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PROBLEMS OF COMMERCIAL AND NATIONAL PROFITABILITY

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1. Introduction

There is a story, which could be apocryphal, of a country, which shall therefore be nameless. It was on the edge of war. The cabinet met to discuss strategy, feeling that they ought to decide in a rational way what their objectives were, and, when these were decided, by what routes and with what force and penetration they should counter-attack. But after forty eight hours of debate in which they touched on matters as separate as their army's cooking arrangements and the reactions of the press to what they might decide to do, they said in despair to the generals who were lurking in the shadows, "You know the enemy. Now fight the war." Which the generals did.

Now it is not difficult to see why discussions of project evaluation and investment criteria slide off the conference table and are lost in the shadows: why it is virtually impossible to get agreement at the top on what investment criteria in the public sector should be. I believe it is almost, if not quite, unknown to find a country where there is a logical connection between whatever form of central economic planning there is and lower level public investment decisions; that is, where the investment criteria which are necessarily implicit in all but the most rudimentary of economic plans are carried down consistently to investment decisions at all levels. Indeed it is common to find inconsistency of criteria even within particular subsectors of the public sector, like transport or fuel and power; and even, within subsectors again, between pricing and investment decisions.

Before going on to the economics which is the heart of our argument, perhaps it would not be amiss to consider briefly some of the political realities creating these inconsistencies for this is not a battlefield where it is sensible to ignore politics. One reason why it is difficult for a government to hammer out a consistent set of investment criteria is that discussions of economic choice easily become confused with closely related issues stirring the passions; private and public ownership, planning versus the price mechanism, centralisation and decentralisation of power. None of these confusions is surprising, particularly that of purpose with ownership; but they hinder rational argument. Secondly it is not the habit of politicians always to set out their reasons for action clearly, especially to set out in advance the principles on which they intend to act (and such a declaration of intention in advance is of course what an investment criterion is.) It is not political wisdom to be so explicit, however much one hedges with statements that one will act differently in special circumstances. Furthermore ambiguity of statement often achieves consensus where perfect clarity provokes dissent. Thirdly the notion that investment criteria should be co-ordinated and consistent presupposes that the decisionmaking process in a nation is consistent in the sense that all political, among which must be included economic, decisions are harmonised to achieve compatible aims. But everyone knows that the process of governing is not like that, whatever the overt form of government. Many decisions are

not taken rationally, but emerge as a vector of pressures, pressure groups, conflicting interests and personal ambitions; and it is inevitable that it should be so. The political process cannot be smoothed away into some overall maximising process. It is unthinkable and probably undesirable that this should happen since it would mean the obliteration of most of the individuality and independence of mind of lower level decision-makers. The cost in terms of loss of energy and incentive could outweigh the gain in rationality.

So far apart are the actual words of political and economic decision-making on the one hand, and of investment criteria and the social welfare function on the other, that one wonders whether there is any point in trying to bridge the firmament between them. Such a bridging must be a limited adventure to have a chance of success. All that one can say is that the attempt to formalise the seamless web of an actual piece of decisionmaking as if those responsible were trying to maximise something may throw light on motives or the adequacy of means. Alternatively, a normative discussion of what alternatives would be chosen if certain principles (criteria) were adopted may be useful in illuminating the possible and so affect policy.

But it is not political reality alone which makes it impossible to think of economic decisionmaking in practice as the maximisation of some given social welfare function. The economic literature on investment criteria in underdeveloped countries has been large, but it has been admitted not once, but several times, that it has not been satisfactory. The ideas that relate to project evaluation converge from two directions: the theory of the firm and its investment policy on the one hand. Business investment procedures have in practice been developed with several ends in view: profit maximisation, incentive to management, the prevention of fraud, the reassurance of shareholders, and, to a limited extent, some backchecking on past decisions. The other direction of influence is the theory of economic growth, and as an integral part of it, the macroeconomic theory of investment. It does not take much imagination to see the difficulty. In asking for the right investment criteria for the individual enterprise, particularly in an underdeveloped country, we are asking for the efficient secret of economic growth, a secret which it is too easy to keep; and we are asking for it in general in such a form that will enable individual decisionmakers in the economy, heads of firms and public enterprises, directors of agricultural programmes, and so forth, to optimise their behaviour in relation to the overall national economic criterion. The theories of economic growth and planning are not far enough advanced to make this as yet a theoretically feasible programme.

Therefore however one approaches the problem whatever one says on investment criteria cannot be satisfactory: whether one starts by considering what is

implied for individual project evaluation by national economic planning, or whether one starts from the other end and asks how considerations of national, as against commercial, profitability diverge from society's standpoint.

In the next section this stage of the argument is carried on in more detail: (1) it is only recently that a long debate on the definition of an optimum growth path has ended by the demonstration that a large number of supposedly independent criteria were special cases of the recommendation that a country should maximise its growth rate subject to some rate of time preference. (2) The question of the choice of a rate of social time preference is considered briefly. (3) Even when there is agreement on the exact criterion, there are informational and computational problems which make it impossible at present to maximise that criterion consistently for an economy. But (4) no country will maximise a single well defined criterion. It is not even an approximation to the truth. Even if we suppose they are consistent, the existence of different criteria for different purposes, stretches the informational and computational problems further. These are the questions considered further in the next section; and they reinforce the same conclusion we have already come to, that the choice of investment criteria must be broken down into a number of suboptimisation problems.

Section 3 accepts this conclusion and discusses alternative investment criteria from the standpoint of some imaginary administrator whose duty it is to define investment criteria for public enterprise bearing in mind questions of consistency and sources of finance. Section 4 particularises further and considers the problem of fulfilling investment criteria other than ordinary commercial profitability, from the point of view of someone evaluating a project: what measurements might he be expected to make? Where might he reasonably expect help?

2. The Impossibility of a Nationally Consistent Set of Investment Criteria

(2.1) Investment Criteria and Economic Growth. Any equilibrium growth path can be made to yield an investment criterion. To take as the simplest case the familiar Harrod (1939, 1948) model, $GC=S$. Or to conform to the symbolism we want to use: $\Delta y/y = K/\Delta y = S/y$. If S/y (the proportion of income saved) is given, then the maximum growth rate, $\Delta y/y$, will be achieved if the investments chosen are those that minimise $K/\Delta y$, (the capital output ratio). Conversely if $K/\Delta y$ is given, the policy maximising S/y maximises $\Delta y/y$. All investment criteria having their roots in the theory of economic growth have their roots in one or other of these simple notions. The first has a rough correspondence to the static notion of efficiency (maximisation of the value of output with given inputs, the difference being that the only input specifically mentioned is capital). The second reflects the dynamic notion that the rate of growth is a function of the rate of savings. There is no reason why an (investment) policy achieving

the one should achieve the other in any finite time period. But unfortunately it is not the case that a policy which sets out to minimise $K/\Delta y$ in any finite time period will maximise S/y (and therefore, for that matter, $\Delta y/y$.)

As it happens confusion over the objectives of maximising output and maximising growth has been at the heart of the theoretical debate in economic literature over investment criteria. Professor Sen (1960) has shown that the dispute is essentially political or ethical: over the social rate of time preference. * It has been proved by von Neumann (1938) that the highest possible rate of growth for an economy is equal to the highest rate of return on capital (profits) on certain assumptions. The germ of truth here is intuitively obvious: if we suppose that an economy saves the highest possible proportion of its income and invests this to maximise the (average) rate of surplus (Δ/Y), then it could not possibly grow faster. But what is the highest possible proportion of savings? (1) If we suppose an economy in which the growth of population is at the same rate as economic growth, then labour will be freely available at a constant real wage in which case the increase in consumption will be a function of capital accumulation. The remainder $(\Delta Y - \Delta W)/Y$ will be surplus available for investment. What will be invested will depend on the proportion of this surplus saved. If we assume that this surplus is all profits and make the 'classical' savings assumption that all profits are saved ($s^p = 1$) we have the maximum rate of growth (given the assumption about population growth). (2) But we can get a yet higher rate of growth if we make an assumption that is sometimes thought relevant to underdeveloped countries; there is disguised underemployment such that additions to the non-agricultural labour force can be recruited without any increase in aggregate wages (consumption). (In other words the shadow price of labour is zero: of Lewis (1954)). Output does not fall when workers leave the land, and taxation is used to reduce the income of the farming sector so that it stays the same per head. In such an economy the whole of the increase in income is investible surplus ($\Delta y/y = S/y$). Unless we consider the possibility of actually reducing aggregate consumption, this growth path is the highest one can imagine, the maximum maximorum. (3) But to come down towards earth, if one supposes that there is a cost in terms of increased consumption in getting labour off the fields into the factories, then the rate of growth will be correspondingly lower. Little (1961) has made a useful double distinction: first between "extraneous" and "functional" consumption. An increase in "functional" consumption is an increase necessary to increase the labour force, or to redistribute it between sectors, or to raise output per head of the workforce. "Extraneous" rises in consumption are unnecessary in the same sense: windfalls, consumption increases achieved by union bargaining, or the

* Chenery (1961) discusses the background to the controversy as a conflict between the static and dynamic notions of efficiency.

generosity of government or employers. The other distinction is between increases in the non-agricultural wagebill which the government can offset by increased agricultural taxation to keep real consumption per head constant, and those it cannot: the feasibility of such an offsetting policy of course depends on institutional factors and political strength. The conclusion is that economic growth in any economy may imply rising real wages either because this is a real cost of increasing output, or the government is unable to prevent it through tax policy. The higher the growth of real wages in this situation, the lower the rates of profit, savings and growth, as Morishima (1960) has demonstrated.

Indeed again the point is obvious intuitively, meaning only that the more a growing economy has to pay out as consumption the less its investible surplus. The kernel of the intuition remains even if we relax some of the assumptions of the von Neumann-type model*.

(1) If we introduce an open economy, a higher rate of growth becomes more feasible. It becomes easier to see how the 'Keynesian' problem of sufficient demand to keep the rate of profit up in such circumstances may be solved, if we imagine growth very much biased towards exports, the proceeds from which are (mostly) saved and reinvested. (2) If we allow that some proportion of profits is consumed ($sP < 1$), the growth rate will be lower (by exact analogy with Morishima's argument above). (3) If some proportion of wages is saved ($sW > 0$) then to that extent any increase in wages will not be a leakage from growth. (4) If there is imperfect competition and externalities, then the social will diverge from the private rate of profit and the optimal investment mix to maximise the growth rate will be different; but the general proposition will not be affected that the greater the investible surplus the higher the growth rate. (5) If there are internal economies and diseconomies of scale, in so far as these are anticipated and reflected in the profit rate, there should be no difficulty. (6) If there is technical progress, the effect depends on its causation. If technical progress is a function of the rate of investment or of the growth rate (Kaldor (1957), Arrow (1962)), then a fortiori, the higher the rates of savings and investment, the higher the growth path. But if the form of the relation varies between investments the optimal investment mix will again be different.

In section 2 we will consider investment criteria which relate to the maximum growth path. But what would such a growth path imply? It would mean that all increases in consumption would be accounted a cost of development. In other words, production's aim would be to produce more production; and if one were to imagine it proceeding ad infinitum the result would plainly be absurd, since there would never be an increase in (non-functional) consumption per head. And the purpose of economic growth is, in the end at least, to raise consumption per head. But several economists (e.g.

* There are excellent discussions of this type of model by Hicks (1965, ch. 18), Hahn and Matthews (1964), and in much more detail in Koopmans (1964).

Little (1961), Balogh (1962)) have recommended a movement in this direction for a finite period; a 'big push' of investment is needed in some countries if the bogey of increasing population outstripping the growth rate is to be avoided, or to establish certain growth-oriented propensities. Afterwards, the 'millenium' is allowed to break and the capital accumulation is used to increase the standard of living. The proposition can also be put as the maximisation of terminal capital, given the time period; and since consumption is given a weight of zero, the concept of social time preference rate does not apply.

But although such a policy (given the real wage function) would be the highest possible growth rate, it is obvious that countries cannot be so ruthless towards consumption. And it is equally plain that a government is not being in any sense irrational if it opts for a lower growth rate to allow consumption to rise faster than is necessary or 'functional' in the Little sense. If then society is to give weight to consumption before the 'millenium' is allowed to break, the question is what weight; and if we divide a finite period into slices of time, what weight in each slice? (The converse assumption to the maximal growth path is of course to give present (year 1) consumption infinite weight and future consumption no weight at all so implying zero saving: 'eat and drink, for tomorrow we die'). One possibility is to try to give equal weight to consumption in different time periods in the sense of trying to achieve the maximum constant level of consumption per head over time. This notion has received great attention recently as the 'neo-neo-classical' theorem or the 'golden rule' of growth, (e.g. Phelps (1961); Robinson (1962 4th essay); Swan (1964); Hahn and Matthews (1964, pp 816-7)). Under certain very restrictive assumptions (constant proportionality growth, constant returns, no technical progress, infinitely durable capital all profits and no wages saved inter alia) it can be shown that this growth path is realised when savings and by implication the capital-labour ratio is such that the rate of growth equals the rate of profit. * But if one tries to be more realistic here by relaxing assumptions, the model loses its intuitive appeal; there is no likelihood in the real world that a policy of growing at a rate so defined would achieve anything like a constant level of consumption per head or the maximum constant growth rate of aggregate consumption. Which further strengthens one's feeling that there is nothing particularly optimal (Pearce, 1962) about this growth path anyway: why a constant level? Or, abstracting from population growth, why a constant growth rate of consumption?

Most discussion of the optimal growth path takes place in terms of the social rate of time preference; the more one discounts future consumption, the less savings and the lower the growth rate and vice versa. Thus the notion of a variable rate of time

* The marginal cost of any increase in deepening investment above this would exceed the marginal benefit. This yields the maximum constant growth path of consumption; which on the assumption that population grows at the same rate implies a constant level of consumption per head. This is a special case of the von Neumann type model. See Hahn and Matthews, (1964, sec.III).

preference provides a continuum from a rate so high that it virtually implies zero savings or the 'eat and drink, tomorrow we die' policy, to a rate so low that it approximates to an infinite postponement of consumption or the maximal growth path. The idea that socially desirable time-path of consumption is one that can be approximated by a discount rate has been challenged by a number of writers (Feldstein, (1964); also Solow, (1963 ch. 1)) : society might want the weight to be given to consumption to rise gradually over a limited time period (perhaps while society 'tightens its belt') and then increase more rapidly. Of course there are an infinite number of time paths which could be held to reflect various value judgements about the desirable balance between consumption and saving over time. This generalisation of the problem has been called the choice of social time preference function, meaning by this a time-stream described by a sequence of variable short period discount rates. (The notions underlying the various versions of the von Neumann model, the 'eat and drink tomorrow we die' and the constant level of consumption per head models are all such that though they can be represented by a function, they cannot be represented by a rate). All the same it will simplify the argument of the next sub-section if we talk on in terms of a time preference rate.

(2.2) Choice of Social Time Preference Rate. The optimal growth path and therefore the implied investment criteria will depend on the choice of a social time preference rate. As we have seen the lower the rate of time preference chosen, the less future consumption will be discounted in relation to present, the higher the savings needed and in principle the nearer the actual growth rate to the maximal. Many economists have written on the considerations which might be supposed to influence a government's selection of rate. (Among others Sen (1961), Feldstein (1964); Henderson (1965) are informative.) As one might expect when the advice concerns an ethical or distributive point, the distribution of income, the advice conflicts. But the real point so far as it concerns us is that no government has shown the slightest inclination to take a decision on the social rate of time preference as such. This is simply not the kind of decision governments are in the habit of taking, however fundamental and logically necessary it is to the selection of an optimal growth path, and, by deduction, investment criteria. Neither is it possible to pretend they take this decision sequentially, perhaps annually or in the context of a (five-year) plan, so that in effect these add up to a social time preference function (see the end of 2.1 above), (even though of course from the point of a given investment decision, one rate rules.)

The truth is that governments approach this problem from quite another angle, particularly the governments of underdeveloped countries. They find themselves prevented from increasing the rate of saving and therefore the rate of growth by certain constraints. They cannot cut the proportion of income given to consumption now by discounting future consumption less heavily: (1) because a large part of the population is near subsistence; (2) there is a threatening population growth rate; (3) 'functional' increases in consumption are needed to reallocate labour towards the growth sectors or to increase

output per head in agriculture; (4) 'functional' increases in consumption are needed as an incentive to entrepreneurship, and (5) savings, (a moderately high propensity to consume out of profits as well as a high interest rate is needed to stimulate savings); (6) just as in highly unionised countries there are various 'ratchet' effects why wages tend to drift upwards non-functionally for some groups in emulation of others. One of the strongest forces here is that regions tend to feel that some attempt should be made to prevent greater income inequality between them, even if this is at the expense of faster overall economic growth. Insofar as these arguments are compelling it is difficult to see how many countries can take much that amounts to a decision on time preference in the direction of postponing consumption increases though they should be able to take the reverse decision if they wish.

What is involved can be shown in another way (cf. Marglin (1963), Solow (1963 ch. 3), Chakravarty (1964a)): most, though by no means all, countries do choose, in the sense of aim at, a growth rate. There is a problem of distinguishing net from gross investment but if one knows the assumed savings proportion, then in principle one can deduce the average profit rate: $(p = \Delta y / \Delta K = \Delta / Y \cdot Y/S)$ Suppose $p = 1/40.4/1 = 10\%$; but one knows that the ex post, rate of profit after tax in the private sector is 15%. Then assuming that the private sector is responsible for 60% of total output and that propensity to save is uniform, we can deduce that the equivalent rate of return in the public sector is 3 $\frac{1}{3}$ %. This is a type of situation which, it is often held, exists in practice: the ex post private rate of return is higher than that in the public sector. Even if one were to make the further assumption that on average equally profitable investment opportunities exist in the private and public sectors, what deduction can one make from this? That the public sector by accepting a lower marginal rate of return on investment than the private sector is deliberately redistributing income towards the future, in other words is implicitly adopting a positive rate of time preference? That is a possibility. But in practice a low rate of return in the public sector is more likely to be explained by pricing policy: the traditional reluctance of public enterprise to maximise profits. (In which case some of the return properly attributable to public enterprise is reflected in a higher profit rate in the private sector inasmuch as that is imperfectly competitive and a consumer of the goods and services of public enterprise; otherwise by an increase in consumers' surpluses (real wages) insofar as its goods and services are final products. If, as is certain, some public investment yields goods and services which are deliberately provided free or below cost, this failure of the apparent to reflect the true rate of return is true a fortiori! see Foster (1960)). In conclusion then, it is only if a transfer of investment funds from the public to the private sector could lead to a higher social rate of return on that investment, that is, a higher growth path, and the government deliberately chooses to retain these funds in the public sector, that one can argue that the government is trying to redistribute income over time in a way equivalent to the use of social time preference rate functional. However,

even if one were to establish that the government were acting to this effect, one would normally expect to unearth some other reason for them doing so: probably ignorance or ideology.

This is why it seems better to fall back on the other kind of explanation rather than determine a phoney social time preference rate from the growth rate: and assume that the governments of underdeveloped countries do not sacrifice a higher for a lower growth rate unless they feel there is a functional, institutional or historical necessity for them to do so; that the political necessities are normally outside constraints, such as the pressure of regional interests forcing them to permit more 'extraneous' consumption than they would otherwise wish. It is still then possible to argue in detail that a higher growth rate is achievable, for example by arguing that higher savings could be mobilised through higher taxation without an offsetting disincentive to private savings or entrepreneurship; or that the marginal return from tax reform in increased savings would be greater than marginal cost; and so on. But where does this leave the notion of an optimal growth path of an economy? It leaves it very much a pragmatic question and the extent to which a given target rate can be altered also a pragmatic question. Insofar as notions about the social rate of time preference come into arguments about the determination of the target growth path, one can normally say that an underdeveloped country would normally prefer to grow faster even by saving more if it were thought feasible.

(2.3) The efficiency of optimal growth paths. Let us assume, for the lack of being able to say anything more ambitious, that the growth rate aimed at by the government is the optimal growth path for that economy. Even should a nation agree on this, there are reasons why it is impossible for it to carry this resolve through into a set of investment criteria. For a moment let us wheel ourselves back to an earlier phase of economic literature. It was a commonplace of early nineteenth century economics that free enterprise could achieve an optimal allocation of resources through the price mechanism (though this was always carefully qualified by the best economists). Much thought has been given in this century to demonstrating the very restrictive assumption on which this would be valid (e.g. by Pigou (1920), Kuhn (1935), Bergson (1938)). Pigou (1920) showed that there were divergences between 'private' and 'social' cost and benefit because of imperfections in the price mechanism, the redefinition of the marginal conditions so that marginal social product would equal marginal social cost for all factors in all markets would realise an optimum, in the restricted sense that society's real income would be maximised given its resources, inputs and initial income distribution. One development of the Pigovian analysis (e.g. Lerner (1944) and Meade (1948)) explored the use of taxes and subsidies to bring about such an optimum; but Barone (in Hayek, (1935)), and Lange (1936) and Lerner demonstrated that the same optimum could be achieved in principle by centralised, co-ordinated 'socialist' planning. Some years later it was shown by Kuhn and Tucker in a famous theorem (see DOSSO (1958) ch. 8) that the same optimum could be

established in principle through the use of (non linear) programming methods. It was also shown by implication (e.g. Bergson (1938), Nordin (1947)) that any allocation could be defined as an optimum; and so in principle could be realised through appropriate taxes and subsidies or 'socialist' planning.

Since economists became more interested in dynamic optima, there has been a redefinition in dynamic terms of the static problem of an optimal allocation of resources; (Mahuvaud (1953), (1961), also Koopmans (1957 pp 105ff)). But the old debate over the methods by which it can be achieved has not been conducted anew rigorously in dynamic terms. However there are certain analogous propositions that can be put forward for acceptance by the intuition: (1) The concept of a divergence between 'private' and 'social' which was defined by Pigou in relation to static equilibrium can be redefined in relation to any growth path. The difference between a private and social cost and benefit is then one that has to be eliminated if the given growth path is to be achieved. Just as in the Pigovian situation, the presumption is that the optimum cannot be achieved by individuals maximising their own (private) welfare functions. (It follows as a corollary that the Pigovian definition of divergence is inexact for the new situation: a social cost is not a 'cost' simply to whomsoever it accrues, and conversely a benefit. What is a cost and a benefit if only defined in relation to a given growth path. For example as we have seen already, a von Neumann growth path implying the maximisation of terminal capital, also implies that any increase in consumption is a cost, not a benefit; while another growth path implying a different social time preference function, implies that consumption increases are benefits, though the weight to be given to any given consumption increase in any given time period depends on the form of that function). (2) If there is a set of shadow prices, that is social costs and benefits, whose observance would achieve the growth path then there is in principle some set of taxes and subsidies which would correct the behaviour of private individuals so that they substituted social costs and benefits for the previous private ones. It will be noted that there is no presumption that the divergences will remain the same over time: in principle one would expect to have to recalculate shadow prices for every time period (Chakravarty (1964 b, p.51)). (3) Similarly it is in principle possible to achieve any growth path by 'socialist' planning. In principle again, this can either be done as is still normal planning technique by iterative methods, of which more below. Or one can achieve it by the use of non-linear programming methods. (From the use of the appropriate programming methods the correct set of shadow prices, and by implication the correct divergences between social and private benefit and cost, would fall out).

Therefore one would say, using again the defensive phrase 'in principle', that one could achieve any given growth path by any of these methods; and that as a corollary one could give meaning to the commonly expressed notion that 'the correct investment criterion boils down to choosing from any pair of projects that with the greater

return on capital, having accounted for all present and future inputs and outputs at prices which equal or will equal social costs and values (external economies are implicit in this statement") (Little, 1962 p.23).

But in practice none of this can be done. Nobody has tried to establish what the divergences between social and private, and therefore the shadow prices, are in relation to any growth path. Therefore no one has tried to work out an optimal set of taxes and subsidies to close these divergences. In recent years writers have in fact become much more critical of the possibility of devising such taxes and subsidies even to correct partial distortions in static allocation problems, (Coase (1960), Davis and Whiston (1962), Buchanan and Stubblebine (1962), Turvey (1963)).*

To take the first of the so called 'socialist' methods, though in practice it is used in some form in almost every underdeveloped country whatever its 'politics'. The standard pattern of such a plan is roughly as follows: there are equations linking total investment, savings, net foreign aid, the growth of income, the demand for the output in different sectors, the supply elasticities, tax revenue, public expenditure, the growth of savings, etc. In more complicated plans these may be integrated with a more or less disaggregated input-output matrices whereas in simpler plans there may only be two sectors, agricultural and non-agricultural. Whatever the set of equations is, there are more unknowns than equations. This means that if one assigns a value to the number of unknowns in excess of the number of equations, one can work out the effects on all the other unknowns. For example, one may assign 'plausible' values to the amount of investible funds and net foreign exchange available; and then solve the equations to find what values are implied for the other variables. The standard procedure is then to see if these derived values are 'plausible'. Or one may start with the period increase in income and find the highest increase compatible with plausible increases in the other variables. If one finds an implausible value, say for the elasticity of supply in the *i*th industry, one can either scale down the income increment until that value becomes plausible; or one can try tinkering with the model, changing some of its coefficients until in the end, by trial and error, one gets what one feels is the consistent set of equations permitting the highest feasible growth path. It is possible to make any modifications to this simple pattern by sufficient

* But the argument that it may be in principle impossible to devise such a system of taxes and subsidies because any given change may have unwanted income distribution effects, fails if the divergence is defined in relation to an optimal growth path which itself is defined so that the freedom is given within which income distribution can be varied. So does the objection that the marginal cost of administering such a change and procuring information may outweigh the marginal benefit since the correct treatment of these real costs is by redefinition of the social costs of achieving the growth path.

iterations, that is, tinkering with the basic equations and resolving them (e.g. see Chakravarty (1964 c), Chakravarty and Eckaus (1964 a.h.c.)). One can have separate equations for all "sectors" and one can define sectors so narrowly as to encompass a single industry or even less. One can have separate sets of equations for n time periods with changed coefficients between time periods to allow for economies and diseconomies of scale and technical progress. One can supplement the plan by special investment analysis of the choice of techniques in each sector to establish optimal capital and other marginal input coefficients. One can experiment with different combinations of final demand. But not only does a very small increase in the number of manipulations greatly increase the time it takes to perform an iteration but there are limits to the saving that can be achieved by using computers since the rationale of this approach is the testing of all derived values for feasibility. Furthermore any increase in complexity presupposes a parallel increase in data. And perhaps one ought to add that the more disaggregated the model, the more people become involved, and layers of command. More people have to be consulted to provide the data and the experience to check feasibility. It is scarcely surprising that all central plans are highly aggregated and are a long way from the detail required to establish what are in effect investment criteria (or shadow prices) for particular projects.*

Though linear programming can greatly speed up the planning process, there are its familiar limitations: the linear objective function to be maximised subject to linear constraints, and therefore no easy way of handling technical progress and other economies of scale. Perhaps the development of non-linear programming techniques (cf. Chenery and Uzawa, (1958)) will solve this problem; but in practice there are more serious difficulties. In practice the kind of process planning used by Manne (1958) for petroleum refining can take account of choices of technique, locational factors, qualitative differences, etc. in a way that is impossible in input-output analysis or the conventional sort of ordinary iterative planning. But the real difficulties of application are the amount of data needed to make comprehensive programming of this kind of work for an economy; for it is obvious that at the least no form of planning can be better than the quality of the data on which it is based; secondly the fact there is no computer in existence which is anywhere near being able to cope with a model identifying processes or projects separately (and as soon as one tries to economise on computer capacity by linking submodels it would seem this introduces optimisation and suboptimisation problems of its own). Lastly there is once again the point that to attempt to plan the community in such detail comprehensively is at odds with what most countries accept to be a tolerable centralisation of decisionmaking. It would seem to make lower level administrators providers and possibly independent reporters of information, but to give them no freedom to decide anything of substance.

* There is an interesting though fragmentary account of the varying degrees of detail attempted in different countries in Tinbergen (1964).

Even if we accept that the future of planning is with linked programming models, it is not obvious that the system of shadow prices necessarily implied by any programming model (see Chenery (1961), also Chenery and Clark, (1959)) in fact corresponds to the system of shadow prices which will achieve in fact the optimal growth path, though the extent and importance of the divergence is an empirical matter. The fact that we may be able to do no better, a point to be discussed in section 3 does not mean that one should not issue a warning against accepting too easily a set of shadow prices derived from what may be a very simplified linear programming. One cannot be sure that the use of such shadow prices need bring one towards the selected optimal growth path.

(2.4) A Complex of Criteria. The arguments of the preceding subsections presumed that there was one social welfare function describable in terms of an optimal growth path. And that once this was selected, the problem became one of deducing from this the prices and investment policies which would achieve that path. It is perhaps worth mentioning, though not exploring the implications for computational and informational complexity alone, of the self-evident fact that nations are not prepared to submit their decisions to one overriding criterion, economic or otherwise. Different criteria obtain for different decisions and at different periods of time. Although in principle it must be possible iteratively or by programming to find a set of shadow prices, maxima and constraints that would faithfully represent any complex of consistent criteria, the mere computational and informational complexities would make a solution even more impossible than the situation of the last section showed one to be. However the importance of this is that even when one comes to consider the shadow prices and investment criteria appropriate to separable suboptimisation problems, the sort of problems arising from a mix of criteria will vex the imaginary administrator of our next section, and the imaginary social entrepreneur of our last section.

3. Selection of Investment Criteria

Let us then imagine ourselves in the position of an administrator whose responsibility it has become to advise on the investment criteria to be used in the public sector; and any constraints to be put on private criteria in the national interest.

We may first suppose that our man first asks himself the question why it is that a number of writers recently have argued the need to supplement the central planning process by project evaluation for particular projects. (1) The first point is that the assumption made in central planning effectively rule out any choice of techniques in normal circumstances. It is usual to assume fixed coefficients as representing from historical data the best, or perhaps, only the average technique. (2) Aggregative planning takes no account of the effect on demand of product differentiation. (3) Because central planning rarely does more than allocate resources between sectors, there is no method of choosing between firms or factories. This may be important because of the existence of economies of scale which may suggest the development of a few enterprises rather than a large number, another factor

missed by the aggregative approach. Or the differences between the firms may refer to natural resource or available manpower differences. Other locational differences whose neglect leads to waste are the distances from raw material resources and markets. The microeconomic literature of project evaluation is full of examples of the selection of sites for enterprises, far distant from materials and markets, which could not possibly be justified economically. There is no formal reason why investment decisions based on centralised planning (which takes no account of situation whatever) may not make the most absurd mistakes of this kind. The case therefore of those who want project evaluation is that centralised planning techniques miss important differences between alternative investment possibilities and that this is an important cause of waste in the economy. A subsidiary argument used is that an investment appraisal beforehand is an incentive and test of management.

His problem is then to devise policies which are feasible. The investment criteria he recommends must be as consistent as possible with the priorities established by the central plan; but they must aim to eliminate important causes of waste missed by that plan. Considerations he must bear in mind are (1) that the national plan has probably selected a target growth path (which has implications in principle for shadow prices); (2) that the plan as such has only achieved the allocation of a certain number of scarce resources between a limited number of broadly defined sectors; (3) as far as possible the investment criteria must be consistent with those priorities but he will be pressed by other central and local government and other interests to modify investment criteria in the light of other policy objectives. (4) While the central planners can probably pass on to the Ministry of Finance the responsibility of trying to finance projects, he has to realise that if the investment criterion is not profitability, there is a possibility that projects will not be self-liquidating. (5) He must consider administrative feasibility, but in particular there are severe limits to the adjustments that can be made to private investment criteria through taxes, subsidies and direct controls. This is not a matter of ideology, but of fact.

But we will suppose his problem simplified in one respect. In his country nobody questions the proposition that all public sector calculations are to be done on a discounted cash flow basis so that projects are to be ranked by their present values since this method alone allows correctly for any time profile of revenues (benefits) and costs. As corollary it follows that no defence is successful of more primitive procedures, crude rates of return, payoff periods, cost benefit ratios.*

(3A) (2A) Profit maximisation, We suppose our administrator is first pressed to consider profit maximisation as the criterion for project evaluation in the public sector.

* Good explanations of DCF can be found in Merrett and Sykes (1963), Bierman and Smidt (1964), Grant and Ireson (1960) and a more mathematical in Kemeny et. al. (1962); and of the limitations of cost-benefit ratios in McKean (1958).

The first class of objections to this is that it is an inappropriate criterion for public enterprise. Of course there are public services where the government deliberately provides services free or below cost; but let us consider first that large part of the public sector in most countries selling goods and services commercially: in many countries some transport, fuel and power, steel, heavy industry among others. There are several standpoints from which profit maximisation can be thought inappropriate for such enterprises.

Standpoint 1 It will not lead to an optimal allocation of resources, while marginal cost pricing would. Since most forms of industry as a matter of fact show increasing returns, this means widespread subsidisation if marginal cost pricing is interpreted logically as short run marginal cost pricing. There are several arguments which one could develop against MC pricing but perhaps three is enough. One is that it does not provide a method of ranking investment at all. In its simple form this is fallacious since the appropriate criterion is to allocate investible funds so as to choose the mix of investment that maximise consumers' surplus. The second argument is that even if there is an investment criterion it implies measuring the areas under demand curves which is fraught with difficulty. I believe this objection overdone and oversceptical of human ingenuity; but rather than develop replies here, I will pass to Standpoint 2: the argument of secondbest (Lipsey and Lancaster (1957)). If the adoption of marginal cost pricing affects the public sector alone and implies lossmaking in most industries because of the prevalence of increasing returns, then the products of the public sector will undercut substitutes (perfect or imperfect) produced in the private sector. From an efficiency standpoint this means an overexpansion of the public relative to the private sector. By a similar argument such a move is likely to increase the profitability of complementary products in the private sector. However it is difficult to follow the logic of this argument to its conclusion since any change of criterion in one sector relative to another may worsen the allocation of resources overall. What we are toying with here is an argument for identical criteria (whether marginal cost pricing or some other) in all sectors. But in principle this would mean either the absorption of the private by the public sector or vice versa. That there will be some overall inefficiency due to difference between criteria is the price we pay for having a private and a public sector. The justification of the division is presumably an (economic) belief that one sector can do some things better than the other, or is political. So that to argue against marginal cost pricing on these grounds is two-edged. The most important argument against marginal cost pricing in underdeveloped countries is probably Standpoint 3:* since the static theory of resource allocation has no relevance to a growth path, social marginal cost pricing ought to be redefined in relation to the chosen

* I have considered the first and second arguments against MC pricing in much more detail in Foster (1963) which may perhaps excuse the curt treatment here. I would not suggest what I there described as the modified consumers' surplus maximisation approach in an underdeveloped country because of the third argument given above.

growth path. As explained in section 2 we are unable to follow through the implications of any growth path so far as to be able to define the relevant marginal social costs in detail. Byegones ought to be treated as byegones in relation to a growth path as to static equilibrium. Nevertheless a nation may value savings more highly, in the sense that it would like to achieve a higher growth path and needs more savings to do this. Since a marginal cost pricing policy under increasing returns means public enterprise tends to make financial losses (while attempting to maximise consumers' surplus) it is a policy which by comparison with profit maximisation tends to increase the growth of consumption (real wages) and depress the growth of savings. (The propensity to save out of profits or government revenue is higher than that out of real wages). Since in practice there are limits to the savings that can be raised by increasing taxation, there is a strong case for governments charging profitmaking prices in the public sector in order to increase aggregate savings.

But one might ask if there should not be limits to this? Otherwise should the government act monopolistically where it can to increase savings, or even forcibly form larger monopolies to this end? There is no a priori answer. It is an empirical question in every case whether the inefficiency of inadequate savings from the viewpoint of the chosen growth path or the inefficiency of monopoly is more of a brake on economic growth. (Symbolically this is a case where, in the Harrodian identity $\Delta Y/Y = S/Y = \Delta Y/\Delta K$, the last two terms are known to be inversely associated with each other in this respect, but the elasticity of the relationship is unknown). It is just a hunch one has, that in most countries it would increase the possible growth rate to raise the rate of profit in the public sector in order to increase savings; and that opposition to this change in pricing policy is motivated by non-economic arguments; for example that there is, in effect, something morally heinous in a public enterprise making profits. This is usually a hangover from the old socialist antipathy to private profit which is surely, whatever else one may say, simply nonsense when public profits are in question. (See Lefebvre and Chaudhuri (1964)). Of course there are public projects where it makes sense to subsidise consumption. First where in fact the 'consumption' is investment, for example, health, education and irrigation where these in fact raise the rate of economic growth. Secondly if it is felt as a matter of ethics that there are some people and activities which should be subsidised even at the expense of economic growth. The first category logically implies the use of a social rate of return to rank investment projects: the second the use of an efficiency criterion to find the cheapest method of giving the subsidisation required (cf. McKean, (1958)).

Does this mean then, that the consideration just mentioned apart, that one would support the use of profit maximisation as the public sector investment criterion? This is to ignore the fact for various reasons that the growth path shadow prices are not the same as market prices: (1) because the government normally wants to achieve a higher rate of growth and therefore savings than the savings market does. (2) because the political and economic cost of correcting wrong prices e.g. the exchange rate, are too high for the

government. (3) because there are other policy reasons why prices are incorrect. (4) because of imperfection in the price mechanism. If one argues in spite of the existence of these divergences that profit maximisation should be adopted, it must be because one feels that the extra efficiency arising from the profit maximisation approach outweighs the potential allocative efficiency of a shadow price approach. Whether this is reasonable must again be an empirical question depending on the circumstances of the case; and it would be ridiculous to attempt sweeping judgements.

(3.2) Single scarce factor criteria However if our administrator is not content to recommend profit maximisation in the public sector and leave it unconstrained in the private sector, then he will want to explore other criteria. The simplest class are those which concentrate on a single scarce factor and relate the rate of return to its use.

(1) Let us suppose that the first to be considered is the capital-output minimisation criterion (Buchanan (1945), Polak (1943)). 'Choose the project yielding the most output per unit input of capital'. Projects are to be ranked according to their capital-output ratios. This is sometimes put forward as if it were a simple criterion for evaluation (measurement) purposes but it is not: (1) We may take it for granted that the ratios should be in present value form, implying at least that the stream of values of the expected outputs, and also the cost of the initial, and any subsequent, capital inputs should be discounted back to the present. (2) But this implies that from society's point of view all inputs are free except capital so narrowly defined. This is not really what is intended since the basic idea is that the real cost of labour alone is zero. Therefore one should value the capital components of the cost of all inputs; e.g. if the plant uses steel, the capital cost of producing that steel, and by extension the capital cost of producing the capital goods used in the steel industry and so on backwards until we are back to goods produced by labour inputs alone, if such exist. (It is sometimes suggested that the capital components of other inputs are reflected by their market prices, but this is nonsense. The problem would only be avoided if it were mandatory for producers to quote a shadow 'capital' price for every product they sell? (There is a further problem here since the quoting of such a price implies the allocation of overheads). (3) The argument also supposes that there is no capital component in labour costs. True of unskilled labour, it need not be true of labour in which money has been invested for education and other training. (4) The criterion also implies that land and other natural resources should be valued by their capital components; but as Marshall pointed out years ago, one will get an incorrect allocation of resources if one does not allow for scarcity rent in decisionmaking. (The dynamic context does not affect the truth of this.) The criterion ignores all such scarcity rents).

However we can imagine what it would be like to be able to calculate the true capital-output ratio (in present value terms); but one will only suppose it at the least to be a good criterion if we can assume constant returns to scale, that is, no scarcity rents earned by inputs. We may consider the matter from another angle: the validity of the assumption that labour has a zero price, because of underemployment, in many underdeveloped

countries. Since Lewis (1954) this has been commonly assumed and hotly debated. If it were true one would be required to disregard all labour costs unless 'capital' cost is defined to include any human investment capital costs. And yet we know that both a public enterprise and its suppliers will be required to pay wages, paying its own wages and a price to his suppliers to enable them to pay theirs. Yet it is at least possible if he follows the criterion then the surplus of revenue over capital costs will be insufficient to pay these wages and input prices. In many arguments this problem is shovelled out of sight in the notion that the government should undertake 'compensatory' finance, through the budget.

But this presents practical difficulties: a given number of labourers leave the land. We do not want agricultural output to decline or aggregate money incomes to rise. Therefore the farmers are to be taxed on amount equivalent to the real incomes enjoyed on the land by those who have now left it. As the wagebill rises in the non agricultural sector, no taxes in the agricultural sector must be raised by an equal amount. But the effect of the policy will depend on how the taxes are raised. A simple increase in agricultural taxes across the board is bound to have side effects. Experience suggests that when new industry is set up round a town a high proportion of the labour force comes directly or indirectly off the land in the vicinity. Certainly there is no presumption that labour leaves the land at a constant rate per acre. So that to increase average agricultural taxation will lower real income per head on farms from which a less than average number have migrated and vice versa. An attempt might be made to mitigate this by raising corrective taxation on a local basis, though the same kind of problem will arise unless the increase in taxation is related to the actual farms which people have left. Then one runs into another familiar difficulty: there will be no incentive to leave the land. The man setting the rules for project evaluation cannot set the price of labour (less any capital component) to zero unless (i) government does raise agricultural taxation in the proportion required, but this is most unlikely since considerations of equity and politics will dictate that no-one should be made worse off as a result of the change. Therefore one can normally assume a less than equivalent increase in taxation, (and even if inflation is used to limit consumption there is likely to be some increase in the average real wage from this cause). (ii) the enterprise and/or its suppliers are subsidised fully for their expenditures.

But all this assumes that the real cost of labour, bar institutional difficulties, is in fact zero. Most research suggests that it is not. There is a real cost of getting labour off the land into the factories. Sometimes investment is needed to maintain agricultural output. The administrator is in a double dilemma here. Plainly this investment is a real cost of a project employing labour, and ought to be counted so, yet at the same time it is only a cost if the investment is made. If it is not, then there is another kind of cost. Furthermore there is the fact that some labour is scarce, usually skilled labour, and it would be a mistake to represent its social costs as zero.

For all these reasons it is difficult to maintain the pristine simplicity of the capital output minimisation investment criterion.

A related criterion is one which would maximise savings. The Galenson and Leibenstein criterion (1955) was in the form: $p - (y - n \cdot w)/k$ where p is the (rate of) profit; y the machine output; n the number of workers per machine; w their real wage rate; k , the capital cost of the machine. In discussing this criterion one must distinguish clearly between means and ends. A crude interpretation of the Galenson-Leibenstein thesis is that savings tend to be maximised if one chooses techniques with the highest capital-labour ratio because these earn the highest profit and so yield the most savings. About this there are several obvious points to be made: (1) if the proportion of profits saved varies between projects, the crude criterion needs modification (see Ranis (1962) and Leibenstein's (1963) reply); (2) strictly if there is savings out of wages (whether this varies with the type of labour employed or not) this should be taken into account, but in practice this is likely to be much less important; (3) the notion that one should maximise the capital-labour ratio neglects what is happening to the capital-output ratio: there is no presumption that a project which has a high capital-labour ratio is more efficient in terms of output than one with a lower ratio. But this problem can be avoided if we redefine the criterion in present value terms, as we should anyway: maximise the present value of the discounted stream of saved profits (sP) plus saved wages (sW) resulting from a project minus the discounted stream of capital and other input costs, (less the proportion of wages saved). (4) Strictly one should take this further and eliminate from all input costs any element of savings since from the social point of view any saved part of profits made on an input is a social benefit, not a social cost. The calculation of these savings proportions greatly complicates the procedure: where one stops must depend on the time and money one feels one ought to or can devote to the analysis.

But if we take the criterion so far, the underlying logic of it suggests that one ought to take it a step further. The logic of the Buchanan-Polak criterion was to minimise the capital (savings) input in relation to the value of output. The logic of the Galenson and Leibenstein criterion is that one should maximise the savings (capital) output, given the costs of the inputs. If we combine the two we get the proposition that we should rank investment projects by the net effect they have on savings (capital). If we interpret this strictly, the social costs of an investment are its capital consumption. These appear directly in its capital costs and indirectly as the capital used up in its material and (educated or trained) labour inputs. The benefits are the savings increments resulting from the project, directly as savings out of profits and wages, (and possibly, if some of the benefit is passed on to consumers through lower prices), savings out of their increased real income; and indirectly as the equivalent savings in the value of the inputs. (Checking one can see there is logically no possibility of double counting). (Because of the great practical importance of working capital in many underdeveloped countries it is perhaps worth pointing that an increase in this is also a cost. Sen (1964)).

This would seem to be an improvement logically on either of the two criteria taken separately as long as we can assume the non-existence, or virtual unimportance of,

factors earning scarcity rents; and that the social cost of labour really is zero (or equal to sW)* But just as with the Buchanan-Polak criterion, the same difficulties arise if these are not realistic assumptions, because we then want to introduce a non-zero shadow price for labour; and there is also the question of how to finance what may easily not be a self-liquidating project.

The third criterion of this kind we may consider is the foreign exchange criterion, (see Chenery (1953) Tinbergen (1958 pp. 39 Lt.), Chakravarty (1964c)). Little (unpub.) its point to move directly to a more sophisticated version of it, is to maximise the net foreign earnings from projects. The sense of this is plain: foreign exchange is the scarcest resource in most underdeveloped countries and it is persistently undervalued by the official exchange rate. In just the same way as we isolated the capital components in all costs and the savings components in all profits directly and indirectly, one would do the same for foreign exchange. One problem in the interpretation of the criterion should be simpler: though there may be foreign exchange costs in all or any inputs, even skilled labour, one would normally not expect to subtract anything from the money costs of inputs for induced foreign exchange earnings. (This could only not be the case if economies of scale induced by purchases for the project were effectively to raise export sales and earnings). This criterion on the face of it means setting all other input costs and outputs to zero.

But there is a conceptual problem. If we take the absorption approach to integrating international trade to the domestic economy (see Johnson, (1958 ch. 6), it becomes natural to think of any surplus of exports over imports as a surplus of national output over national expenditure and therefore as an increase in savings. To make up the balance one is able to import savings from abroad. And developing this point further it is natural to think of imported savings as in every way a substitute for domestic savings. An increase in domestic savings makes it possible to increase exports or import substitutes so that, ceteris paribus, there will be a greater surplus on the balance of payments and therefore inflow of savings. In this case introducing foreign exchange simply ties up our last criterion. We had said nothing about the treatment of inputs and outputs of a project entering into foreign trade. We can now add in the cost of any imported inputs among the capital (savings) costs and vice versa with any exported outputs. (The chief difference is that we are no longer going to count any savings out of profits made abroad, or repatriated, as a social benefit). If we care to call this new criterion the Foreign Exchange (savings) criterion we could equally well call it the Savings (Foreign Exchange) criterion. Of course we still avoid none of the difficulties associated with the real value of other inputs or with financing.

However at this point we should face up to a difficulty which in one form or another has been dogging us all along. Capital and labour are not perfect substitutes for each

* Two comments: if sR (rent) = 1 then scarcity rents present no problem to the double criterion. If there is disguised unemployment such that the real wage of labour is truly zero, sW is irrelevant unless the proportion saved is different for agricultural and nonagricultural labour

other because of the scarcity of savings. But conventional theory tells us that in an equilibrium situation the marginal utility of savings should equal the marginal utility of consumption. In the back of our mind and at the back of these criteria is something like the von Neumann model. Yet the whole theoretical basis of the argument of this section so far is to say that savings (capital) has a value while consumption (real wages) has not. What then do we mean? Are we saying that in fact the rate of interest is too low and that if it were higher then more savings would be forthcoming and the economy would be able to achieve a higher growth rate? If this were so, then would it not be more logical to give savings, capital and foreign exchange a (shadow) price reflecting this optimal rate of interest? There may be several reasons why governments force interest rates low: one is the belief that an increase in interest rates would be undesirable because it would imply an income distribution towards the rich. (To raise the interest rate and at the same time the marginal rate of taxation would not affect the supply of savings). And it is true that countries do not normally stop to consider how far, or even whether, they are sacrificing growth (and absolute income levels) to equality when they make decisions like this. Another kind of argument is the Keynesian which would state that savings is a function of income and not of, or only marginally of, the interest rate, (Hicks, (1937)). In that case the supply of savings is simply determined by the level of income, income distribution and possibly institutional factors and liquidity preference. A rise in interest rates in such circumstances would indeed be a gift to the rich, since it would provide no more savings. But the calculation of a marginal internal rate of return (a shadow price) is necessary for the optimal allocation of investment resources: for what we have here in essence is a nationwide capital rationing problem (cf. Steiner (1959)). Though this line of argument can be used to explain why governments do not allow their interest rates to rise to a more realistic level and as a consequence why it is right to use a shadow interest rate in project evaluation, it does not explain why we give weight to savings (capital and foreign exchange) alone in our calculations and zero weight to consumption. So far we have discussed this point in terms of whether labour, in particular, has zero social cost because of disguised unemployment; but what from one point of view is a social cost from another is a real wage. Do we really want our investment criteria to proceed on the assumption that there are no diminishing returns to increasing savings and as if our sole ambition is to approach a von Neumann-Morishima growth path? What in fact we must mean is something more limited: that the actual increase in savings that we would be likely to achieve from a savings maximisation criterion would be small relative to the volume needed to attain the desired (optimal) growth path, whether that be a von Neumann path or one which allows a faster growth of real wages. And it is always open to government to revise zero weighting given to consumption increases of the "extraneous" or non-functional kind. Then of course one would have abandoned the simplicity of a single scarce factor investment criterion. We would need a function to maximise which would involve re-weighting savings and consumption: a weighting which might expect to alter over in time in favour of consumption until the desired growth path is reached.

But this is not the only kind of reason why one may dispense with a single scarce factor investment criterion. We have so far made a distinction between one factor ascribed a zero price (roughly, labour) and another factor, savings, foreign exchange or capital which is assumed homogeneous and therefore can be valued at the one market price. (There is nothing to be gained by imputing a shadow price). But it is a strong assumption to assume that they are homogeneous in respect of achieving the desired growth path. For example it implies that the elasticity of supply of savings is uniform, that is, that there are no imperfections in the capital market. This is nonsense: most writings on the subject (cf. Vakil and Brahmananda (1964)) make it clear that some kinds of enterprises find it easier to raise funds than others. Small family firms may tap local and family sources of savings which would otherwise simply not be available as savings and would be consumed; while large firms and the government draw their funds from the finite resources of the capital market (and taxation). From a social point of view savings of the first kind are less of a social cost (when they enter into the cost of a project) and less also of a benefit (when they emerge as a benefit) than savings drawn from the capital market or taxation. In principle one may want to have a number of shadow prices for different categories of savings. (It may be asked whether it is important: it may well be when one is comparing alternative investment possibilities in the public and private sectors. For example, the question whether to make a certain investment in roadbuilding or rail improvement may be affected because road haulage is largely financed by small savings whereas rail finance generally has to be found by the government).

Similar problems arise if we bring in foreign exchange. The logic of the theory suggests that savings and foreign exchange ought to be perfect substitutes also; but they are not. (1) Granted that in underdeveloped countries both tend to be undervalued in relation to their growth rate shadow prices, it would be sheer accident if they were to be undervalued by the same amount. The official exchange rate frequently undervalues foreign exchange by more than the interest rate does domestic savings. One expedient suggested by Little (unpublished) is that domestic capital goods and therefore by implication, domestic savings, should be valued as if they were imported at their c.i.f. cost. This of course raises valuation problems for capital goods which are not in fact imported and may also raise problems about labour intensity of domestically produced goods, but this expedient greatly simplifies the calculations. One revalues all capital costs and components at their 'import' price and all savings in some average way as if it were foreign exchange. Then one works out the present value on the basis of the new weights. (2) Nevertheless this procedure assumes that the imbalance between foreign exchange and domestic savings is a monetary phenomenon to be corrected by a price change. But in fact savings and foreign exchange are not perfect substitutes for each other. There is no presumption that any given domestic savings will find its way to the production of exports and import substitutes if that should be socially most profitable. In general foreign exchange is a more perfect market than

domestic savings; so that there is a presumption for this reason that foreign exchange is still more valuable than domestic savings on average and should be given a yet higher shadow price. (3) There are even reasons however against giving foreign exchange a unique shadow price. If any given foreign exchange earnings are tied to the purchase of specific imports, then such earnings have less value by a well established proposition of economics. But there is (4) a more important sense in which to find a single price of foreign exchange is oversimplifying the problem: optimum tariff theory (Johnson (1958, ch. 3)) suggests that the optimum price (tariff) will vary between goods because of differences in their elasticities of supply and demand (more formally their net revenue elasticity in respect of their foreign exchange price). A government determined and able to maximise its net revenue from foreign trade would establish tariffs and export subsidies to this end. If the foreign exchange rate is wrong as well, this means that a government instead of requiring project evaluators to use one shadow rate of exchange, would specify different shadow export and import prices for different commodities. (For a related argument see Bagchi (1962 pp. 665, 6)). So that once again we are liable to be drawn into arguments for a system of shadow prices rather than a homogeneous scarce factor criterion.

To recapitulate, all scarce factor criteria have certain limitations:

- (1) their use implies giving a zero price to some factors and valuing the one, the scarce factor at the market price (though it could be any price since its use is a numeraire).
- (2) Objections that the zero price assumption is unrealistic tend to be met first by redefinition of the scarce factor. A distinction is made between zero price labour (unskilled) and skilled labour. The difference in value of the latter is attributed to investment in human resources and that element in labour costs is assimilated to the scarce factor. Insofar as the real cost of taking labour off the land is investment to maintain agricultural output, that, too, can be assimilated. And as we have seen the notions of capital (in the Buchanan-Polak criterion), savings (in the Gelenson-Leibenstein) and foreign exchange are assimilated. So that the scarce factor criterion becomes in effect a savings maximisation criterion including everything except what is more illuminatingly to be described as consumption rather than labour cost. In other words it becomes the criterion related to the achievement of von Neumann path. (Any functional increase in wages necessary to raise the growth rate on this definition can be regarded, if one chooses, as investment). However this does not mean that we have to suppose that society is aiming at maximum growth, but simply over the relevant range it is interested in increasing savings, not consumption. But as soon as one wishes to maximise a function which is some compound of savings and consumption, it is necessary to assign shadow prices to the two, which may well be supposed to alter relatively over time as one approaches the desired growth path.
- (3) Other reasons for introducing shadow prices is the belief that the twofold distinction of factors into savings and consumption, on the assumption that, in every other respect, factors are perfect substitutes, is sufficiently

unrealistic in relation to the achievement of the desired growth path.

(3.3) Shadow prices As soon as one begins to think in terms of shadow prices instead of a scarce factor criterion, the floodgates are open and it is tempting to let oneself be washed away in a flood of distinct possibilities. We have already argued the possibility of distinguishing between different sources of savings, and also between different exports and imports. To this may be added a long list of scarce factors previously submerged beneath the homogeneity assumption. Several writers (e.g. Hirschmann, (1958)) have stressed the shortage of entrepreneurial skill and public administrators as a bottleneck (see also Myint, in Berrill (1964 p. 188)). Skilled labour may be short though unskilled is abundant, particularly technologists and applied scientists. It is easy to postulate a large number of distinct shadow prices.

A second kind of shadow prices relates to external economies and diseconomies of another sort. There is a long literature stemming from Rosenstein Rodan (1943) arguing the importance of external economies in growth. The notion of take-off implies that there are certain activities (investments) which have far reaching consequences (external economies). Plainly if we knew what these activities were and could make an estimate of their consequences then it would be sensible to count them in as benefits, using shadow prices, in project evaluation. The trouble is that this is an area where there is little exact knowledge. Both the 'balanced growth' and the 'unbalanced growth' argument depend upon different theories about the causation of external economies. The first lays great stress on the fact that the return from a project is likely to be higher if it takes place in conjunction with a number of other projects. (This need not in fact give rise to external economies since balanced growth in the sense of equi-proportional growth in different sectors may mean firms internalise other firms' external economies so that on balance the benefits of complementarity are reflected in higher private profit rates all round). But in contradistinction there are those, chiefly influenced by the importance of economies of scale, who argue for unbalanced growth, a theory that implies much more obviously a divergence between the social and private rate of return. Whichever theory one holds and there are many versions of each (cf. Sutcliffe (1963)), the problem is that there are very few facts indicating what investments will have appreciable external economies.

The third category is where shadow prices are needed not so much because of imperfections in the pricing mechanism but more deliberately because of pricing policy. We have discussed why it is thought public enterprise should not make profits earlier in this section (3.1) but if, for whatever reason, it is decided to persist with such policies then it may be reasonable to use shadow prices for planning purposes. A good example of the importance of this is railway rates. Lefebvre (1964) has analysed the consequence of averaged rail rates in distorting locational policy in India. The worst kind of case is when one finds a commodity whose delivered price is the same whatever the distance travelled.

Although possibly a form of price discrimination sensible for a private firm, it is obvious the distorting effect this can have on location. Though one would hope a government would have the courage to rationalise transport rates, they frequently lack it. But it is still possible to make sensible decisions using the real transport costs as shadows. A similar situation arises where rural services are provided below marginal cost and are subsidised by town dwellers; or at the opposite extreme where the social overheads which have to provide for population growth in a town (Leleber (1965)) are not reflected in money costs.*

A fourth use of shadow prices is to reflect judgements about income distribution, though they are in practice rarely used to do this. Let us suppose there is a fastest growing region and our social investment criterion indicates that it would be best to locate a certain steel plant there; but it is decided to locate it somewhere else, the implication is that a sacrifice of the national to the regional growth rate: there must logically be some weight (e.g. 2 to 1, lots of etc.) which will "justify" this decision in the sense that it will be logical to make that choice. Whatever weighting it is which switches the choice, is the minimum implicit weighting that is given to this regional distribution policy. It would be perfectly possible to begin in the opposite manner and declare a weighting so as to redirect investment towards lagging regions. This could be built in as shadow price into the criterion. The principle however is clear, all modifications of criteria for the sake of income distribution can be represented by the use of shadow prices. (Marglin in Maass (1962) has an excellent analysis of the treatment of income distribution effects in cost benefit analysis).

So it is possible to think of an infinite number of reasons for complicating an investment criterion with shadow prices. Some of the drawbacks are obvious: (1) the additional information needed to establish what the shadow prices are. Most discussions of methods of calculating shadow prices, (Tinbergen (1958 pp. 39 ff), Chenery (1961), Chakravarty (1964e)) make it clear that these can only be done using simplified models. To calculate foreign exchange shadow prices, Chakravarty suggests one should design a simplified model of the economy heavily biased towards industries entering into international trade, using programming techniques. This should give one some idea what the right shadow price would be. The more shadow prices one tries to calculate the more difficult it is to use simplified models, or to make them consistent. (2) The more shadow prices the greater the effect of any relative error in throwing the calculations out. As we have seen if there is a homogeneous scarce factor one does not have to select a shadow price at all, but as soon as there is more than one factor for which a shadow price has to be found, it is important to get the relativities right. The more shadow prices there are

* The second best problems raised by the use of planning prices which are not money prices are extremely complicated: there is some discussion of them in Foster and Beesley (1963), Beesley and Foster (1965).

the more it is like a lattice (in mathematical terms) and the more important and difficult it is to get the shadow prices ordered. (3) There is also a dissemination problem even if we assume that any enterprise knows what its shadow prices are. As we have seen even the simplest criteria means that purchasing firms have to know certain information about the nature of their suppliers' costs and distribution of profits which it is not normal commercial practice to provide, or even know. A system of shadow prices will only work if it is made mandatory for firms to provide such information to make the system workable. (4) But the more complicated the system, the easier fraud. Clearly private and public firms can work such a system to their advantages (and where the allocation of overheads is involved it is very difficult to see how in principle firms can be prevented arranging their bookkeeping to make the most of the situation). (5) Lastly one must mention the more shadow prices there are the more complicated the system of taxes and subsidies required and the more devious the indirect effects. Similarly the problems of financing public enterprise become at the least time consuming.

However there is one other matter our imaginary administrator has promised to consider: consistency of any criterion he recommends with the national plan. As soon as one defines investment criteria in terms of shadow prices the possibility arises of absolute shortages of some factors; however one may weight the value of, say, skilled labour, by giving it a high shadow price, there is always a possibility that one has got the rates of substitution between it and other factors wrong, so that at the stated price there is excess demand for skilled labour. This simply means that one has fixed the shadow prices too low. To some extent one can use foreign exchanges as an all purpose reserve to meet demands of this kind by increasing imports; but it is obviously important that at least as far as the most important projects and factors go, one can have some kind of signalling process by which demands for factors are predictable in advance from reports, and some reviewing process by which shadow prices can be varied reasonably frequently. (On the other hand, of course, the danger of frequent changes in shadow prices is that one may set up a cobweb of uncertainty). An alternative method would be to allocate amounts of the more important scarce factors to the various 'sectors' on the basis of some preliminary assessment of priorities. One would then require the decisionmakers within that sector to treat material balances as constraints upon a maximising process (cf. Steiner (1959)). It should then be possible afterwards to determine from the implicit valuations of factors whether the supply of any given factor allocated to a 'sector' should be increased or reduced (on the assumption that demands for factors on a sectoral basis were reasonably predictable from one time period to the next). In this system shadow prices would have a different role to perform, but to achieve the same objective.

But in the end all one can deduce from the reflections of this section is that our imaginary administrator will have to compromise somewhere between the

simplest and most complicated criteria, and that possibly he should pay more attention to the administrative and financing problems than is perhaps usual (but see Dosser (1962)).

4 Project Evaluation

There is a sense in which the problems of project evaluation are too specific for brief general treatment. All are alike only in being different. One can try to string together awful warnings from examples showing what mistakes have been made through haphazard procedures, but try to lay down principles for project evaluation is not easy. There are two main classes of problem on which perhaps something general may be worth saying. There are first those which might be met by a Manual of Project Evaluation. Such a manual one would suppose would first explain the simple mathematics of compound interest and its application to investment analysis; and would establish the case when it is more convenient to use an external discount rate than a marginal internal rate of return approach. (There is a good brief appraisal of the issues in Henderson (1965)). We might then suppose that it would enumerate some of the standard pitfalls when one moves away from profit maximising discounted cash flow to cost-benefit analysis: the dangers of double counting, the proper treatment of taxation, the rationale of discriminating or not discriminating between pecuniary and non-pecuniary external economies and diseconomies, the treatment of income distribution effects and so forth. But if it is to be a useful manual it will go on to specify the form of the investment criteria to be used, (though the government may want some variations between sectors).

There is a strong case for asking the project evaluator to consider the feasible alternatives first from the standpoint of profit maximisation as a standard for comparison, before going on to compare them using the social investment criterion specified. To do this he will want to know what are to be accounted costs and benefits of the projects, secondly for what categories of costs and benefits, if any, he is to accept market prices; for which categories, the shadow prices are to be given him, and lastly where he must establish his own values. The second grouping, one may suppose, will include the more important scarce factors, but there is bound to be some fitting of square pegs into round holes here. The project evaluator will normally feel that the skilled labour or savings he has to deal with is rather more or less scarce than the average implied by the shadow price. It may be wise to give some range for a shadow price. Alternatively one should allow him to present a case for special treatment, provided that in each case he produces his supporting evidence. The third category where he has to find his own shadow prices will probably be any external economies of the balanced or unbalanced growth kind. Here again one would want his evidence for including social benefits or costs of this kind in his evidence.

It will be sensible also if the evaluator is given instructions about the treatment of uncertainty because this can often make the presentation of a case misleading. As far as possible the uncertainty of every separate costs or benefits item should be

assessed separately. For some items certainty equivalents may be good enough, but for the more important items, some discussion of the possible dispersion of values should be attempted. No project evaluator should ever be allowed to make an overall allowance for risk for the whole project (by using a higher discount rate or by hedging on the demand side or some such expedient). These are very obviously substitutes for thought and are only justified if it really can be argued that the evaluator cannot do better.

It is also important that the evaluator should make a financial appraisal of the chosen alternative to illuminate the financial implications of the chosen alternative. Another important point is that he should make clear in what way his conclusions depend on investment or other policy decisions by other decisionmakers. We have given one example: the fact that the withdrawal of labour from the land may only be compatible with maintaining the level of agricultural output if investment is undertaken on the land. The project evaluator may also be required to make other sensitivity calculations to test the sensitivity of the project to changes in the rate of discount, in labour costs or the value of foreign exchange.

There is a real danger here that requiring too elaborate calculations will greatly raise the shadow price of one kind of skilled labour, the evaluators, and the danger anyway of a manual is that it will fail to distinguish between the degrees of detail required by projects of different degrees of importance.

But there is one other kind of difficulty met with the project evaluator which cannot easily be dealt with by a manual. It is quite obvious that some special investigations will be needed to establish the shadow prices of savings, foreign exchange, etc. But if external economies, the effects of pricing policy, etc., are to be taken seriously, it throws a great burden if in fact their evaluation is to be left to the officials of the enterprise. There is a large field for special studies; and special studies have the advantages also that they are more likely to be impartial and to avoid the different estimates of the same magnitudes which is virtually certain when several agencies independently are trying to measure the same things.

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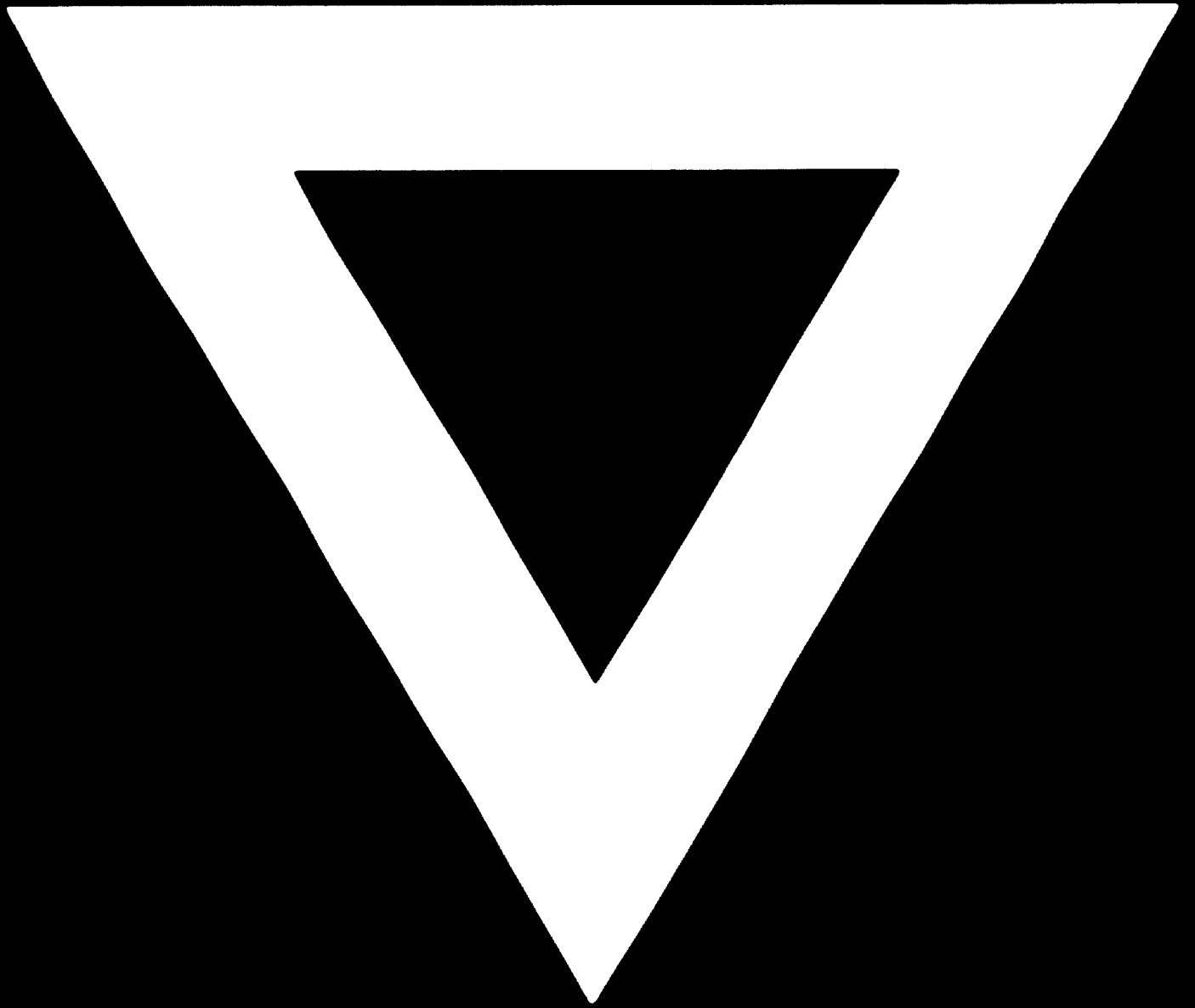
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