightening credit. These studies suggest that when the interest rate is considered – alone or together with other elements of non-price rationing of credit – it has significant negative influence on categories of expenditure for which borrowing is common.

A full-scale study of the savings behavior of India [32] suggests that there would be considerable room for expanding productive investment consistent with the same overall sum of positive savings in the economy. Using totals for the last three years reported (1954-57) we find that productive investment – which we will define as farm, non-residential and business investment and government corporate and commercial investment and (arbitrarily) one-half of individual's investment in transport – accounts for 62.2 per cent of the sum of gross domestic investment and dis-saving. Non-productive investment – defined as residential construction, one-half of individual transport investment, the operating deficit of government administrative departments and the total net increase in the liabilities of individuals – accounts for the remaining 37.8 per cent.

the general price level — need not be affected. There might be some upward pressure on the prices of capital goods, due to increasing short-run costs during the transition to a new pattern of allocation of capital funds. In the long run, however, most capital goods industries are marked by constant or increasing returns to scale,[37/] and any price increases should be temporary.

In order to describe the elasticity of the supply of capital it is necessary to define more carefully the "price of capital" which corresponds to the annual wage rate as the "price of labor." It is not possible to identify this, as Qayum and others do, simply with the interest rate. Capital goods will be employed in a project only if it is anticipated that they will add enough to production to cover that fraction of the total initial outlay represented by the depreciation allowances plus the interest costs (whether real or imputed). Consider a project built with borrowed money which realizes a constant level of earnings continuously over the useful life of its capital equipment. It will be able to retire its monetary capital from the beginning of operations, and the average annual interest cost will be substantially less than the rate at which the loan was contracted. If we were to ignore compounding, we could say that the average interest costs on a loan would approach one-half the contractual rate as the retirement of monetary capital approached an immediate, continuous and even flow. The effects of a gestation period, lumpiness in repayments and compounding of interest charges will make the actual average cost somewhat higher. But we may approximate the annual "price of

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37/ See, for example, Chenery [10], especially p. 643.

capital" by the price of capital goods times the sum of the rate of depreciation and one-half the rate of interest.[38/]

If we assume the price of capital goods to be constant, the fact that interest charges represent only a part of the "price of capital" means that the overall price elasticity of the supply of capital will be significantly greater than its interest elasticity. That is, even if a large increase in the rate of interest were required to bid a given amount of monetary capital away from non-productive users, this would represent a much smaller increase proportionately in the overall price of capital to the productive user – and hence would require a smaller increase in productivity to justify paying the price. With a useful life of capital of 20 years, a doubling of the rate of interest, from 4 to 8 per cent, increases the "price of capital" by only 38 per cent. Thus, increases of relatively small proportions in the marginal productivity of capital resulting from subsidization will enable investors – if permitted to do so – to offer interest rates which are proportionately much higher.

If we are correct in our assumption that increases in the market rate of interest can yield significantly more

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38/ For example, consider again a project with a constant yield over a useful life of 20 years. If the present value of the yield just equals the cost of the marginal unit of capital equipment, that unit of capital will be on the borderline between acceptance and rejection. At an interest rate of 4 per cent, compounded annually, the gross annual yield must be at least 7.358 per cent, or the annual depreciation allowance (5.0 per cent) plus 2.358 per cent, which is .59 times the rate of interest. At an interest rate of 8 per cent, for which the effects of compounding are more intense, the gross annual yield must be 10.185 per cent of the price of the marginal piece of capital equipment, or the rate of depreciation plus 5.185 per cent, which is .648 times the rate of interest.

capital to the subsidized sector, then a policy which takes full advantage of this supply elasticity will obviously be preferable to one which does not. Tinbergen correctly warns that permitting "even a small waste of capital may bar the possibility of improving the situation of superfluous labor." It does not seem enough, however, to urge as a consequence that "everything should be done to restrict capital requirements for a given type of production." (p. 49) It is also necessary that equally restrictive standards be applied to the non-productive uses of capital and that productive users be encouraged to employ fully the capital which is thus released. When, however, accounting prices are calculated on the assumption that the supply of capital is perfectly inelastic and the capital tax is levied only on subsidized users, non-subsidized users are permitted to maintain their utilization of capital according to the market interest rate rather than the higher standard set by the marginal productivity of capital in productive enterprises. It is in part to prevent such a misallocation at the expense of subsidized users of capital that we propose an alternative policy to deal with the problem described by the accounting price theorists.

B) <u>An Alternative Policy</u>

Our alternative policy has two elements which parallel the subsidy on the employment of labor and tax on the use of capital by which the accounting price policy is intended to stimulate current output. The first element is based on a simple logic. Insofar as the ultimate objective is increased output, which is the assumption of each of the accounting price theorists, this will be more effectively realized through the subsidization of output itself rather

than through the subsidization of employment regardless of its contribution to output. Since the demand for labor is derived from the demand for output, an output subsidy (based on value added in all new investment projects) would also stimulate the demand for labor, though not necessarily by as much as would an employment subsidy. The second element aims to utilize the increased demand for capital resulting from subsidization to draw as much capital as possible from non-productive to productive users. It therefore consists of a market interest rate which is free to reflect the total demand for capital in the economy and to ration that capital among the users who are prepared to pay the most for it.

In practice, an output subsidy is a highly flexible policy instrument and can be applied in different degrees to different sectors or projects, taking into account any externalities associated with each.[39/] Insofar as policy aims only at increasing the general level of output, however, the subsidy would properly consist of a payment of a uniform percentage of value added in new investment projects. The actual percentage – and hence the size of the subsidy – would be based on the government's ability to raise revenues and on a comparison of the marginal benefits of increased subsidization with those of increased investment in long-run development.

39/ The accounting price theorists often mention the possibility of external economies in some projects as an additional justification for the use of accounting prices. They offer no argument, however, that such economies are likely to be attached to the employment of labor in a particular project rather than to its overall level of output. The output-subsidy policy would seem to be an easier basis from which to recognize particular external economies or diseconomies attached to the output of a project.

Whether or not there were some initial disequilibrium in the capital market, government subsidization – either of output or of employment – would tend to cause an upward shift in the demand curve of producers for capital. The proposed policy would let the government respond by raising the rate of interest charged by its own lending agencies and by banks under its direct or indirect control. This would require no additional administrative machinery for the capital market; lending agencies would need only to respond to directly-perceived market forces by increasing rates for all borrowers in order to equilibrate supply and demand. If there were no legal or institutional barriers to the borrowing and lending of marginal funds by producers in the public and private sectors, a single market rate of interest (or structure of risk-differentiated interest rates) would thus determine the costs, whether real or imputed, of employing monetary capital anywhere in the economy. At the same time, a single market wage rate would determine the costs of employing additional labor.

A general increase in interest rates would introduce the possibility of additional gains to private owners and lenders of capital. The likely size of such gains, however, is not very great. Much of the lending in question is done by governmental agencies themselves. The bulk of the remainder is typically done by the banks, which, if they are not state-owned, are in almost every case subject to sufficient central bank control that the government could realize as its own revenues the proceeds from higher interest payments.[40/] The most efficient way to deal with any

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40/ For example, in response to an increase in the demand for credit the central bank can increase the discount rate

remaining private gains is to tax the recipients of capital income enough to offset most of the benefits to them from the increase in interest rates. (This is entirely consistent with a political constraint against lowering their net incomes.) To tax productive enterprises for their use of capital would be to penalize them for increased use of the most productive factor of production available to them.

Under the output-subsidy policy, subsidized producers could explore the capital market and bid more whenever marginal units would contribute more to production than to cost. The increased price would force non-productive users (and the less efficient productive users) into hiring less capital, perhaps in some cases substituting labor for it. For example, not only might fewer luxury apartment buildings be built, but those which were would incorporate fewer automatic conveniences and require more unskilled attendants. Firms in the productive sector – especially those able to make the most efficient use of increased capital – would be able to employ more of it.

The total use of labor in the economy as a whole might be less than under the accounting price policy. Profit-maximizing project managers in the subsidized sector would substitute capital for labor, however, only if it would

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and adjust reserve requirements so as to siphon off the increased earnings of commercial banks. See Chandler ([7], p. 4) for a survey of the strong legal powers of most central banks in otherwise underdeveloped economies.

If, as is conventionally assumed (see footnote 11) recipients of capital income have a zero marginal propensity to consume, then any private gains would affect the distribution of wealth in the economy but would automatically permit equivalent government expenditure without inflationary consequences.

clearly result in the attainment of higher levels of production. In fact, only in the special case in which the elasticity of supply of capital is actually zero would the output-subsidy - free-interest policy provide as little additional current output as the accounting price policy at the same financial cost.[41/]

Of course, it is possible to modify the accounting price policy further so that it not only incorporates cost constraints but also takes account of any elasticity in the supply of capital. The capital tax might be more broadly

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41/ In this special case, if producers behave competitively and the returns to scale are constant, the price of output and market prices of capital and labor generated by a given subsidy under the alternative policy would bear the same relationship to each other as the market price of output and the accounting prices of capital and labor generated by the same net subsidy under the accounting price policy. The former would have their absolute values determined by the market price of labor, the latter by the market price of output.

Wolfgang Stolper has suggested to me that a less cumbersome alternative policy would be a lump-sum payment tied to increased output or employment and equal to the net subsidy indicated by an accounting price policy. Such an alternative would be preferable to an output subsidy under either of two assumptions: a) that the supply of capital is inelastic, or b) that it is impossible to tax away quasi-rents paid to capital as its market price is bid up by producers. Unlike the accounting price theorists, I specifically reject the first assumption, but the second is subject to empirical variation across countries. If it is possible to increase the available supply of capital it can probably be done most effectively by giving a gross subsidy to producers which enables them to bid more in the capital market. (When the analysis is extended, as below, to a multifactor world, a lump-sum subsidy policy depends on either of the two assumptions being valid for each factor other than unskilled labor. The cumbersomeness of the output subsidy policy also increases, however.)

applied in the economy than most accounting price theorists envision, and the level of the accounting prices for both capital and labor might be calculated so as to maximize output in the face of a degree of elasticity in the supply schedule for capital. The two policies will still differ in their effects, however. So long as labor and capital are at all complementary — which is almost certain to be true in any real production situation — subsidies tied to the use of labor will induce producers to attempt to hire some additional capital. But unless the two factors are perfect complements — i.e., unless their proportions are fixed — a labor subsidy will entail some bias in favor of additional amounts of labor. Increased employment *per se* would contribute more to profits, even though additional use of capital would contribute more to output. When a policy is based on a labor subsidy rather than an output subsidy, then, the attainment of a particular level of output will entail larger net subsidy costs; or, alternatively, the expenditure of a given amount of money on subsidization will result in a smaller increase in output.[42/]

There are several reasons other than the more efficient utilization of capital why an output-subsidy policy

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42/ The subsidy costs of a fixed output target may be illustrated for the readily-calculable case in which the elasticity of supply is unity. Let us suppose that the labor productivity exponent (α) of a Cobb-Douglas production function is .4 and that we seek to increase output by 20 per cent. Even if the accounting price policy were modified to take into account the elasticity of the supply schedule it would indicate an increased capital use of only 9.5 per cent as against 13.9 per cent for the output-subsidy policy; labor use would increase 37.6 per cent as against 29.8 per cent. The net subsidy cost of implementing the modified accounting price policy would be 80 per cent greater than the cost of the output-subsidy policy.

could be expected to contribute more to output when applied in the real world.

1) When subsidization is tied to increases in employment rather than to increases in output, there is a greater danger that the level of subsidization will become a political issue. The same kinds of pressures which prevent the government from taking any action to lower the market wage rate may prevent it from raising the accounting wage rate once it has been established. Such an irreversibility might discourage the use of a trial-and-error method as a means of determining the ideal level of subsidization.

2) Policy must necessarily be executed in a world of imperfect knowledge. Both policies require that the government estimate the effect of a degree of subsidization on output and the effect of increases in output on the financial capacity to subsidize. An advantage of the output-subsidy policy, however, is that planners need not have a precise knowledge of the degree of elasticity in the supplies of capital and labor. Once the promise of subsidization has been made, it is for the producers themselves to test the factor markets. Interest rates can be permitted to adjust passively to the increased demand for capital as it is actually felt, and this adjustment will determine the marginal rate of substitution between capital and labor in all uses. The accounting price policy, on the other hand, has two active policy instruments which determine that rate of substitution — the accounting prices of the two factors — and plans based on specific assumptions as to market responses to these prices could go seriously awry if those assumptions proved incorrect.

3) The most serious difficulty of an accounting price policy, however, is one which is obscured by models

which utilize only capital and labor. In the real world there are several other factors of production which can be distinguished — land and natural resources; technology; management and entrepreneurship; and labor skills — and there is no reason to imagine that the availability of any of these is rigidly fixed in the economy as a whole, let alone in the subsidized sectors. Thus, the problems of the policy in a two-factor model may be generalized: subsidies tied to the use of a particular factor of production will induce producers to hire some additional amounts of all complementary factors but to favor the subsidized factor as against all others not perfectly complementary to it, even though further increases in those other factors might contribute more to output. Consider the simple example of a firm that would be able to eliminate some inefficient procedures, and hence some unnecessary jobs, by hiring and following the recommendations of a time-study expert. The cost savings might be enough to justify hiring the expert if the actual market wage rate were the basis of the calculation of labor costs but not if the lower, accounting wage were the basis. Thus, an action which would reduce the total financial cost of attaining a given output would be taken under the output-subsidy policy but rejected under the accounting price policy.

The ingenuity of entrepreneurs leads them to seek to increase production or to cut costs in multifarious ways, and it is impossible and unnecessary to describe them all here — or to anticipate tham all in the formulation of policy. But a policy of subsidizing employment provides incentives for producers to maximize employment, not output. If independent weight is to be given to the employment-

producing aspects of a development program, employment subsidies may be justified, although realistic planning must recognize that there is a point beyond which the price of an increase in current employment is a reduction in current output. If, on the other hand, it is output alone which is to be maximized, there is a compelling and inescapable logic to the idea that it is output which should be subsidized.

IV. Other Uses of Accounting Prices

There are two other issues raised by the accounting price literature which deserve some attention. The first is the argument that accounting prices are necessary because the present prices of factors and products may differ from those which are likely to prevail upon the successful completion of the development program. The second is a more limited interpretation which some have placed on the applications of accounting price theory.

A) Changing Prices Over Time

Tinbergen offers another major reason – in addition to factor market disequilibrium – why market prices and "intrinsic values" may differ. "The realization of the investment pattern will itself influence these values, but only after some time, since investment processes are essentially time-consuming." He formally defines accounting prices as the values which "would prevail if (i) the investment pattern under discussion were actually carried out, and (ii) equilibrium existed on the markets" (p. 39).

Logically, the definition in this form lacks consistency, since it seems to require that a single set of prices meet two different and possibly contradictory criteria.

Economically, that lack of consistency is confirmed, since a successful development program will entail a rate of growth of capital which is greater than that of labor. Over time, then, the price of capital should decline relative to that of labor, whereas Tinbergen argues that for short-run equilibrium the relative price of capital should increase.

The definition makes sense only if Tinbergen means to imply that a set of accounting prices is a whole matrix of values, with a different vector of prices appropriate to each time period. A rational investment policy, whether public or private, will, after all, look to the prospects for changes in prices — of the goods being produced, of complementary and substitutable goods, and of factors — and will take these prospective changes into account in accord with their magnitude, their importance and their certainty. In actual practice private producers may not adequately allow for the impact of planned development programs on future prices. The real issue, however, is whether this failure is attributable to some defect in the criterion of profit maximization, requiring correction through a set of artificial accounting prices. If it is not, planners, rather than imposing such prices on the public and private sectors, might merely communicate their own estimates of changes and the bases of these estimates (perhaps adjusting the general level of any promised subsidization accordingly). Investors would be able to make appropriate adaptations in their own plans — on the basis of rational profit-maximizing calculations. There would be results different from those intended by the planners only if investors were unwilling to put total reliance on the accuracy of the estimates. Given the number of times in recent years that planners in various parts of the world have been forced to scale down

ambitious development goals in mid-Plan, there would seem to be room for some healthy skepticism in this area. A policy which suggests rather than imposes future prices seems more likely to be successful.

B) Allocating Government Capital

There is another, more modest sense in which some economists use the term "accounting price." In executing projects in the public sector, government agencies use monetary capital a) which seems to have no market price, having been allocated for development purposes from government revenues, or b) the market price of which is artificially low because of preferential interest rates offered by foreign governments or domestic banks. The problem is to determine acceptable rates of return for projects, and the basic rate selected might be termed an "accounting price" for capital, though it has no necessary connection with the "accounting price policy," with its subsidization of the use of labor and tax on the use of capital. Many of the comments of the theorists, when removed from the context of the overall theory, have relevance for this narrower problem. In particular, Chakravarty [6] does not make clear whether the policy he proposes would value labor at its market price or its accounting price, and his analysis has been interpreted in this more limited sense.[43/]

43/ Mason [28], for one, has interpreted Chakravarty in this way. The ambiguity on this point arises because, although Chakravarty states that the shadow price of labor may be zero (p. 50) and includes no explicit labor cost term in the total cost expression which he seeks to minimize, he does include the "current operating expenses of the project" (p. 65), which might well include labor. Since his technique for estimating the shadow price for capital is independent of this discussion, it may be evaluated separately.

According to the analysis we have offered in Section III, potential investment funds have three alternative uses — to reduce levels of non-developmental expenditure, to reduce taxation, and to increase levels of subsidization of employment or output. Welfare will be maximized if in each period the marginal social value of all three of these uses is equal.

The future gross returns of current investment will be contributions to future budgets. Additional current investment will be justified so long as its gross returns — weighted by the marginal social cost of taxation in each of the periods during which they will be realized, and discounted back to the present by the social rate of time preference — are greater than the current marginal cost of current taxation.

If the total level of current investment can be determined in this way, the only remaining problem is how to allocate investment funds between public and private projects. The point of departure for such an allocation should be the market rate of interest for the safest marginal investments available. This may or may not be the price at which most capital is actually obtained by the public sector. But so long as capital markets operate well enough to permit marginal amounts of capital to flow between the public and private sectors, this rate at least represents the opportunity cost of using more capital in the public sector rather than lending it to private producers. Use of the market rate as a criterion for public projects would follow Tinbergen's prescription:

> Some indication of equilibrium interest rates may be derived from (a) the rate at which it would be possible to attract additional capital, and (b) the profitability of marginal projects, corrected for risks involved. (p. 39)

This can represent a single, consistent criterion, the two elements serving as the blades of a Marshallian scissors. Projects in the public sector would be expanded or contracted to the point at which the discounted productivity of marginal units of capital equalled their price. Expansion would involve bidding additional capital away from the private sector, consistent with a basic inflationary constraint on the growth of the money supply; contraction would entail lending additional government capital to private firms In either case the prevailing market rate of interest might change as a direct result of the adjustment. But in the end, the overall forces of supply and demand for capital would be in equilibrium and the marginal productivity of monetary capital would be equal for both sectors, as judged by a common rate of interest.

The simplicity of this criterion stands in notable contrast to the pretentious sophistication of Chakravarty's formula for the shadow rate of interest. He begins by writing off the market rate as irrelevant:

> Whatever approximations we may devise for computing the shadow rate of interest, even though they are correct only in a qualitative sense, will be more useful than relying on the observed market rate of interest in economies characterized by market imperfections, etc.

Although he distinguishes other cases, his own formulation is offered only for the case in which returns to scale are constant and rates of capital growth in all sectors of the economy are identical. He introduces a formula derived by Solow [41] for the relationship between the rate of interest (ρ), the overall rate of growth (g), the relative share of profits in total income (D), and the savings coefficients of profit recipients and wage earners. He

then simplifies this relationship by taking a weighted sum of Solow's two savings coefficients and using it as a single expression for the global savings ratio (s). His formula for the rate of interest becomes:

$$\rho = \frac{g}{s/D}$$

Chakravarty contends that if the market rate of interest seems to understate the "real scarcity" of capital, then that rate sets the lower limit for the appropriate shadow rate to be used in planning, while the value (ρ) indicated by the formula sets the upper limit. Applying the formula to varying estimates of the relevant parameters for India, he obtains a value for this upper limit of from 8 to 12 per cent. (pp. 57-63)

This approach suffers from at least three difficulties:

1) If the rate of interest indicated by the formula has any validity, it should be more than simply the upper limit to the appropriate shadow rate but should be a direct estimate of that rate itself. Chakravarty offers no reason why the ideal rate does not have as good a chance of being above the rate calculated as below it.

2) Not only is the formula based on some special assumptions that Chakravarty explicitly introduces, including the highly unrealistic one of proportional sectoral growth, but — as Solow makes clear in his original formulation — it requires a number of other simplifying assumptions as well. These include: a) that production conforms to a Cobb-Douglas function employing only capital and labor, since "land and natural resources are to be thought of as abundant and free"; b) that capital consists of a "single type of durable machine"; (c) that both capital and labor are fully employed;

d) that the economy is in a "golden age" of growth in which "all extensive magnitudes (labour force, stock of machines, both outputs) are growing exponentially at the same rate" and hence there are "constant prices, a constant interest rate, and a fixed optimal durability of machines"; e) any technological progress is "neutral" and "disembodied," and f) a number of other simplifications of reality common to growth models.[44/] Solow's assumption a) should be enough to render results irrelevant for India, but assumption c) directly contradicts Chakravarty's premise that surplus labor is available, and assumption d) precludes the possibility that the capital stock may grow faster than the labor force. Even if a highly abstract model such as Solow's were based on assumptions which were consistent with the problem, its legitimate function would be as a contribution to pure theory. The precipitous jump from such a model to quantitative conclusions about the real world can only be judged a perversion of that function.

3) It is difficult to see how this or any other a priori theoretical estimate of the shadow interest rate, however realistic the assumptions on which it is based, could be of very great use to the planner. The ultimate requirement is for a single rate which will equate the overall supply and demand for capital in the economy. If the planner seeks limits within which such a rate will be found, he need only look to the pure rates of interest originally being applied at the margin to projects in the two sectors,

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44/ Readers of the Chakravarty article were offered no caveat as to the highly abstract and admittedly fictional assumptions on which Solow formula was based.

public and private. When capital is permitted to flow from the sector with the lower marginal productivity of capital to that with the higher until equality between them has been attained, the resulting rate of interest will necessarily lie somewhere between the two original ones.

V. Conclusions

The accounting price theorists have concentrated on a single aspect of the problem of many underdeveloped economies — the existence of large pools of unemployed or partially-employed workers — and have concluded that this may justify an accounting wage of zero. When, however, one considers other aspects of underdevelopment in those same countries — the low productivity of the unskilled workers who would be employed, the low propensity of such workers to save, the severe limitations on the ability of the government to raise revenues, and the pressing need for higher levels of physical and human investment — the inadequacies of the theory become clear.

Because the accounting price theorists do not seriously examine these budgetary constraints and alternative uses of development funds, they advocate levels of subsidization determined by the extent of the unemployment rather than by the limits on the fiscal capabilities of the government. Because the theorists mis-diagnose "disequilibrium" in the capital market, they do not consider the possibility of price elasticity in the supply of capital and thus overlook opportunities to increase its stock. Because the theorists utilize simplistic two-factor models of production, they overlook an endless variety of ways in which output could be increased if output, rather than

employment, were being subsidized. The theory, then, cannot be resurrected by the simple act of recalculating accounting prices to take into account the elements thus far neglected — budgetary constraints and elasticity in the supply of capital. In a multifactor world no policy which works through subsidies for the employment of labor and taxes on the employment of capital will maximize output, which is ultimately the basis of present and future welfare in any underdeveloped economy.

It is difficult, then, to join in the lament of the accounting price theorists that actual planning decisions have so seldom reflected their teachings. For example, Papanek has complained:

> Criteria applicable in determining the composition of development programs have attracted considerable attention among economists — but the planning bodies that exist in many countries have paid this literature little heed and relied on 'common sense' and political considerations. ([33], p. 307)

The conclusions of this paper suggest that the amorphous dictates of "common sense" — necessarily including an irrepressible concern over budgetary implications — would take a country far closer to an optimal development policy than the relentless logic of the accounting price theory.

VI. Appendices

A) Net Subsidy Costs

Let output in projects be a function of the capital and labor employed:

$$X = X(K, L).$$

In projects designed to maximize profits at market prices, the marginal products of the two factors will equal their market prices (in real terms). That is, when employment has been carried to the level (L_o) indicated by profit maximization, then:

$$(1) \quad X_o = X_o(K, L_o), \text{ and}$$

$$(2) \quad \frac{\partial X_o}{\partial K} = R_m, \quad \frac{\partial X_o}{\partial L} = W_m$$

When projects are designed to maximize profits at accounting prices, the marginal products of the two factors will equal their accounting prices and the employment of labor will increase (to L_1). Letting

$$(3) \quad L_1 = L_o + \Delta L, \text{ and}$$

$$(4) \quad X_1 = X_1(K, L_1), \text{ then}$$

$$(5) \quad \frac{\partial X_1}{\partial K} = R_a, \quad \frac{\partial X_1}{\partial L} = W_a$$

Due to diminishing returns to a single factor, the marginal product of labor will have fallen. Due to complementarity between factors, the marginal product of capital will have increased. Thus:

$$(6) \quad R_a > R_m \quad \text{and} \quad W_a < W_m$$

The Euler theorem states that, when returns to scale are constant, payments to factors at their marginal products will exhaust product.

$$(7) \quad X_o = R_m \cdot K + W_m \cdot L_o$$

$$(8) \quad X_1 = R_a \cdot K + W_a \cdot L_1$$

The net subsidy (S) consists of the gross subsidy for labor less the tax on capital:

$$(9) \quad S = (W_m - W_a) \cdot L_1 - (R_a - R_m) \cdot K$$

Multiplying through and substituting from (3):

$$S = W_m \cdot L_o + W_m \cdot \Delta L - W_a \cdot L_1 - R_a \cdot K + R_m \cdot K$$

$$= W_m \cdot \Delta L + (W_m \cdot L_o + R_m \cdot K) - (W_a \cdot L_1 + R_a \cdot K)$$

Substituting from (7) and (8):

$$S = W_m \cdot \Delta L + X_o - X_1$$

Letting $X_1 - X_o = \Delta X$:

$$(10) \quad S = W_m \cdot \Delta L - \Delta X$$

That is, the net subsidy equals the additional financial cost to producers — the increase in labor employment times the market wage — less the additional output generated.

Since, from (2), (5), and (6): $\frac{\partial X_1}{\partial L} < \frac{\partial X_o}{\partial L} = W_m$, it follows that

$$(11) \quad \frac{\Delta X}{\Delta L} < \frac{\partial X_o}{\partial L} = W_m;$$

i.e., the discrete increase in output associated with the discrete change in employment is less than the initial marginal product.

Multiplying (11) by ΔL, we have $W_m \cdot \Delta L > \Delta X$; therefore the required net subsidy indicated in (10) is positive.

In the case of the Cobb-Douglas production function ($X = L^{\alpha} \cdot K^{1-\alpha}$) the net subsidy can be shown as a function of the increase in labor intensity. Let $L_1 = \lambda L_o$. The market wage will be:

$$(12) \quad \frac{\partial X_o}{\partial L} = \alpha L_o^{\alpha-1} \cdot K^{1-\alpha} = \alpha \frac{X_o}{L_o},$$

while the new level of output will be:

$$(13) \quad X_1 = (\lambda L)^{\alpha} \cdot K^{1-\alpha} = X_o \lambda^{\alpha}$$

and the increase in output will be:

$$(14) \quad X_1 - X_o = X_o(\lambda^{\alpha} - 1)$$

Corresponding to (10), the net subsidy will thus be:

$$\alpha \frac{X_o}{L_o}(\lambda - 1)L_o - X_o(\lambda^{\alpha} - 1), \text{ or}$$

$$(15) \quad X_o(\alpha\lambda - \alpha - \lambda^{\alpha} + 1)$$

This is identical to the single-period cost component derived by Qayum.

B) Qayum's Cost Calculations

Several chapters of Qayum's book (VII-X) are, in effect, devoted to making the argument that financial cost will not operate as a constraint on a program of accounting prices. He argues that, when the accounting prices are determined by his definition of the labor constraint, and even when this entails substantial increases in employment, "the financial burden as a proportion of the national product in the current period will be very small"(p. 93). The policy will not "result in a reduction in the volume of savings," even when subsidization is seen as drawing down that volume (p. 101), and the "inflationary pressure" created by the policy will be "quite negligible" (p. 109).

i) The Productivity of Labor

The major difficulty with the hundreds of numerical examples on which these conclusions are based is that they all incorporate a gross overstatement of the marginal productivity of the labor concerned. In the first place, Qayum employs a Cobb-Douglas production function, which always assumes an elasticity of substitution between capital and

labor of unity. This in itself rules out the possibility of a marginal productivity of zero, although all the other accounting price theorists conceive of this as a distinct empirical possibility.[45/] Even given the Cobb-Douglas, however, it is notable that Qayum states initially that the labor productivity exponent (α) in the function "may be roughly assumed to be equal to .75" (p. 81). Though he lets every other parameter vary during the course of his calculations, he maintains this assumption, without further defense or explanation, throughout his analysis. While .75 is the value for α which Douglas found for the most-highly developed economy, that of the United States, many theoretical discussions and empirical studies indicate that the value for the overall labor force in underdeveloped countries, where labor skills and experience tend to be much lower, should be as small as .4 or even .3.[46/] Even beyond

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45/ Even if we assume some positive elasticity of substitution for all factor proportions, empirical evidence suggests that the value should be considerably less than one. Clague [13], for example, fit a constant elasticity production function to comparative plant data for nine kinds of manufacturing in the United States and Peru. He found values for the elasticity of substitution almost uniformly below .5, and usually far lower. The lower the elasticity, the more rapidly does the marginal product of labor drop as production becomes more labor-intensive.

46/ For Douglas' original findings, see [14], chaps. V-VII. In an effort broadly to estimate the appropriate labor and capital exponents for each of the regions of the world, Kristensen, et al, argue that "the available data as well as a priori considerations seem to indicate that (the labor exponent) is highest in the developed regions, whereas (the capital exponent) is highest in the underdeveloped regions." They offer estimates of labor exponents of .60 for Latin America, .50 for Africa and the Middle East, and .35 for Asia (with a corresponding capital exponent of only .50, representing diminishing returns to natural

this, the accounting price theorists exclude from consideration — on the grounds that they are not likely to be in short supply — all managerial, skilled and semi-skilled elements of the labor force. When one is primarily speaking of unskilled, agricultural workers drawn from the rural sector to increase output in the urban, industrial sector, the relevant productivity exponent may be substantially lower than any found empirically for an entire economy — perhaps as low as .25.

Merely assigning lower values to α in the production function suffices to alter substantially every one of Qayum's conclusions. His version of the function may be written as $X = L K^{1-\alpha}$, where X is output, and L and K are the amounts of capital and labor employed. He assumes employment in the absence of subsidization may be as little as 70 per cent of the labor force. Thus, his own definition of the labor constraint (questioned in the next section) initially calls for levels of employment in new projects roughly 43 per cent higher than those indicated at market prices.

We may begin by assuming a reasonable value to the propensity to consume of newly-employed-workers — say 95 per cent — and by assuming a capital-output ratio at market prices of two, which is greater than Tinbergen's estimate for India and Mexico. As a first benchmark, we have seen that it is always desirable from the standpoint of the

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resources). ([25], pp. 253, 255.) Empirical findings include values for the labor exponent of .41 for Ghana [44], .3 for agriculture in the United Arab Republic [19], and values ranging from .40 to .77 for India ([15], p. 20). A South African study found an exponent for non-European labor in manufacturing which was less than half as large as that for the more highly skilled European labor [5].

Development Budget to carry employment to the point at which the ratio of the accounting wage to the market wage equals the propensity to consume. If, as Qayum assumes, α were .75, this would indicate a 23 per cent increase in employment (and a consequent 16 per cent increase in output). If, on the other hand, α were .4, employment would be increased by less than 9 per cent (and output by 3.5 per cent); and if α were .25, employment would be increased by only 7 per cent (and output by only 1.7 per cent).

It is, of course, possible for the government to induce higher levels of employment and output without experiencing a net financial loss, by utilizing the contributions to the Development Budget generated by the increases just described. If α were .75, a self-financed program could increase employment by 47.5 per cent, or slightly more than would be required by Qayum's version of the labor constraint. (Output could thus be increased by an impressive 33.8 per cent.) If α were .4, however, financial capacity would be exhausted by an increase in employment of 20 per cent (resulting in an output increase of 7.6 per cent); and if α were .25 that capacity would be exhausted when only 17 per cent more workers had been hired (increasing output by only 4 per cent). While the latter figures still would represent a useful contribution to output, they suggest that employment of the magnitude Qayum describes cannot be eliminated, even proportionately in a given year, without cutting into funds which would otherwise have been available for investment.

A policy of actually increasing employment by 43 per cent in the projects of any given period can also be evaluated. When α is .75, such increases have a net subsidy

cost of 1.5 per cent of the basic level of output in those projects and increase that output by 31 per cent. When α is .4 costs would equal 1.8 per cent of basic output and generate a 15 per cent increase in output. When α is .25, costs are somewhat lower (since a lower market wage rate is indicated) at 1.4 per cent of basic output, but output increases are only 9.4 per cent. In the latter case newly-employed workers would have to save a remarkable 13 per cent of their wages if the subsidy were not to reduce funds available for investment. (In 1962 the government of India saved just over 1 per cent of net domestic product.) Thus, even with Qayum's highly restricted definition of the labor constraint and his very optimistic assumption of an elasticity of substitution of one, the program will not – as he argues – be costless.

ii) The Labor Constraint

The problem of defining an absolute labor constraint is more complicated than Qayum and other accounting price theorists imply. If there exists a large pool of unemployed workers – e.g., 10 to 30 per cent of the labor force, as Qayum suggests – then an absolute labor constraint would permit them all to be absorbed immediately in the projects originating in the initial year of a subsidization program. This, however, might not only be impossible on financial (or technological) grounds[47/] but might represent a poor

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47/ Unemployment of 30 per cent implies that employment in the economy as a whole must be increased by 43 per cent to absorb the entire labor force. Assume, for example, that 1/20 of the capital stock goes out of service in a particular year and releases 1/20 of the employed labor force; and that current net investment equals half of gross investment. Then capital equal to 10 per cent of the previously-existing

allocation of labor resources. The translation of an overall labor availability into an annual constraint on the absorption of the unemployed is an effort to find that time path for that absorption which would contribute more to total welfare than any other. The use of a single-period model, however, obscures the problem of defining that path. For example, Chenery [9] presents a model for the investment decisions of a single period which simply defines the availability of labor as a particular number of units. Qayum deals with the problem in his multi-period model by presenting – but not defending – a formula which states that the amount of the labor force absorbed in new (and renewed) projects in each period should bear the same proportion to the total labor force as the amount of new gross investment bears to the total stock of capital (p. 90). Given his assumption that the rates of growth of capital and labor are constant and equal, the formula implies that the pool of unemployed workers will be reduced to zero by equal shares of the growing labor force in each period over a complete depreciation cycle. The criterion is, of course, completely arbitrary.

When the overall problem is seen as one of maximizing welfare over time, the definition of the annual labor constraint will differ depending on whether one uses the consumption of previously-unemployed workers or some function

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stock would have to be combined with labor equal to 48 per cent of the previously-employed workers to eliminate all the unemployment in one year. In other words, the labor-capital ratio in the average new investment would have to be nearly five times greater than that in the average existing investment. If there are some sectors, such as agriculture, in which the application of additional labor will not be productive, then employment increases in labor intensity in the other sectors – accounting for half of existing employment or less – must be all the greater.

of total output as the welfare index. If one is seeking to maximize the discounted value of consumption over time, the sooner workers can be employed the larger will be this value: the annual labor constraint is then the total amount of unemployment. If output is the criterion, however, it is necessary to consider the danger that future labor shortages will curtail output in the investment projects of future years. It might be desirable (even in the absence of a budgetary or technological constraint) to absorb in the initial year something less than the full number of unemployed workers available, but the implied annual constraint on the use of labor would still entail a considerable bias towards its early employment.[48/] Under either definition of the welfare function, then, a correct translation of an overall labor constraint into annual terms makes it all the more apparent that a realistic cost constraint would be binding and the labor constraint would not.

48/ If and when all available labor had been absorbed and technologies adopted which made output in existing projects dependent on their continued employment, new projects would be restricted to the labor released by depreciating projects and generated by the natural growth of the labor force. By contrast, projects initiated earlier (but still operating) might embody much more labor-intensive technologies, and this would be economically inefficient. While unemployment persists, however, defining the current labor constraint as anything less than the full pool of available workers would be tantamount to deferring the employment of the excluded workers (or their successors in the labor force) until the full pool is exhausted. In the absence of a budgetary constraint, such deferment would be consistent with maximum welfare only if the discounted value of the stream of marginal products of labor in projects originating in the year in which unemployment was to be finally exhausted were greater than the discounted stream of marginal products in currently-originating projects. The latter sum will include one or more additional years of work, and these will occur at the beginning, when the discount factor is least; both of these considerations imply a considerable bias toward the early hiring of workers.

C) The Productivity of Investment

i) A Graphical Representation

The three kinds of impact of investment on output and employment may be seen with the help of Figure 2, which depicts the output in period j of a project which originated in period i. (The figure is similar to Figure 1 in the text but shows output at all levels of employment. For employment less than $O\text{-}L_o$ output is represented by a constant average output-per-worker rather than by a varying marginal product over an unobserved range.) When capital is limited to some (unobserved) amount K_o, employment at market prices will be the amount $O\text{-}L_o$. Total output per worker with K_o and $O\text{-}L_o$ is represented by the height of the square box $O\text{-}B\text{-}C\text{-}L_o$, labor's share in that output being the area of the box below the market wage line ($D\text{-}W_m$) and capital's share the area above it. The characteristics we have assumed for the production function imply that the marginal product of labor will be an inverse function of the labor intensity of the project and invariant as to scale. In the figure marginal product is depicted as falling off at levels of employment beyond $O\text{-}L_o$ until it equals zero at $O\text{-}L_4$, at which point employment (and hence labor intensity at K_o) has doubled.

This behavior of marginal product should be compared with that in which the capital initially available to the project is some larger amount, K_1. Employment at market prices would be greater by the amount $L_o\text{-}L_1$. The new marginal product of labor would start to decline at A and would also fall to zero (as indicated by the new curve MPL_1) when factor intensity had doubled, but in this case at L_6 rather than L_4. Since $O\text{-}L_4$ is twice as large as $O\text{-}L_o$, and $O\text{-}L_6$ is twice as large as $O\text{-}L_1$, the horizontal distance $L_4\text{-}L_6$ is

twice as large as the distance between L_o-L_1. The vertical height of the wage line, however, is constant. The downward slope of the new marginal product curve is thus less than that of the old.

Consider first the case in which capital is only K_o and the amount available for subsidization of these projects in period j is equal to the triangular area W_m-I-Y. The subsidization will induce additional employment equal to L_o-L_2. If, however, more of the Development Budget in period i had been devoted to investment rather than to the subsidization of output in that period, the capital in this project might be equal to K_1, with the three impacts we have cited in the text on the level of employment and output in period j. In the first place, the basic amount of employment, for which no subsidization is required, would have increased from O-L_o to O-L_1. (Alternatively, we may see this increase as the allocation of the earnings of the new capital above its earnings at the initial market price, or W_m-A-B, to the subsidization of the employment of these workers.) In the second place, since the slope of the new marginal product curve is less pronounced, the same amount of subsidization would have induced a larger increase in employment. That is, if the subsidization of L_1-L_3 additional workers entailed a net subsidy A-P-Z, equal to the original subsidy (W_m-I-Y) required to induce the employment of L_o-L_2 additional workers, then L_1-L_3 would represent a larger increase in employment. In the third place, the additional capital would have earned a return at the original market price of capital which is represented by the rectangular area W_m-A-E-C. This can be considered an addition to the Development Budget and could be used to subsidize employment and output in the current period (if this would contribute most to welfare). If

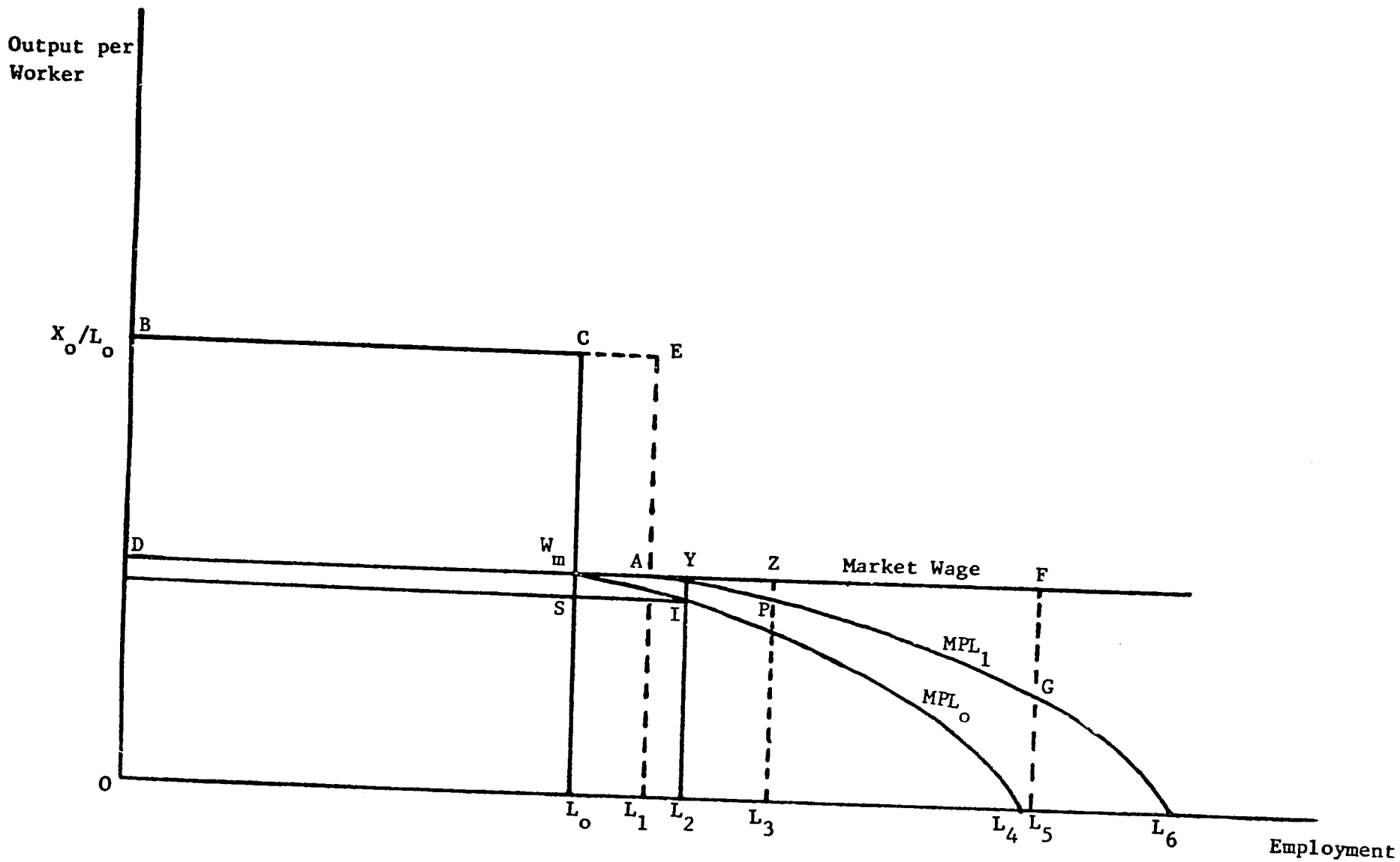
Output per Worker
X_o/L_o
B
C
E
D
W_m
A
Y
Z
Market Wage
F
S
I
P
MPL_1
G
MPL_o
O
L_o
L_1
L_2
L_3
L_4
L_5
L_6
Employment

FIGURE 2

all these earnings were used in this way, employment could be increased to approximately the level $O\text{-}L_5$, such that the additional subsidy required, P-Z-F-G, just equals W_m-A-E-C.

ii) A Mathematical Representation

The approximate formula for the impact of additional investment on future consumption may be derived from the formula for the net subsidy derived in appendix A:

$$(1) \quad S = W_m \cdot \Delta L - \Delta X$$
$$= W_m \cdot L_1 - W_m \cdot L_o - X_1 + X_o$$

If we require a constant level of subsidization of the operations of the projects but permit employment of labor to increase as the capitalization of the projects increases, we should set the total differential of the subsidy term equal to zero:

$$(2) \quad \Delta S = \Delta L \frac{\partial S}{\partial L} + \Delta K \frac{\partial S}{\partial K} = 0$$

Partially differentiating (1), in which X_o and L_o are constants (given by market prices), we get:

$$(3) \quad \frac{\partial S}{\partial L} = W_m - \frac{\partial X_1}{\partial L} \; ; \; \frac{\partial S}{\partial K} = - \frac{\partial X_1}{\partial K}$$

Substituting in (2):

$$\Delta S = \Delta L(W_m - \frac{\partial X_1}{\partial L}) - \Delta K \cdot \frac{\partial X_1}{\partial K} = 0$$

Dividing by ΔK and rearranging:

$$(4) \quad \frac{\Delta L}{\Delta K} = \frac{\partial X_1}{\partial K} \cdot \frac{1}{W_m - \frac{\partial X_1}{\partial L}}$$

Since consumption per worker is $c \cdot W_m$, the change in future consumption associated with the increased capital but with no increase in external subsidization is:

$$(5) \quad \frac{c \cdot W_m \cdot \Delta L}{\Delta K} = \frac{\partial X_1}{\partial K} \; \frac{c \cdot W_m}{W_m - \frac{\partial X_1}{\partial L}}$$

or, according to the notation in the text,

$$MPK \frac{c \cdot W_m}{W_m - MPL} .$$

The total differential on which this is based ignores the impact of increased capitalization on the marginal product of labor at any given level of subsidized employment increase, so that this formulation excludes the second of the three impacts described in part i) of this appendix.

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