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THE SYSTEMATIC EVALUATION OF DEVELOPMENT PROJECTS

by

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THE AGRICULTURAL ECONOMICS RESEARCH UNIT

The unit was established in 1962 at Lincoln College with an annual grant from the Department of Scientific and Industrial Research. This general grant has been supplemented by grants from the Wool Research Organisation, the Nuffield Foundation and the New Zealand Forest Service for specific research projects.

The unit has on hand a long term programme of research in the fields of agricultural marketing and agricultural production, resource economics and the relationship between agriculture and the general economy. The results of these research studies will be published as Unit reports from time to time as projects are completed. In addition, it is intended to produce other bulletins which may range from discussion papers outlining proposed studies to reprints of papers published or delivered elsewhere, with a view to bringing the topics discussed before a wider public. All publications will be available to the public on request.

The unit is directed by the Head of the Department of Agricultural Economics, Professor B.P. Philpott. In addition to the full time research staff of the unit some members of the teaching staff of the Departments of Agricultural Economics and of Farm Management are engaged in research projects financed by the unit.

THE SYSTEMATIC EVALUATION OF DEVELOPMENT PROJECTS

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PREFACE

This, the first paper of the Agricultural Economics Research Unit, springs from a research project, directed by Dr. J. T. Ward, concerned with the economic aspects of resource development in New Zealand.

This field of study involves the use of special analytical techniques which are described in the paper. Though these techniques were developed, and are being used, for the specific problem of land development, they are perfectly general in nature and can be applied to the evaluation of any development project. It therefore seemed to us appropriate to circulate the present bulletin describing these techniques, which will be of interest not only to economists but also to government and business officials involved in making important decisions in the field of investment and project development. The paper was originally given by Dr. Ward to the 1964 Conference of the N. Z. Association of Economists.

12 February, 1964 B. P. Philpott

THE SYSTEMATIC EVALUATION OF DEVELOPMENT PROJECTS[1]

Resource Development and Economic Growth.

In 1960 Sir Douglas Copland concluded his paper to the Industrial Development Conference in Wellington with the warning "...the assumption upon which economic statecraft in the modern world must be based is growth. Those who fear it, or entertain doubts about the risks involved will be bypassed while the rest of the world goes forward." [2]

At that time there was little awareness of the need for greater growth in New Zealand and still less any recognition that conscious planning might be required to achieve such growth. Since then the climate of opinion has changed. Publication of reports by the Monetary and Economic Council [3] and by the New Zealand Institute of Economic Research [4] together with the dire utterances of many individual economists, have focussed attention upon the poor growth performance of New Zealand in the last decade and have emphasised the unpalatable fact that many countries are likely not only to achieve a standard of living comparable with ours but to outstrip it during the next decade.

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1. I am indebted to Professor B.P. Philpott for his helpful comments on this paper.
2. Sir Douglas Copland "Economic Problems for New Zealand in an Expanding Economy." Industrial Development Conference, Wellington, June, 1960.
3. Monetary and Economic Council "Economic Growth in New Zealand" Report No. 2, May, 1962.
4. C.A. Blyth "Economic Growth 1950-1960" Research Paper No. 1, N.Z. Institute of Economic Research, 1961.

These warnings appear to have influenced political thinking and it is surely less true now than it was only a year or two ago to say that growth is a neglected topic even though it is not yet a major objective.

Economic growth, however, is not a single entity. It is an amalgamation of rising production in various sectors of the economy and of specific development projects in these sectors. Concurrently with the more general acceptance of the need for faster economic growth we have been presented with an impressive list of large scale development projects, some of which have already been embarked upon while others are still in the embryonic stage. Amongst the major industrial development projects may be listed the proposals for a steel industry based on the iron sands of the North Island, for an aluminium works based on the Manapouri scheme of the Southern lakes, and for a further expansion of other hydro-electric power schemes. Apart from these and other major projects in industry, transport and communications, we must envisage a considerable further expansion of many smaller private industrial schemes.

A further change in public opinion appears to have been a belated recognition that for many years ahead industrial expansion in New Zealand will be dependent upon increased agricultural production because agriculture remains overwhelmingly our major earner of overseas currency. Some of this expansion will come from bringing in new land. The Department of Lands and Survey has almost one million acres of unimproved or reverted land under

development at the present time while it regards a further three million acres as potentially capable of development. A second major claimant to broad acres is the New Zealand Forest Service; planting targets to meet projected requirements for timber and pulp are an additional million acres under exotic forests by the year 2000 and a further million acres by 2025.

A more rapid expansion of higher education is a prerequisite of greater material growth and we must all welcome the extensive but long overdue rebuilding at the existing universities and the development of two new universities at Palmerston North and Hamilton. Nor must development in secondary and primary education be overlooked. Other areas in which further public investment is required are transport, hospitals and other social services.

Clearly there is no lack of development projects. Can it be said however that the country has a development programme in the sense of an overall plan? It appears rather that we have separate plans for industry, agriculture, forestry, education, etc. Indeed, an overall rate of development has not yet been formulated. In conformity with our well-known propensity to favour the concrete rather than the abstract, we are approaching this problem from the ground up; that is, on the basis of specific investment projects, both in the public and the private sector, upon which an investment programme is being built up almost inadvertently.

Two critical questions may be posed -

1. How can individual development projects be evaluated?

2. How can the selection of individual development projects be integrated into an overall plan for national economic growth?

There has been much discussion of the theoretical concepts necessary for resolving these questions and increasing interest in developing operational tools for their solution in practice. [1] I assume that where an adequate planning apparatus exists the simultaneous solution to these problems could be achieved by the use of comprehensive macro-economic programming models. [2] Unfortunately New Zealand at present lacks such a planning apparatus and it is no part of this paper to discuss the sophisticated planning models. Rather I wish to suggest that, accepting the situation in New Zealand, our primary requirement is a systematic method of evaluating individual development projects so that they have a common basis for comparison and that their relative merits may be reviewed in a more consistently objective manner.

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1. Amongst many references see in particular H. B. Chenery, "The Application of Investment Criteria", Quarterly Journal of Economics Vol. 67, 1953, pp 76-96, W. Galenson and H. Leibenstein, "Investment Criteria, Productivity and Economic Development" Quarterly Journal Economics Vol. 69, 1955, pp343-370 and A. Kahn "Investment Criteria in Development Programmes" Quarterly Journal Economics Vol. 65, 1951, pp 38-61.

2. For example see "Programming Techniques for Economic Development" United Nations Economic Commission for Asia and the Far East, Bankok, 1960, especially Chapter IV, 'Integration of a Programme of Projects with an Investment Plan'.

Co st-Benefit Analysis.

The method I wish to suggest is that of cost-benefit analysis. This is a technique which has attracted an increasing amount of attention since its original use some twenty years ago by United States Government agencies for evaluating water resource projects. It has been widely used for analysing proposals for comprehensive development of river basins.[1] More recently Eckstein and other writers have extended this analysis to regional development in a broader sense[2] while McKean has suggested that in a more generalised form it is suitable for analysing many different aspects of government expenditure.[3] McKean's examples range from allocating a budget amongst competing departments to evaluating the comparative military effectiveness of "B 29 bombers as compared with System X".

I believe that the application of this type of analysis to development projects in this country would be of great value, not only because it might result in more correct decisions than if these were made in an arbitrary fashion, but also because it would ensure a more thorough consideration of all aspects of the proposed development than appears to be the case at present.

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1. See Sub-Committee on Evaluation Standards, Report to the Inter-Agency Committee on Water Resources, "Proposed Practices for Economic Analysis of River Basin Projects" revised May 1958, Washington D.C. Also J.V. Krutilla and O. Eckstein "Multiple Purpose River Development" Hopkins, Baltimore, 1958.

2. Otto Eckstein "Benefit-Cost Analysis and Regional Development" Chapter 15 in "Regional Economic Planning"; European Productivity Agency, OEEC, Paris, 1961.

3. R.N. McKean "Efficiency in Government through System Analysis" Publications in Operations Research No. 3 - Rand Corporation. Wiley, New York, 1958.

A systematic way of thinking about projects is clearly a first requirement towards arriving at correct solutions. The following steps provide the logical framework for cost-benefit analysis.

1. Recognition of the point of view from which the study is being made, i. e. an individual firm or farm, an industry, a regional area or the nation as a whole. Such a distinction is essential because differences in the point of view taken will determine the relevant investment criteria and can affect the results of the study and the policy recommendation. This is due to the divergence of private costs and benefits from social costs and benefits; we no longer accept that the 'hidden hand' of Adam Smith's free market maximises social welfare. One particular aspect of cost-benefit studies might be to investigate those areas in which social welfare might be advanced by a projected development but private benefit would be insufficient to provide the necessary incentive to invest. (An example might be private development of high country properties.) In such cases analysis might establish a case for public subvention in the form of tax relief, special depreciation rates for heavy initial investment, etc.

2. Identification of the development project. This requires a clear, precise statement of the proposed project. It is not sufficient to state that it is desirable to make New Zealand independent of overseas supplies of a particular product and therefore it is proposed to establish such and such an industry in this country. This is purely a policy statement.

The project statement must be precise in terms of capacity, of quantity and quality of output whether the project relates to a steel industry, hydro-electric works, pulp mill, cotton mill, land development scheme, or any other type of investment.

3. Consideration of all feasible alternatives; that is the alternative ways in which the project could be developed technically, including different scales of operation. This is vital if a correct decision is to be made; a development project might be ruled out if presented in terms of one particular technical proposal whereas it might be acceptable in another form. Moreover the requirement to present technical alternatives will make it possible to consider the project within a broad economic framework right from the start.

4. A detailed economic analysis of the project (in terms of its alternative schemes if necessary) and an assessment of it according to a previously selected criterion. This is the core of the direct contribution made by the economist and much of the rest of this paper will be concerned with establishing a suitable criterion and formulating the type of economic analysis generally adopted for cost-benefit studies.

5. A review of the intangible elements associated with the project. The intangibles are those considerations which must be taken into account from a social point of view but which cannot be expressed in a financial form. Intangibles may vary from considerations of national security or prestige to regard for scenic beauty, from personal preferences for particular

types of work to social considerations of equity. In some fields, notably housing, transport and town planning, considerable advances have been made in expressing what were formerly regarded as intangibles in financial form.[1] In others, quantitative measurement still appears inconceivable, but a formal consideration of intangibles along with those elements susceptible to monetary evaluation will frequently make a rational choice possible. For example it may be impossible to assess the beauty of Lake Manapouri in financial terms but it should be possible to calculate what the preservation of that beauty would cost the nation in terms of loss of annual net output if the proposal to raise the level of the lake were abandoned. This, I believe, is the only rational basis upon which a decision could be made.

6. Decision, or policy recommendation which should take account of both tangible and intangible considerations.

The Choice of Criteria.

The choice of investment criteria is a critical feature of a development study and much of the recent discussion in the economic journals on investment in the undeveloped countries has centred on this topic without as yet any final agreement.

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1. N. Lichfield "The Economics of Planned Development" The Estates Gazette, London, 1956.

A number of the capital intensity criteria suggested have incorporated, implicitly or explicitly, the concept of a rate of profitability or rate of return on investment capital. An outstanding example is Chenery's criterion:[1]

$$SMP = \frac{V}{K} - \frac{C}{K} + \frac{Br}{K}$$

where SMP - social marginal product

K - capital investment

V - social value added domestically

C - total domestic costs

B - balance of payment effect

r - premium for overseas currency.

There are a number of valuable concepts in this criterion which I shall refer to again later. It is however subject to the criticism that it assumes explicitly that V, C and B are constant annual flows and can accordingly be expressed as a ratio of initial capital investment. For many development projects these assumptions are not valid. Operating returns and costs are not uniform, especially where the development phase is extensive, while the capital investment may also be spread over several years.

For this reason the concepts of rate of profitability or capital intensity have not been used in cost-benefit studies; instead the criterion adopted has been the relationship between total costs and total benefits, both expressed in terms of present values or of annual equivalents by the

1. H. B. Chenery op cit.

application of compound interest techniques. In American empirical studies of river catchment development areas the criterion used has generally been the ratio of the present value of total benefits to total costs, V/C. If this ratio is greater than 1 the project is considered to be economically worthwhile of itself, while the magnitude of the ratio provides a ranking index where the problem is one of choosing between a number of technical alternatives.

For more general analysis, however, covering a wider range of projects, it may be reasoned that a more valid criterion will be the maximisation of net benefit, i.e., total benefit minus total costs, V - C, expressed as present values (or alternatively as annual equivalents). In the usual form of present values the difference between total benefits and total costs is known as the present worth of the investment. It will be apparent that where the present worth is positive the ratio V/C will be greater than one, similarly where it is negative, V/C will be less than one. The two criteria therefore give similar results in assessing the absolute value of a project but they do not give the same results in ranking a group of projects. The V - C criterion has the operational merit that it takes into account the scale of each investment as well as its efficiency and it therefore records the net contribution made by individual projects to the national economy over the planning period. As such it is more meaningful and more readily understandable than an efficiency ratio.[1]

1. For a full discussion of the theoretical justification for using the V - C criterion see F. A. and V. Lutz "The Theory of Investment of the Firm" Princeton , New York, 1961. Also R.N. McKean op. cit. Chapters 2, 5 and 6.

Adopting this terminology we may designate the net contribution made to the national economy over the life time of the asset as the social present worth of the project. This is defined in our basic equation as:

$$SPW = V - C \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where V and C stand for the present values of total benefits and total costs.

In some cases all categories of benefits and costs may be regarded as of equal significance and accordingly included under the general terms V and C. In others, certain benefits or costs may have a particular significance and may require discriminatory treatment. For developing countries investment capital and foreign exchange usually fall into this category. For New Zealand the mobilisation of internal capital or the raising of foreign loans does not present the acute problem it does for many poorer countries but the balance of trade position is acute and the effect of any development project upon earnings or disbursements of overseas currency is of particular significance. This has, of course, long been recognised in New Zealand; indeed I believe that it has been overstressed and that many industrial projects have been encouraged on the vague criterion of 'import replacement' with scant regard to their effect upon the allocation of domestic resources.[1] What is required is a

1. On the other side of the world Britain's agricultural policy has embodied the same fallacy; the present level of agricultural subsidies is witness to the excessive internal cost of import replacement for foodstuffs.

criterion which takes both aspects into account. I suggest that this may be done by incorporating Chenery's concept of a specific balance of payment effect into the general cost-benefit formula. I propose therefore the following modification to our basic formula:

$$SPW = (V - C) + a(X-M) \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where V - total domestic benefits

C - total domestic costs

X - additional earnings, or savings, of overseas funds

M - additional expenditure of overseas funds

a - the premium for overseas currency, reflecting the degree of overvaluation of the domestic currency in the current situation.

Having suggested the basic form of the investment criterion it is now necessary to examine the individual elements involved, to break them into their component parts and to discuss the problem of measuring them in quantitative terms. [1]

For the moment I shall defer discussion of the time element of benefits and costs and assume that all are expressed in terms of their capitalised or present values.

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1. On a number of these points I am incorporating definitions used by Chenery op cit.

$$SPW = (V_1 + V_2) - (C_1 + C_2 + C_3) + a\left[X - (M_1 + M_2)\right] \quad \ldots\ldots (3)$$

where,

V_1 value of direct domestic benefits, i. e. increased consumption of particular product on the home market, valued at the premium import price with the effect of taxes, tariffs and subsidies eliminated.

V_2 value of indirect benefits; internal economies including any reduction in cost to other producers in the same sector or in other sectors of the economy. In some cases, such as transport services which are widely used, measurement can only be approximate.

C_1 direct operating costs of labour and domestic materials. In undeveloped countries, an investment project will make possible the employment of labour otherwise unemployed or underemployed. In such cases domestic labour should not be charged at the market rate but at a lower 'shadow price' reflecting its true opportunity cost. In New Zealand, where the labour market has been characterised by overemployment rather than underemployment for many years, the true cost of employing labour in a new project is the loss of alternative output in some other line of production. This effect will be difficult to measure and in general must be approximated by

charging the market rate for labour.

C_2 - domestic development costs of labour and materials.

C_3 - indirect domestic costs; any external diseconomies occasioned by the project to other producers in the same sector or in other sectors of the economy. The measurement of indirect costs and benefits is a matter of some complexity. Certain effects may be readily identifiable and measurable, for example the off site benefits which result from a conservation programme in a catchment area. Others result from the interrelationship between the sector in which the investment takes place and other sectors of the economy with which it is vertically connected, for example, the effect of a conservation programme upon the fertilizer industry and upon the wool and meat processing industries. The analysis of this group of benefits and costs for a large investment programme would require a detailed study of inter-sector accounts. For a small investment programme the impact upon other sectors may be approximated by the use of existing 'value added' measures.

In addition to these primary effects an investment project will have secondary effects upon the economy. It is a usual practice to ignore these unless there is a state of unemployment or underemployment when the secondary consumption and employment generated should be included in the total benefits

resulting from the scheme. Such multiplier effects can only be measured by an adequate social accounting system. Where the investment problem is one of choosing between technical alternatives of similar scale secondary effects may be ignored as they are likely to be of approximately the same magnitude whatever alternative is selected.

X - increased earning of foreign currency or savings of foreign currency due to import replacement. Export prices should be valued at f. o. b. prices with allowances, where appropriate, for marginal revenue effects. Import replacement should be measured in relation to the cheapest overseas source.

M_1 - increased expenditure of foreign currency on operating costs, i. e., imported materials.

M_2 - increased expenditure of foreign currency on capital items, i. e. plant, machinery.

As with domestic costs and benefits, each of the items X, M_1 and M_2 should be subdivided into primary (direct), primary (indirect) and secondary effects.

a - the premium for foreign currency. This constant, which as formulated here will be greater than one, will be an arbitrary value approximating the extent to which the currency is over-valued, i. e., if it is assumed that the £NZ is overvalued against sterling by 10% then a would be 1. 1, if by 25% then

a would be 1.25. The higher the value given to a the greater the weighting given to projects designed for import replacement or for increasing exports.

The rationale of this premium is that in many developing countries, costs and benefits in foreign currency are more important to the economy than the official rate of exchange suggests. The shadow price for foreign exchange should approximate the equilibrium rate of exchange but in the absence of detailed econometric studies it will have to be determined intuitively.

The Analysis of Time:

The relationship between benefits and costs is complicated by the fact that due to the nature of investment they cannot relate to the same period of time. Most development projects necessitate heavy investments of capital initially with subsequent lower operating costs, while the flow of benefits typically takes the form of a stream of output commencing some time after the initial investment and continuing for a varying period into the future. The problem of bringing flows of benefits and of costs to a comparable time basis may be resolved by the use of the compound interest techniques of compounding, discounting and capitalisation. Anticipated future returns may be discounted and summed to determine the present, or capitalised, value of V; similarly, future operating costs may be discounted to their present value and

added to the initial capital investment to give a single value for C. An alternative approach is to express both V and C in terms of annual equivalents by transforming discrete streams of benefits and costs into continuous uniform streams.

The same technique is applicable to analysing the choice between alternative projects; a comparison of the relative social present worths of the projects provides the most valid basis of choice. This type of analysis is particularly useful where the projects exhibit marked differences in the time patterns of their costs and benefits.

In analysing development projects the rate of interest used for calculating present values or annual equivalents can have a marked bearing on the result of the study. A project which has a positive V-C value at low rates of interest may have a negative value at higher rates, while a comparison of two projects with different time patterns will be influenced by the rate selected. The present worths of projects with a long period of investment, such as forestry, are peculiarly susceptible to the rate of interest used.

There appears to be a popular belief that there is something socially or even morally wrong in allowing public investment decisions to be influenced by interest rates and an even more widespread belief that if a particular development project is financed by the state it should be subject to a low rate of interest. These beliefs reflect a failure to realise that the main role of the rate of interest is to act as a

rationing mechanism for allocating scarce capital resources to those projects which will make the best use of them in terms of their contribution to national output. The rate of interest used to determine the present worth of individual projects should ideally be the marginal efficiency of development capital; this, however, raises theoretical and practical difficulties and for practical planning purposes we may have to settle for some arbitrary rate. As a rule of thumb measure in New Zealand we might consider using the rate of interest on development bonds for domestic capital and that on overseas loans for foreign capital.

A second factor which affects the magnitude of present values of benefits and costs is the length of the planning period, or investment horizon. Clearly, the social present worth of a profitable investment will be greater if its net benefits are capitalised over a period of forty years rather than twenty years, although, due to the effect of discounting, the discrepancy is less than might superficially be supposed. The major point at issue is whether the time period taken into account should relate to the anticipated working life of the asset or to some arbitrary planning period. Although there has been much discussion on this point [1] the former appears more logical especially when projects with a long period of production are under consideration. For example

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1. For a topical comment on this point see R. Turvey "Present Value versus Internal Rate of Return - an Essay in the Theory of the Third Best", Economic Journal, Vol. LXXIII, 1963, pp 93-98.

a twenty year planning period would rule out forestry plantations for timber production, while even a ten year period would discriminate against many other forms of land development, conservation, river basin development, etc. For practical comparative purposes it would be advantageous to equate the investment horizon to the first productive cycle of the asset with the longest period of production.

A further complication in a dynamic world is the fact that investment decisions have to be made now in anticipation of returns that lie in the future and are therefore uncertain. This raises the question of what monetary values should be placed upon anticipated future returns and costs. The likelihood of error is clearly very large especially for projects with a long planning period. Three possible procedures may be considered:

1. Present values may be projected into the future.
2. The values used in the studies may be based upon forecasts of future values. This approach requires a greater attention to econometric research than has yet been achieved in this country. Studies would require, amongst other things, analyses of recent price trends, of income and price elasticities and of the rate of technical change in specific industries.
3. Instead of working with single valued expectations a series of analyses could be made using a range of values. This

procedure would throw light on the stability of the result and its sensitivity to changes in critical variables.

A final point which has to be considered in relation to investment over time is the element of risk. Apart from the uncertainty of future prices which is common to all forms of investment, the degree of risk that the physical outcome may not be what is anticipated will vary from one project to another. This risk will generally be greater in projects dependent upon physical processes of growth, i. e., land development for agriculture or forestry, than in those of an engineering nature. No agreement has been reached as to how risk may best be incorporated into cost-benefit analysis in theory or in practice, beyond the ad hoc advice that where other considerations are equal the more certain project should be preferred to the risky one. Approaches that might be considered for introducing a risk premium into the study are to include a probability analysis, to adjust the anticipated returns, or to increase the rate of interest used to discount future returns above the general planning rate. From the point of view of operational simplicity the second of these appears the more desirable.

The Role of Cost-Benefit Analysis.

In this paper the role I suggest for cost-benefit analysis is primarily that of providing a standard method of evaluating specific development projects. I should like to propose that all government departments and agencies concerned with the investment of government

funds should evaluate their projects in this way. The government, which in a small country must necessarily make the final decision on all major development projects, would then have an objective basis for considering each project and for comparing alternatives. In the absence of an overall planning apparatus the government would also have the responsibility of laying down the values of some of the constraints that the departments would have to incorporate in their analyses, notably the rate of interest and the premium for foreign currency, which initially would have to be determined intuitively. As a first practical step we might simply propose that no development project should be undertaken unless this economic evaluation had shown that the present value of future benefits was likely to be greater than the present value of the costs involved, with due allowance for intangibles.

Successful planning would require that the total number of projects approved for any period were such that they just utilised the available supplies of limiting resources (capital and overseas currency) available for development. The ideal solution might be sought in a number of ways. In the first place, the government could require all potential projects to be evaluated on this basis and then select the optimum combination of projects from those whose benefits exceeded costs. Selection would entail ranking the projects according to the magnitude of their social present worths and then choosing the group of projects which, within the given restraints, had the greatest

aggregate present worth. An analogy from private business would be a private investor with limited capital choosing the investment portfolio which he believed would secure him the greatest growth of capital. Unlike the state however the private investor would not have to take 'extra-market' prices or intangibles into account in evaluating individual investments.

A problem raised by this approach is that the ranking order of projects would vary according to the values assigned to the rate of interest and to the premium for overseas currency. If the arbitrary values were far from the ideal values a sub-optimum group of projects could be selected. One way of overcoming this would be for the government (through its planning agency) to follow a process of trial and error in which the shadow prices for capital and overseas currency were adjusted until the requirements for the group of projects with positive social present worths just equalled the resources available. This would mean in effect that the 'planning' rate of interest and rate of exchange were being used as rationing sieves even though they were not being put into operation on the market. A more sophisticated approach to the problem would be to use development programming. This method would determine the optimum combination of projects, subject to the given constraints, and would simultaneously throw up the ideal shadow prices for capital and for foreign currency. The use of these techniques presupposes a more comprehensive planning machine;

if this were to be established cost-benefit analysis would take its place as one of the operational tools that could be used for determining a development programme; it would be complementary to other techniques, such as input-output analysis, sector accounting, comparative cost analysis and development programming. [1]

In countries such as New Zealand where a macro-planning apparatus does not exist the integration of development projects would require that each major project should be evaluated on a cost-benefit basis and the results expressed in terms of social present worth, together with estimates of initial requirements of domestic and overseas capital and a capital profile for the development period. The projects would then be ranked and selected on the basis of maximising the social present worth. In this way cost-benefit analysis would provide a technique not only for evaluating individual projects but also for integrating the successful projects into a development plan.

A list of development projects currently under discussion in this country to which cost-benefit analysis could be applied is given below. The list is not meant to be exhaustive but is illustrative of the larger projects which could suitably be analysed by this method. Superficially there might seem little in common between the setting up of a steel industry in the North Island and the establishment of a sugar beet

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1. See W. Isard and J.H. Cumberland "A Synthesis of Operational Methods in Regional Analysis" Chap. 17 in "Regional and Economic Planning" European Productivity Agency, OEEC Paris, 1961.

industry in South Otago. In fact, both of them would make demands upon scarce resources of materials, labour and overseas funds, both would have an impact upon domestic production and also upon the balance of trade and both would involve considerations of capital investment and returns over time. These elements are common to all the projects listed below.

Each of these individual projects could be subjected to the same systematic evaluation although the detailed requirements of the study would vary. The basic data of the studies of large scale industrial and urban development would be provided by the planning and production engineers, traffic engineers, surveyors, architects, etc. while pastoral development projects would require the co-operation of those skilled in agronomy, animal husbandry and farm management. In all cases the studies would require market analysists to assess the potential scope for products and other economists with the role of co-ordinating the studies of those trained in other disciplines.

List of development projects in New Zealand to which cost-benefit analysis could be applied.

Aluminium industry at Bluff.

Manapouri hydro-electric scheme.

Steel industry based on iron sands in the North Island.

Development of the Mackenzie Country.

Large scale land development for farm settlement.

Large scale planting of exotic forests.

Development of a pulp industry in Nelson province.

Expansion of the fishing industry.

The establishment of a sugar beet industry in Otago.

Large scale soil conservation projects.

Transport developments - airways, roads, additional ferry services.

Urban development.

Cost Benefit Analysis as an Engineering Tool.

I want now to consider briefly the use of cost-benefit analysis as an 'engineering tool' for determining the optimum 'scheme' for any given project, to which I referred earlier in the paper. In this role this type of analysis is concerned not with evaluating a project already formulated but with planning the project from the initial stages. The fundamental problems involved will be the choice of technique and of scale of operation. Alternative schemes for developing a project will involve differential benefits and costs and as such have an economic aspect as well as an engineering aspect. I believe that this point is not understood in the case of much of our primary development in New Zealand. One of the major contributions that this type of analysis could make would be in providing a systematic framework for analysing alternative technical programmes for a given project.

The choice of technique involves selecting a particular scheme of development or method of operation from amongst a number of technical designs that may be feasible. The choice of possibilities

may range over a narrow technical field or may involve much wider considerations as for example where either capital intensive or labour intensive methods are feasible. In all cases analysis should be directed to finding that scheme which is the optimum from the economic point of view, which may or may not be the one considered most efficient or desirable from the technical point of view. An example which has caused some controversy in America is the choice between a large, possibly spectacular, dam and a series of smaller, more proasic, dams for developing a river basin. Other examples which might be considered in New Zealand are the optimum length of period of land development before settlement for agriculture, and planting and tending regimes in forestry.

Problems of this nature are basically of the form, 'what is the best way of achieving a given outcome? The ranking of alternative techniques according to their net benefits will throw up the solution as the project which maximises net benefits will be that project which exhibits the least cost for achieving the desired result.

In some cases not only the technique of development but also the scale of the project may be a matter for decision. Projects for hydro-electric works, harbour installations, pulp mills, forest plantations, etc., may all be envisaged at different scales of operation. A decision amongst scale alternatives requires analyses of the potential market for the product, the technical aspects of

production and the availability of resources required. Again the cost-benefit approach provides a useful means of analysis in terms of net benefits. In this case however, once a basic scheme has been analysed, further analysis may be conducted in terms of the marginal or additional benefits and costs to be expected from successively larger schemes rather than the absolute magnitude of net benefits for each scheme. A larger scheme should only be chosen if the additional benefits anticipated appear likely to exceed the additional costs involved. A good example is provided by the Manapouri hydro-electric scheme. A critical question in this case is not whether the total benefits of the larger scheme (involving raising the level of Lake Manapouri) will exceed the total costs involved, but whether the additional benefits expected will be sufficient to offset the additional costs, including the intangible loss of scenic beauty.

The Application of Cost-Benefit Analysis.

In presenting this paper I hope to draw attention to the merits of cost-benefit analysis, not as a theoretical model but as an operational tool. That is to say, I should like to see it put into practice. The economics department at Lincoln College is applying this type of analysis to studies of land development for agriculture and for forestry and we intend to extend its use to research in conservation, irrigation and other developments in the primary sector. I hope that its use for analysing projects in other sectors and for national planning will also be considered.

There are of course many difficulties involved. The quantitative measurement of benefits and costs, especially those due to indirect and secondary effects, raises many conceptual and practical problems and the results are unlikely to be as accurate or precise as we would like. This should not however blind us to the merits of tackling the problem in a systematic and objective way, while an appreciation of the difficulties involved might encourage us to seek the means to solve them rather than continue to ignore them.