SETOR DE INDÚSTRIA

A SUGGESTED METHODOLOGY OF INDUSTRIAL PROGRAMMING AND DIAGNOSIS

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Before discussing methodology proper, it would be convenient to state that the principal aims of industrial programming should be the following:

(1) projections of development by industries;

(2) to help determine government economic policies, and policies in regard to industrial development in particular. Under this heading may be included government programmes of investment, both in public sector, industries and in the infrastructure (transport, energy, etc).

The first aim is obviously only a means to realize the second. The projections will help to determine perspectives for the balance of payments, needs for investment both in industry and the infrastructure, etc. On the basis of such perspectives the government can arrive at decisions on management of the balance of payments, the tariff structure, fiscal incentives to investment, distribution of finance for various needs etc. These policies may, of course modify the initial projections. Thus, -- in the final analysis, projections, programmes and policies are to be simultaneously determined so as to be mutually consistent.

To help determine what lines should be followed in the diagnoses the methodology suggested for programming will be discussed first.

Methodology of Industrial Programming

The basic approach suggested in this paper is comparative industry analysis. Attention is therefore focussed on those aspects that are common to, and comparable as between the various industries. This does not mean that there do not exist peculiar aspects requiring special analysis in several industries. In fact, such special analysis may constitute the major part of analysis of the industry, in several cases. Even in the application of comparative analysis to each of the several industries there should be considerable variation (in particular as regards the elaborateness of the analysis), depending on the characteristics of the industry, its importance, its hetherogeneity, whether it is a traditional industry or one in which there is scope for considerable import substitution, the nature of available data, etc. The program suggested is only the last common denominator for all industries.

Industrial programming is an art, and cannot be reduced to an exact science.

Our second preliminary remark is that this paper will stop short of the level of preparation of projects. We believe that projections and planning should, usually, move from the general to the particular and not vice-versa.* (However in a minority of cases, in newer industries, there may be need for preliminary exploration of projects to indicate possibilities which industry analysis, in view of its broader nature cannot discover -- or to provide data for industry analysis). If industry analysis indicates that development of certain industrial activities, or certain ones in a particular location, are practically certain to be uneconomic, there is hardly any need to go ahead with more detailed, even though preliminary, examination of corresponding projects. If on the other hand, industry analysis indicates that a certain activity is practically certain to be economic, a high priority should be given to project studies in that field. If industry analysis suggests a marginal nature for some activities some project studies may be indicated, not only for their own sake, but also to obtain more definite conclusions on whether such activities would be economical. There follow our suggestions for industrial programming. It should consist basically of five steps.

(1) Projections of consumer demand (to which should be added exogenous projections of exports prepared by the foreign trade sector).

(2) Calculations of inter-industry (input-output) relationships, including capital coefficients (with projected modifications).

(3) Calculations of the comparative benefits and costs or, in other words the comparative profitability, in the various industrial activities.**

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* This view is contrary to that implied by Murray D. Bryce, "Industrial Development" (a work largely concerned with project preparation) in which it is suggested that the authorities responsible may start out with a vague notion of a potentially profitable project, hire a team of technical experts to determine the broad requirements of raw materials, etc. for the project, and only then examine whether this fits in with the general nature of the economy (see pp.101-120)

** See subsequent definition

The objective is to rank them in order of their comparative advantage , for purposes of development of import substitution or of export activity; and also for deciding on incentives to completely domestic activities. (In some industries, one may have to be satisfied with mere projections of production, instead of selection on the basis of comparative cost).

(4) The fourth step will be one of synthesis of the (previously ranked) industrial activities to obtain a ranking of inter-linked sequences of activities. The ranking will also be in terms of comparative advantage ; but obviously this will be a final ranking.

(5) The fifth, and final, step will consist of a trial balancing. Let us select the "n" highest ranking sequences of activities -- say 30 sequences (the total number is chosen on the basis of common sense) out of a total of 40 possible sequences of activities. Then, using the input-output coefficients (including the capital coefficients) one can calculate total requirements of investment, foreign exchange, labour, etc. These totals (adding them to the results of exercises for the non-industrial sectors) will then be compared with the likely availabilities or targets for these latter variables. According to the direction of the imbalance shown in this trial balancing one can then add or reduce activities for import substitution (or export promotion). The trial balancing can then be repeated on the assumption that, say, the 28 (or the 32) highest-ranking activities will be developed during the plan period*

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* This methodology is basically similar in principle, in spite of possible operational differences, to that suggested in the paper by Dr. Mário Simonsen. The two important differences from that paper are:

(i) that "comparative benefit/cost ratio" has been substituted for "capital-output ratios" as the ordering principle. Thus in this paper it is considered that labour cost, on the basis of some accounting wage-rate, should be included in the cost calculations. This is based on the guess that the marginal productivity of labour - - in subsistence agriculture is appreciably above zero in the Brazilian economy. There are also hidden components, of "labour" costs -- e.g. housing for urban labour, investment in training of labour -- that are really capital costs, but are difficult to determine. Admitedly, comparative benefit-cost ratios should, in the majority of cases, be in accordance with relative capital-output ratios. It may also be noted that it is due to the fact that this paper takes into account other elements of cost

Theoretically speaking, the fourth and fifth steps can only be satisfactorily resolved by linear programming (or, more realistically, by an approximation of a linear programming model to a non-linear one) with electronic computers. In such programming, the opportunity cost of capital, and the equilibrium rate of exchange will be variables to be simultaneously determined, along with the selection of sequences of activities for development (the input-output relationships will be taken account of in the model), in the final solution. However the fourth step is not likely to be as difficult as it may seem at first sight, because, we believe, the structure of inter-industry relationships is not that complicated (see further discussion below). The fifth step may also not be difficult, if the first trial does not result in a great disequilibrium in regard to investment, the balance of payments, etc.

There follow more detailed suggestions for these four basic programming steps.

Demand Projections

For projections of consumer demand, one should begin with classification of the demand for the products of a given industry according to major categories, on the basis of the kind of variables that influence demand. For each category of demand, one may use one of the following four methods of projection:

(i) based on time series analysis;

(ii) based on analysis of family budgets;

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* besides capital cost (which is implicitly the only cost considered in the Simonsen paper) that it runs into the difficulty that an initially unknown variable, namely the opportunity cost of capital (or in other words its cost relative to other costs), enters into the determination of total costs.

(ii) Since this paper is concerned with methodology for programming of only the industrial sector, it is assumed that the amount of foreign exchange available each year ("autonomous" exports plus net inflow of foreign capital) is given, and that the industrial programmes must be drawn up so as to be in equilibrium with this restraint. No assumption has been made regarding the nature of balance of payments restraints, i.e. whether inflow of foreign capital each year should be regarded as given or whether the objective should be to minimize the total present value of deficits over the perspective plan period, etc.

(iii) international comparisons;

(iv) relationship of demand to auxiliary variables (other than income and price), when relevant.

Though these methods are alternative they can also be used as complementary (if time permits) for cross-checking purposes.

(1) In time-series analysis, the objective should be to calculate demand as a function of three fundamental variables, and in some cases a fourth. The three fundamental variables are population, income per capita, price of the article (relative to the general price level). In some cases, the demand function should include a growth factor as a function of time (independent of growth in income and changes in relative prices). The idea is that for some of the newer articles of consumption, demand may gradually grow even if income were to remain constant. This is the same as saying that there may be a "demonstration effect", which will only become fully effective over a period of time. The relationship of demand to the four determining variables should be calculated by multiple correlation analysis of the time series available. This will require, in the first place, the basic data on time series of prices (these will also be useful for other purposes, in particular for analysis of comparative cost); and, in the second place, the availability of trained personnel (and of time) for somewhat sophisticated statistical analysis. A further difficulty is that it may not be possible to separate the effects of the growth factor, i.e. of time, where relevant) because until 1961, national income in Brazil was growing at a fairly steady rate each year. If some of the above-mentioned difficulties appear to be serious, the best that it may be possible to do, as a first step, may be to calculate the relationship of demand to income from time series (ignoring price changes and growth factors). To simplify matters even further, it would be sufficient, in view of the fact that the projected range of growth of national income (6% to 7% per annum) is roughly the same as the rate at which income has actually grown in the postwar period, to merely

project past trends of growth of final consumer demand, as a first approximation.

It should also be remembered that, in the case of durable consumer goods in some circumstances, the demand is for a certain level of stocks of such goods with consumer, rather than for a particular annual flow. In such cases, it would be appropriate to first calculate the stock demanded, as a function of income, price, etc. and therefrom to deduce the annual flow required.*

(2) Demand may be analysed from family budget data, classified by income levels. In other words, one obtains a correlation of expenditure on a particular article or group of articles with the various income levels. The fundamental logical weakness of family budget analysis is that it assumes that one when one income group attains, at some subsequent date, the level of income now enjoyed by a higher group, its pattern of consumption will then be identical with the present consumption pattern of the latter. This assumption is highly dubious, because expenditure patterns are related to social standing, as well as to income levels. The second important weakness of family budget analysis is that relates to a particular point of time and therefore to a particular, perhaps exceptional, set of relative prices. It does not average out fluctuations in the relative price structure, as a reasonably long time series, of at least ten or fifteen years, would tend to do. We have not yet examined available family budget studies, but we believe they are fairly out of date. Furthermore, such studies generally produce data on money expenditures by broad categories of consumption. Data on consumption of specific acticles in physical units, are more rarely available, and if so are less reliable than expenditure data. Analysis of the latter necessarily involves deflation by price indexes, with the consequent possible margin of error, and analysis of total demand for somewhat heterogeneous categories of consumption. For all of these reasons, demand analysis

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* See also Mário Henrique Simonsen, op. cit. pg. 30

based on family budget studies must be considered inferior to time series analysis. When the two yield widely different results -- as they often will -- the latter should be preferred. Nevertheless, family budget analysis could be undertaken, time permitting, for its possible usefulness as a check on doubtful projections based on other methods.

In addition to available family budget data, one may consider undertaking sample family budget surveys specifically for purposes of demand (as distinct from the objective of stablishing weights for calculation of cost of living indexes). Such sample surveys appear to be most useful in the case of newer articles of consumption, particularly durable consumer goods, for which cases other projection method may be inadequate. For durable consumer goods, in view of their high unit prices and relatively limited sales, the samples should be special ones, giving high weightage to the high income and urbanized groups which account for a large part of the consumption of these items. A general family budget survey (unless the sample were very large) would not show a sufficient number of sales of each consumer durable good to produce reliable estimates of demand functions.* Perhaps the Fundação Getúlio Vargas or other research institutions conversant with the matter (e.g. the Faculdade de Ciências Econômicas of the University of São Paulo) could undertake such special consumer enquiries and the subsequent analysis -- both of which could be quite laborious -- maybe in collaboration with the respective manufacturing association.

(3) Comparisons of demand with countries which are now at a higher income level should only be resorted to, when other methods of projection are impossible or very dubious.

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* Application of Poisson's law of probability (relating to a small number of occurences) will readily show that, unless the total sample size were very large, the sampling even in a general consumer survey would be larger even for estimation of total nationwide sales of each consumer durable item, particularly passenger cars, not to speak of estimation of income-elasticity price-elasticity, etc. of demand for these items.

S.ch international comparisons are subject to a number of limitations; of which the most obvious is that one should try to select countries in which socio-economic conditions are as similar as possible to those in Brazil.

(4) As regards the fourth method -- the relation of demand to auxiliary variables, -- we refer to cases of joint demand or derived demand. For example, the demand for paper for schoolbooks can be estimated from educational programs; and the mileage of roads to be constructed may affect demand for automobiles.* In the particular case, where the trends of production in a particular industry are merely projected (instead of being determined on the basis of comparative costs, which is the general approach suggested -- see discussion of activity analysis below) the industrial inputs of that industry will of course, be simply determined with the help of input-output coefficients.

Inter-Industry Relationships and Capital Coefficients

The second major stepwould be the estimation and projection of inter-industry relationships, including investment. These should be available from two sources:

(1) The comprehensive input-output table for 1959 now under preparation by a special working group.

(2) The special studies of the subsectors of the industry group should provide data on the major inputs of each industry.

The first source is more comprehensive. It is presumed that the data will be in value terms and will thus not give direct information on physical requirements. The second source, which is used in what is known as "commodity balancing", is more detailed and should generally provide data in physical terms.

* Strictly speaking, the first is a case of derived demand and the second one of joint demand (of the two elements required for transportation services,whether for business or pleasure).Strictly speaking, cases of derived demand should be treated in accordance with the procedure described later.However,we are here referring to derivation from demand for goods and services which are outside of the manufacturing sector and which can generally be considered as exogenously determined with respect to programes of development in manufacturing.Threfore the derived demands for the appropriate inputs from the manufacturing sector can be calculated on straight forward basis(i.e.without going into ranking and balancing as later described).

Modification to both types of input-output coefficients can be projected for future years when the diagnoses show that these coefficients are likely to change in virtue of technological changes, possibilities of economies of scale, etc. As regards investment, separate data should be calculated on (a) fixed capital coefficients and (b) working capital coefficients. The former should exclude investment in land and should separately state:

(i) investment in buildings,

(ii) investment in plans and machinery

Ranking of Activities by Benefit-Cost Ratios

The third basic step is the calculation of comparative benefit-cost ratios in each industrial activity, and ranking the activities accordingly. We define "activity" as the most narrowly defined industrial process, and which is not necessarily associated with another industrial process. For example, if it is assumed that ethylene can only be used for production of poly-ethylene, and that ethylene cannot be transported over substantial distances (as it is a gas), the production of both can conveniently be considered as jointly constituting a single activity, for the type of industrial analysis we are proposing. For either both of them must be undertaken in fixed proportions, or else neither of them can be undertaken within the country. The word "activity" is used to distinguish it from the production of a particular article, which can be considered as the sum of a number of "activities" in sequence.

To clarify subsequent discussion we also introduce here the concept of "stage" of activity, according to its position in the sequence of production -- i.e. whether it is a relatively basic or relatively final stage of activity. The nature of this definition should be noted -- e.g. machinery production can be a penultimate, instead of a basic activity -- e.g. production of textile machinery. Of course production of machinery can also be a relatively basic activity.*

After classification, will come the next and most

* e.g. steel-making machinery, which is used to produce steel, which is used to produce machine-tools, which are used to produce textile machinery, which is used to produce cloth.

important part of this third step (ranking of activities), i.e. the calculation of benefit/cost ratios. Before proceeding to details of techniques and sources of data for calculation of costs, the three basic principles on which these calculations should be based are stated below.

In the first place, each calculation should relate to the costs in a particular industrial activity. To clarify our meaning, we may say (though the phraseology appears somewhat circular) that the calculation should relate exclusively to the value added or to the cost of the "value added" in that industrial activity. In other words, industrial inputs should be excluded in the calculation of costs in a particular industrial activity. This procedure will have the considerable advantage of separating the benefit and cost analysis for each activity*.

The second basic principle is that the objective is merely to rank industrial activities according to their benefit-cost ratios. The objective in this step is not to make a final selection of the activities which should be undertaken within the country, and even less to determine the magnitude of the activities to be undertaken. Since the production of a particular article is the sum of a sequence of activities, this sequence may be relatively economic (i.e. have a higher benefit-cost ratio) even though some links in the sequence may be relatively uneconomic. Thus the final selection of activities (to be undertaken or stimulated by the government) will depend on the fourth step: i. e. that of synthesis. The selection will also depend on the fifth step (i.e. that of balancing of foreign exchange, investment, etc) This step will implicitly or explicitly determine two fundamental variables: the equilibrium (real rate) of exchange and the marginal rate of return on investments. It can easily be seen that these

*Thus, for example, one will avoid repeating an error made in the ECLA report Economias de Escala en la Industria Quimica, ST/ECLA/CONF.11/L.17; this report calculates present estimates of unit total cost of certain chemical outputs (to examine economies of scale in their production), assuming that unit costs of inputs remain constant as the scale of output expands. This report overlooks the fact that a larger scale production of the more finished output may make possible the larger scale production of its inputs at lower unit costs. A piecemeal analysis of each industrial activity, followed by a subsequent synthesis based on input-output relationships (admittedly, the second step would be complicated), as this paper proposes, would have avoided that error.

"prices" and the quantitative balancing are interrelated. If, for example, the demand curve of exports grows slowly relative to the demand curve for inputs, balance in external transactions can only be brought about by devaluation which will discourage imports and encourage exports. This will mean a higher degree of import substitution -- i.e. that it will be economic to develop in the country an additional number of industrial activities which otherwise would not have been economic -- than would have been the case if the real exchange rate had been stable (i.e. if the demand curves for exports and for imports had grown at the same rate).

The third basic principle (of the third step) is to keep separate the calculation of those elements of benefits and costs which are mutually incommensurable at this stage, because of the fact that two basic variables namely the equilibrium rate of return and the marginal productivity, remain indeterminate until the overall development program (or perspective) is finalized.

Let us consider first the calculation of benefits. In the case of import substitution activities, benefits should be calculated in terms of US$ as the difference between the dollar price of output and the dollar prices of importable manufactured (or mineral) inputs.*It should be noted that this calculation in terms of dollar prices is without prejudice to the question as to whether the industrial inputs should be really imported or should be domestically produced. The purpose is to keep separate the calculation of comparative cost for undertaking each type of industrial "activity". In the case of activities which are evidently more economic in Brazil, calculation of value added in accordance with the above procedure, but in cruzeiros, would be more appropriate. Calculation of value added in cruzeiros** would also be more appropriate for activities whose products cannot, politically speaking, be imported; e.g. consumer durable

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* Strictly speaking, inputs produced by agricultural activities can also be imported and should therefore be included. However, such possibilities seem to have practically no relevance to Brazil.

** In the case of industries whose outputs cannot be imported, but whose input can, the calculation would be even more complicated. In such cases one would have to calculate the former in cruzeiros, and the latter in dollars, keeping the two separate for the time being.

goods, even though their production in the country may be relatively uneconomic.

In regard to the calculation of costs, one should, in the first instance, separate the calculation of current costs and of investment. The reason, as already indicated is that the two are incommensurable, at this stage, because the opportunity cost of capital (its marginal productivity) is unknown. However, under current costs one should include depreciation of fixed capital. Besides, while costs of industrial inputs should be excluded, the cost of non-importable inputs like electricity, transport, etc. should be included in the calculation of current costs*.

When calculating investment required, a further complication is that, in many cases, a part of the investment will consist of imported equipment. In such cases, investment also breaks up into two elements, one in cruzeiros and the other in dollars, incommensurable at this stage, and which must therefore be calculated separately. However, in some cases it may be reasonable to approximate costs of imported equipment by cruzeiro costs of similar domestically produced equipment.

The fourth principle relates to the criteria for ranking of the various industrial activities.

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* To be strictly consistent, costs of electricity, transport, etc. should be excluded, and calculated in the course of analysis of those sectors. Furthermore, in such cost analysis one should separate operational costs from investment in electricity, transport, etc. These operational costs should then be added to those of the industrial activity under consideration, and the total divided by the sum of investment in it and in electricity, transport, etc. (pro-rated or on the basis of marginal investment) to arrive at the rate of return on capital (see below). However, since this is a suggested methodology exclusively for the industrial sector; and since the analysis of costs for electricity and transport would be subject to doubt in view of the necessity for converting into cruzeiros the dollar costs of servicing the large foreign loans flowing into these sectors, (see later discussion); it will be simpler to use estimated cruzeiro costs of infrastructure services

Since there are two unknown variables: the equilibrium rate of exchange, * and the marginal productivity of capital, the series cannot be ranked on the basis of their comparative costs. The only, and provisional, solution is to make an estimate of one or the other of the two variables, and then to rank the series accordingly. For example, if the equilibrium exchange rate is estimated, the "internal" rate of return on capital can be calculated (in the manner indicated below) and the various industrial activities ranked accordingly. On the other hand, if the marginal productivity of capital is estimated, one can calculate capital costs, and therefore total costs, including these. One can then calculate benefit-cost ratios and rank the industrial activities accordingly. For ranking of the various possible import substitution activities inter se, the benefit-cost ratios will appear in the form of so many dollars (of foreign exchange which could be saved) per cruzeiro of costs incurred.

The two above-mentioned criteria will lead to two different rankings of the industrial activities, since one series cannot in general be uniquely ranked according to two criteria. Let us first examine the meaning of each of the two rankings separately.** If activity A shows a higher rate of return than activity B, with a particular estimate of the equilibrium exchange rate, then activity A will always be more profitable than B, at that exchange rate, no matter what may be the marginal rate of return for the economy as a whole implied by the Program (or prospective). If both A and B show a higher rate of return than the marginal rate of return for the economy, they should both be included in the program; if both are lower then they should both be excluded; if activity A is higher than the marginal rate of return, and B is lower, then A should be included and B excluded. *** It cannot happen that A should be

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* Except where both the outputs and inputs of a industry cannot be imported or it would not be economical, to import them. In that case, both benefits and costs are independent of the equilibrium rate of exchange. Such activities can therefore be ranked, inter se, on the basis of their rate of return.

** These implications can be demonstrated mathematically, though it is not done here.

*** If other interrelated activities do not sufficiently lower or raise the total rate of return for a sequence of activities. This will appear at the stage of synthesis - at present it is more convenient to consider each activity separately.

excluded, but B included. All this is true of course only when the equilibrium rate of exchange is equal to the estimated value. Similarly, when activity A shows a higher ratio of benefits to total costs than activity B, at a particular marginal rate of return, it will be more profitable than B at any equilibrium rate of exchange; providing that the marginal rate of return stays at that particular value. Furthermore, if A ranks higher than B in both the rankings, the former will be more profitable than the latter within some range of variation of the exchange rate and of the marginal rate of return in the economy from their estimated values.

The two ratios -- for the two rankings respectively -- should be calculated as follows. In calculation of the ratio of benefits to total costs (incl. capital costs) there will be two cases. The first ranking arises in the case of the ranking of the various possible import substitution activities. In this case, benefits will be calculated as the net dollar value of the "imported activity", or in other words the foreign exchange which could be saved by import substitution in that activity. This benefit would be the difference between the dollar prices of the outputs and the dollar prices of the inputs, both on a c.i.f.basis, as earlier explained. The benefit/cost ratio would then be expressed as so many dollars of benefit per so many cruzeiros of costs. The selection of activities for inclusion in the programme would thus depend on the (unknown) equilibrium exchange rate, but their ranking (i.e. their order) would be independent of this exchange rate. The second case arises when imports of a particular product are out of the question.In this case, benefits would be calculated as the value added in cruzeiros; and benefit/cost ratios would be expressed as so many cruzeiros of benefit per cruzeiro of costs.*

* The question may be raised as to whether when imports are not politically admissible, even though much cheaper (let us say, for example in the case of consumer durable goods)whether calculation of ratios of dollar benefits to cruzeiro costs serves any useful practical purpose. Even here such calculation would at least serve to show the cost of politically oriented decisions. But in such case the ratios of cruzeiro benefits to cruzeiro costs would be most useful. They would serve to show which industries should be stimulated relatively more (or those in which policies must be directed toward countering oligopolistic practices).

The rate of return on capital should be calculated as the ratio of **net benefits** to capital invested. Net benefits should be calculated as the excess of gross benefits, in dollars or cruzeiros, over current costs of the activity considered. In case gross benefits are expressed in dollars (the case of import substitution) an estimate of the equilibrium exchange rate would of course be required to calculate net benefits in cruzeiros.

A complication arises in the calculation of the rate of return on capital in a particular activity, when its income yield (yield of net benefits) is variable over time. For example, activity A may yield a higher immediate rate of return than B; but a lower rate of return than the latter in future years. In such a case, it is suggested that a calculation be made of the "internal" rate of return for each industrial activity, i.e. that which would make the discounted present value of the future income stream equal to the investment required.*

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* As defined by Irving Fisher. If "r" is the rate of return, C_I the investment and I_t the expected income in period "t" then r is determined as the only positive root (if such exists) of the polynomial $C = \sum_{r=1}^{n} \frac{I_t}{(1+r)^t}$

where n is the life period of the physical capital invested. In practice the calculation of "r" will not be anywhere as near as formidable as would appear from the above formula. This is due to the fact that the life period of most investments is fairly long, and that the yield from them becomes stabilized, in physical terms, after a few initial years. The principal difference, therefore, between various industries or projects, is in regard to the construction period, and the time pattern of investments during that period; and the rate of attainment of maximum production thereafter (which depends on making adjustments to cope with practical difficulties encountered in working the equipment, etc; and on the acquisition of experience by technicians and labourers .) This being the case, an initial approximation to the "internal" rate of return, "r" can readily be calculated. Thus assume the construction period of a steel plant were four years, it would be roughly equivalent to making all the investment at the end of the second year. Assume that the breaking-in period is another three years, and that thenceforward the investment will yield 10% per annum. Then r can be approximated as:

$(1+r)^{2+3-1} \quad r = 0.1$

Since"r" is small, we can further approximate this equation by:

$(1 + 4r)\, r = 0.1$

It will readily be seenfrom the equation that the solution is, roughly, $r = 0.075$

In other words, the "internal" rate of return of the steel plant will be roughly 7.5% per annum. Adjustments will have to be made to this figure in view of the peculiarities of the time shape of investment over the construction, and of the yield from investment during the "breaking-in " period. However, these adjustments will be minor and can be arrived at by trial and error. Furthermore, in the type of broad industry analysis we are considering, as opposed to project analysis, it may not be necessary at all to enter into such refinements.

It should be noted that the validity of using the "internal" rate of return (which is in effect an average of the yields from a particular investment over future years) as a criteria for comparing different industrial activities depends on three basic, macroeconomic assumptions:

(i) that the marginal productivity of capital, for the economy as a whole, will be fairly steady over the perspective plan period;

(ii) that the (steady) rate of growth postulated for national income will be consistent with the marginal productivity of capital in the economy as a whole (when capital is applied in an optimal manner); and

(iii) that each activity is small (in terms of income generated) in relation to the economy of the country; and that, to compensate for a time pattern of yield (in a particular activity with a high "internal" rate of return) which is not consistent with a steady rate of growth of national income, capital can be applied (at least marginally) in another activity or combination of activities also having a high internal rate of return. In other words if the former activity yields little return in the near future but much in later years, capital can be applied in some other combination of activities, whose yield will be high in the near future but will not grow rapidly in later years.

All these three assumptions seem to be reasonable (perhaps the best one may have to be reexamined if satisfactory and consistent results should not be obtained from the planning exercise.

If some of the above-mentioned assumptions should not be valid, it would mean that capital must be applied in a non-optimal way (from the viewpoint of maximizing future income) in order to maintain a <u>steady rate</u> of growth; or to look at the converse of

In the above reasoning it is assumed that the available capital to be considered consists of Brazilian savings, foreign loans which are available for use in any one or other of the activities considered, and foreign risk capital. The objective of ranking activities according to their rate of return is to maximize the amount of income obtainable with this (assumed given) amount of capital. However, when foreign credits are available only for a particular industrial activity, at an interest rate much below the minimum probable opportunity cost of capital -- this hypothesis would obviously be applicable to World Bank loans available exclusively for development of the steel industry, at an interest rate of let us say 6% -- the interest on such loans should be included under operational costs for the industry or project.*

The fifth basic principle of the third step relates to the choice between market and accounting prices, for outputs and inputs. The three basic prices, of course, relate to foreign exchange, capital and labour. Other prices, to a large extent, reflect these. It is generally assumed, in theoretical literature on methodology of planning that accounting prices should be

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... the matter, that a steady rate of growth is not the optimal expansion path for the economy.

* On the other hand, when a given amount, say US$100 millions, is available for investment optionally in any industry or industries; the interest cost (even if very low) should not be included under operating costs. Instead, one should apply the same criteria earlier mentioned -- i.e. to distribute the investment between industries so that the ratio of net benefits to investments will be the highest possible; or so that the ratio of benefits to total costs (including capital costs calculated on the basis of the opportunity cost of capital, and not on the basis of the interest charged on the foreign loans) will be highest. The justification for this procedure, is in the case assumed fairly obvious. This US$100 million (along with Brazilian and other capital) should be distributed between the various industries so as to maximize the total return from it.

It should also be noted that the opportunity cost of capital (or the marginal social productivity of capital) should include direct or indirect tax yields from it. Therefore, in the Brazilian economy (as in practically any other rapidly developing, underdeveloped country), it will be much higher than 6% -- and more like 15% or 20% per annum.

preferred to market prices, as the latter will reflect social benefits and costs.* We are not so sure, however. The question depends to a large extent on why market prices differ from accounting prices -- a point which should emerge from the diagnoses. Profits may be high in an industry because of monopoly; wages may be high because of the bargaining power of trade unions. It is true that the evaluation of the activity of these industries at accounting prices would show that it is profitable for the economy as a whole to expand them; and therefore suggest that government should provide incentives to such industries. However, if the government were to follow such a policy -- e.g. by imposing tariffs on competing imports; instead of expansion, the result may be that prices and/or wages may be raised even higher. Even if the activity does expand, a large part of the benefits will go to the factors of production employed in that particular industry. In other words,there is here a potential conflict between the objectives of maximization of total national income and its proper distribution.**Here perhaps the best that can be done is to use some compromise between market and accounting prices. The excess of the market wage rate over the accounting wage rate (the subsistence wage in agriculture) or the marginal wage at which additional labour is available for urban industrial expansion up-to a certain level, may be ignored in evaluation of social cost in that particular activity, but wages above that level may be included in cost evaluation.

In some of the older industries, the calculations of benefit/cost ratios or rates of return for the whole industry may be of only historical interest.***

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* See ECAFE, Formulating Industrial Development Programmes, pp. 17-21.

** Of course, the first concern of government should be to correct oligopolistic practices, excessive wages rates, etc. in the industry concerned -- and if it is successful the above mentioned conflict disappears. However, such distortions will probably persist to a considerable extent. The above argument is meant to apply to such cases.

*** And may be subject to a considerable margin of error because of the difficulty of revaluing historical cost of fixed assets, etc.

In such cases,it may be more interesting to calculate such indicators only for modernization programmes. This really relates to the type of data that financing agencies will (or ought to) anyway require, to scrutinize, loan applications for specific projects. It should of course be up to the industry analyst to decide whether to calculate indicators for the industry as a whole or only for modernization programmes.

As regards sources of data for analysis of benefits and costs, one may suggest the following sources, on a descending level of aggregation:

(i) the Censuses of Manufactures, and the Consolidated balance sheets of enterprises (Fundação Getulio Vargas).

(ii) The industrial price structure coupled with input-output data.

(iii) Special complete industry studies.

(iv) Executive Groups for various industries; trade associations.

(v) Sample surveys of enterprises, from balance sheets or by questionnaire.

(vi) Studies of an individual enterprise; or data for an individual project.

The exploration of, and choice between, these various sources will depend on the industry analysts. However, we may make here the following general observations:

The consolidated balance sheets of enterprises will give roughly the total investment by industries. (Use of the corresponding profit figures to calculate rates of return is a very dubious procedure; as profits are probably understated due to income-tax evasion; on the other hand artificially inflated by inclusion of nominal profits on the industry's own working capital). Overall cost figures are available; however one would require a fine breakdown of the 1960 Census -- similar to that shown in the 1950 Census -- along with roughly comparable figures of production in physical units, to obtain an estimate of average unit costs. Value added figures for the Census are more doubtful (for reasons similar to those mentioned in regard to profit shown in the

consolidated balance sheets of enterprises); the matter is still under examination. In-view of these limitations, as well as the aggregated nature of the data, not much emphasis can be placed on these sources of data.

Prices multiplied by input-output data will also give an estimate of value added whether they can also be used as indicators of costs (in the absence of better data or the latter will depend on judgement of the industry analyst as to whether conditions in the industry are such that prices approximate costs. (The ratio of product prices to c.i.f. prices of similar imported products, or to price of similar products abroad, will give some preliminary indications of comparative advantages. However,such comparisons will relate to the whole sequence of activities leading up to output of that product, and will not identify comparative costs in each activity of this sequence).

As regards special industry studies it may be noted that there exists a considerable number of publications of CEPAL, covering several important industries and, providing at least schematically, data on cost for a number of activities. Mention may also be made of the special cost studies for various industries at present under preparation by the Faculdade de Ciências Econômicas e Sociais of the University of São Paulo with the collaboration of the Brookings Studies ("Complementation Studies" for ALALC).

It is presumed that EPEA will not itself be in a position to directly undertake comprehensive surveys of industries, but it may subcontract work that is required to appropriate research organizations. It may undertake sample surveys of enterprises, by questionnaire or interview, in some cases.

As regards specific industrial projects, the development banks, in particular the Banco Nacional de Desenvolvimento Econômico, and perhaps the Executive Groups for various industries, will be in the best position to supply data.*

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*These data may also be already available with the Industrial sector of the Ministry of Planning.

Synthesis and Ranking of Sequences of Activities

The fifth step will be that of synthesis of benefit/cost ratios or rates of return in individual industries to arrive at the respective total, for an interrelated sequence of activities. A final ranking of the latter will then be obtained. When final stages of activities show the highest rankings, the problem is simple. These activities should obviously be undertaken in the country, to the extent determined by the demand projections. When, however, as we go down the list of rankings, we come to a relatively basic activity which has a higher ranking than other final (or more final) activities, the problem becomes complicated. The complication can be explained as follows. Let us assume that the rankings of activities show that the manufacture of steel-as basic activity - is more economic than the manufacture of paper -- a final activity. It is assumed, however, that steel cannot be exported, either because of import restrictions in other countries or because transport costs are too high. If steel is therefore to be produced in Brazil (in view of the relatively favourable ranking of this activity) some other domestic activity must also be undertaken -- manufacture of consumer durable goods, or of machinery, to use the steel. If it appears economical to manufacture, say, machinery for making synthetic fibers, production of the latter will also have to be established within the country. This one sequence of activities which has to be considered would consist of the manufacture of steel, its use in the manufacturing of synthetic fiber machinery, and the use of the latter in manufacture of synthetic fibers. What has to be ranked on the total benefit/cost ratios, or total rates of return, for each such sequence as unit. The problem evidently becomes more complicated when a high ranking activity is more basic -- i.e. when there is a long chain of activities leading from it to final products. The problem becomes even more complicated when two conditions exist simultaneously -- i.e. the outputs of a high ranking basic activity are used in a number of different activities; and when thine are economies of scale in the basic activity. In such a case the costs of undertaking several associated sequences of activities will be less than the sum of the costs for each sequence considered by itself.*However, in practice

* This is typical of many activities in the chemical industry. Such problems are therefore likely to arise within the industry. However, it is our hope that a general understanding of the industry will enable the industry analyst to select a good path of development for the industry without too much difficulty.

these complications are likely to be much less formidable than they seem, for two reasons. In the first place, basic, high-ranking activities are likely to be few.* In the second place the situation of coexistence of widespread use of outputs of a particular activity (as inputs of several activities) with considerable economies of scale in the former, is likely to be even more rare.** The difficulties of resolving the problems of synthesis will , in any case, only become clearly evident after we have the array of benefits and costs in each activity.

Balancing

The final stage of balancing is merely one of totalling

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* The only important ones appear to be the machinery, steel, and basic chemical industries. In the third, capital-intensiveness together with the economies of scale (further added to the fact that Brazil's supply of raw materials for petrochemicals is unfavourable) is very likely to make these show up as low-ranking rather than high-ranking basic activities. The machinery industries, are definitely high-ranking activities (not taking account of the fact that domestic capital may be required to finance sales of domestic machinery, whereas imported machinery is available on a seven years payment basis -- this factor would make machinery manufacture a low-ranking activity). However, total demand for machinery is fairly closely determined by the amount of capital available for industrial investment. (If one takes account of the fact that development of transport and agriculture may also require considerable amount of equipment, the total demand for equipment may even depend roughly on the total amount of capital for investment, independent of its sectoral allocation). This is due to the fact that while capital-output ratios, or capital-labour ratios, vary enormously from one industry to another, the ratios of investment in equipment to total fixed investment, or in other words the ratio of investment in equipment to investment in land and buildings, varies relatively little as between industries. This is perhaps due to the rather obvious fact that the amount of land and buildings required is roughly in proportion to the volume of machinery to be installed in it. The variations of ratios between fixed capital and working capital would somewhat disturb this stability, but perhaps not much. In view of this relative stability of the total demand for machinery, and assuming that the fabrication of various types of equipment is about equally economic , the question is not whether to produce equipment for making synthetic fibers, equipment for manufacturing electrical machinery, or equipment for manufacturing washing machines. The choice will depend on the relative ranking of these three equipment-using industries.

** While use of machinery and steel is widespread, economies of scale are not likely to be important in the latter (with the present size of the national market) and perhaps not even in the former. The most complicated cases are likely to arise within the chemical industry, but these will be cases for intra-industry analysis.

investments, foreign exchange, employment, etc. in each of the various sequences selected for development. According to the results of this summation, one will add to or reduce the number of sequences included; repeat the summation; and so on.

Upto this point, the reasoning has been based on the assumption that relative prices remain stable. However, the cost analysis may show that some prices are likely to be reduced. In that case demand projections, and correspondingly production programmes will have to be adjusted on the basis of price-elasticity. Also, if the initial exercise shows a substantial decline in the equilibrium rate of exchange, this will tend to raise prices of imported products or those which have a relatively high import content. Consequently, demand projections and production programmes will also have to be readjusted.

Non-Income Objectives

Upto to this point the reasoning has been based on the assumption that the sole objective is to maximize national income. This is of course the major objective; but there are others. Particular mention may be made of employment, income distribution and various political objectives. In other words one may prefer an activity that meets these objectives better, even though it yields less income than another activity. In our opinion, there is no easy a uniform way to solve this problem. One can only arrive at a decision on the basis of judgement. This itself can best be founded on a knowledge of the facts and figures: i.e. on separate calculation of the various elements of benefits and costs, by industry and region; investments costs and labour costs, etc. One can then see that so much additional employment can be obtained at the sacrifice of so much income, or a preferred regional distribution of income can be obtained at a sacrifice of so much total national income, etc.*

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* That is why we do not favour any formula for rating of the various activities or projects that a signs weights to the various objectives; as used in planning in the Philippines (see B. Higgins, Economic Development, p.). Any such formula must inevitably be arbitrary. Consider a formula of the linear type used in the Philippines, say:
rating = 0.7 I + 0.3E
where I represents creation of income and E of employment. Then activity B may rate higher than activity A if it yields (a little less income (for the same investment of capital) a bit more employment. But, equally activity C may rate higher than A if it yields a great deal less income but a great deal more of employment It appears to us, however, that , while B may be selected in preference to A, C should not be preferred. The reason is that,

The flexibility in judgement in cases of the type just discussed is an advantage of the methodology suggested as compared to mathematical programming. Moreover the latter can only by approximation (which may make the method cumbersome and laborious) deal with such non-linearities as economies of scale (when they are continous rather than step-wise). However, once the basic data have been assembled, mathematical programming may also tried at the same time as the methodology suggested. One can then see which yields more satisfactory results -- or use one to improve the other. One can then draft the various government policies (programmes of direct investments and incentives) that seem to be most appropriate on the basis of the previous work. Their likely implication* in terms of selection of activities and overall balances can then be easily estimated. The process of selection and balancing can then be repeated until a satisfactory overall program is reached.

Conclusion

The essence of the methodology suggested for programming - and for diagnosis -- is analysis of demand and costs and the factors affecting each. Projections of demand (good or bad) are relatively easy to prepare and have been included in plans of most countries. Analyses of costs are much rare; but it is suggested here that it is important to include this item in the programme of study -- even if the analyses have to be, in many cases merely schematic, in view of limitations of data, time and number of personnel. Such analyses will at least serve to provide broad ideas of what would be good paths for industrial development -- even though it is not realistic to hope that one can program, or envisage, the optimal pattern of industrial development. Some amount of cost analysis is essential if one is trying to obtain a relatively good pattern of development, rather than push industrialization at any cost.

... even if C yields the same additional employment at the same sacrifice of income as the total for several B-type activities; selection of the former will imply embarking on a very uneconomic activity, and it will not be possible, during many years to come, to reverse this decision by shutting down activity C or even by making marginal changes in it.

* For example if we are considering a consumer tax on a particular product, its effect on demand can easily be estimated if price-elasticities have been previously calculated.

With the former objective, the first two steps and the first part of the third step (i.e. the separate calculation of the basic elements of cost) will be unavoidable; whether one selects the methodology suggested for programming proper (i.e. ranking of each activity, synthesis and balancing), or whether one selects the method of mathematical programming, or even if the programming is simply based on common sense.

Diagnosis

It is now sufficient to state briefly our suggestions regarding methodology of the diagnoses -- which will constitute the basis for the preliminary work, i.e. in regard to projections of demand and costs, for preparing the Program. The diagnosis may be divided into two phases.

A. Collection of Data

The following items should be covered; after appropriate classification of the industry into sub-categories, were relevant,

(1) (a) Production
(b) Imports *
(c) Apparent Consumption.

(2) Prices

(3) (a) Investments and their relation to additional output;
(b) major input-output coefficients for material,
(c) costs of labour, electricity, transport, etc.

B. Analysis

This should cover

(1) General description of the evolution of the industry since the war;

(2) Principal problems which have faced, and are facing, the industry; and, in particular.

(3) The consumption function:
(a) Its income-elasticity
(b) Its price-elasticity (if possible)

* When considerable import substitution has occurred and particularly in relatively heterogeneous industries (notably the chemicals industry);it will be desirable to separately classify the imports of various classes of raw materials and intermediate products according to the stage of production, and imports of finished products. Obviously only the latter should be added to domestic production to obtain apparent consumption; while data on the former items (separately)will be required to examine the degree of dependence on imported raw materials and intermediates and changes in the same.

(c) Effects of other factors on consumption.

(4) (a) Major changes that have occurred in technology;
(b) Economies of scale;
(c) Changes that have occurred in average size of enterprises, and the effect of these (or other factors) on
(i) Capital-output ratios
(ii) Material input-output coefficients
(iii) Labour-output ratios.*

It may be worth repeating that the above suggestions cover only aspects that should be common to analysis of each industry, for comparative purposes. Analysis of a particular industry may cover a much wider range of problems.

Including, where appropriate, analysis of the effects of distortions (e.g. in the exchange rate, monetary conditions, etc.) on these ratios. i.e. on costs.