AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY
Batch 52

1. SUBJECT CLASSIFICATION
A. PRIMARY: TEMPORARY
B. SECONDARY:

2. TITLE AND SUBTITLE
The coordination of sectoral and aggregate plans

3. AUTHOR(S)
Tryon, J. L.

4. DOCUMENT DATE
1966

5. NUMBER OF PAGES
115p.

6. ARC NUMBER
ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS
NPA

8. SUPPLEMENTARY NOTES *(Sponsoring Organization, Publishers, Availability)*
(In Working paper M-8761)

9. ABSTRACT
(ECONOMICS R & D)

10. CONTROL NUMBER
PN-AAD-234

11. PRICE OF DOCUMENT

12. DESCRIPTORS

13. PROJECT NUMBER

14. CONTRACT NUMBER
CSD-753 Res.

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

CSD-753 Rec
PN-AAD-274

THE COORDINATION OF SECTORAL AND AGGREGATE PLANS

Joseph L. Tryon

M-8761
June 1966

THE COORDINATION OF SECTORAL AND AGGREGATIVE PLANS

I. INTRODUCTION

This paper is an examination of the problems of coordinating sectoral plans with national or aggregative plans. In effect, this subject covers a broader problem, that of linking project level planning with national development planning. For reasons which will be examined below, project planning is almost universally performed by dividing the responsibility for planning projects among separate authorities. Each of these authorities will be responsible for the planning of projects for some sector of the economy. The results of this sort of planning for a given sector can be thought of as a sectoral plan. The coordination of these sectoral plans with the national plan, and with each other, thus becomes the link between project planning and aggregative planning. For the most part, the paper examines the coordination of sectoral planning and aggregative planning, but the basic problem is that of linking projects to aggregate plans.

The connection between these two levels is an important one for the success of development planning. Project planning is the level at which decisions about specific uses of resources are made; aggregative planning is the level at which aggregate resource constraints are

determined. Clearly, unless some strong link is made between the two, aggregative planning is likely to be ineffective and futile. In the other direction, the overall effectiveness of project planning should improve if it reflects factors which can only be determined through aggregative analysis.

Unfortunately the link between sectoral plans and aggregative plans has been exceedingly poor in the brief history of planning in the developing countries. On the one hand, in many countries the planning process has stopped with the construction of aggregative plans. A national plan consists of aggregate projections of various sorts, usually broken into sub-aggregates for various sectors of the economy. But the process often stops there. Actual project-level decisions are made without reference to the plan. As a consequence, the development decisions which a national plan contains, either explicitly or implicitly, have little or no influence over the actual course of development. On the other hand, in many countries no real aggregative plan is drawn up. A collection of projects by sectors may be added together and called a national plan, but plainly this sort of plan does not reflect any decisions which would normally flow from aggregative analysis. Such a plan may

have limited usefulness, but it cannot serve the purposes for which aggregative planning is usually proposed.[1]

The two patterns of planning described in the previous paragraph cover the planning experience of by far the largest share of those underdeveloped countries that have made efforts at planning. An examination of all the reasons for this situation would take us far afield from the purposes of this paper. However, two reasons which are relevant here are, first, lack of understanding of the importance of the two types of planning for each other and, second, lack of knowledge of methods for linking planning at the two levels together. The purpose of this paper is to examine what is known about these two problems.

---

[1] Many development economists, when confronted with the situation described in this paragraph, have concluded that the best way to improve the planning process is to concentrate on improvement of project planning for individual sectors and put less emphasis on aggregative planning. The rationale for this approach is two-fold. First, current practice in project planning could be greatly improved; a concerted educational effort could accomplish a great deal along these lines. Second, the division of resources among sectors is basically dictated by political factors; economic analysis has contributed very little to decisions on the sectoral division of resources. Therefore, so the argument goes, accept the sectoral resources as given and concentrate on the improvement of the use of the resources within the sector. Perhaps the reader will accept this conclusion after reading this paper. I agree wholeheartedly that significant improvement in project level planning can be achieved and the educational effort required should be made. However, I do not think that the intersectoral allocation problem should be dropped. This paper is partly an attempt to find where we stand in this regard.

The coordination of sectoral and aggregative planning can be examined best within the framework of the model planning system that seems to have evolved within the field of development planning for the less developed countries.[2] Briefly, this model system is as follows.

The organization consists of a central planning office, responsible to the chief executive, and a set of lower level planning offices belonging to individual ministries or other government agencies. The planning process operates in both directions. From the top, i.e., the central planning office, comes an aggregative national plan. Goals for growth rates of output and resources will be presented in this national plan, and aggregates of the plan will be broken down into sub-aggegates for sectors of the economy. These sub-aggregates are essentially plans for the individual sectors. In the other direction, i.e., up from the ministry level planning offices, come projects. These projects represent specific resource uses. They can be grouped by sectors to construct sectoral plans to match the sectoral plans derived from the top.

---

[2] Tryon, J. L., and Cookson, F. E., A Critical Survey of Project Planning, Washington, D. C.: National Planning Association, mimeo., March 1966, pp. 186-194. See also Tinbergen, Jan, Economic Policy: Principles and Design, Amsterdam, North Holland Press, 1956; Marglin, S. A., Approaches to Dynamic Investment Planning, Amsterdam: North Holland Publishing Co., 1963; Tinbergen, Jan, The Design of Development, Baltimore: Johns Hopkins University Press, 1958; United Nations Economic Commission for Asia and the Far East, Programming Techniques for Economic Development: With Special Reference to Asia and the Far East, Bangkok, 1960.

Inevitably, plans for a particular sector derived from the project level and from the aggregative level will be inconsistent with each other. Further, the plans for several sectors will be inconsistent with each other; hence, adjustment and coordination are necessary. The problem of adjustment and coordination of sectoral plans within this context is the concern of this paper.

The description above of the model planning system immediately suggests an area where confusion about sectoral planning arises. The phrase, "sectoral planning," is unfortunately used to denote two very different planning problems. These are the planning of related projects together, i.e., planning of projects by sector, and the planning for the entire economy where the analysis is conducted with sub-aggregates called sectors. The first is micro planning; the second, macro. The two need not be incompatible, but they are clearly not the same thing.[3] The sectors which are desirable for micro planning may be--and indeed are--quite different from those appropriate for macro planning.

---

[3] A group of experts brought together by the U. N. Economic Commission for Asia and the Far East attempted to distinguish these two problems by using the word "program" to designate planning of investment for the economy by sectors from above. (See U. N. Economic Commission for Asia and the Far East, Programming Techniques for Economic Development, Bangkok, 1960, pp. 33-34.) Unfortunately, like many other efforts to standardize terminology, this one had little impact on the problem.

The confusion which surrounds the phrase "sectoral planning" is perhaps even greater for the term "sector." What is a sector? Unfortunately the word sector is used in economics in many different ways. A few examples will illustrate the wide variety of uses to which the word is put. The following examples do not exhaust the possibilities.

1. Industrial sectors: agriculture, manufacturing, transportation, etc.
2. Public and private sectors
3. Consumption and investment goods sectors
4. Domestic and foreign sectors
5. Financial and productive sectors
6. Subsistence and market sectors
7. Regional sectors

It is difficult to see what the common element is of each of these examples. The one thing they all share is that each represents a classification of economic activities. Economic activity in this sense means the use of resources to produce an output of value. Properly defined, the sectors of each set cover all economic activity and are mutually exclusive.

It is, of course, possible to omit some activities from a given classification scheme. For example, subsistence-type activities are frequently ignored, since for practical purposes they may not affect the operation of the market activities. Another example of a partial set of sectors is to consider only public activities. This is commonly done for development plans which cover only government expenditures. The basic idea of a sector is retained, however; some defined set of economic activities is divided into mutually exclusive classes, and these classes are called sectors.

At this point, an examination of sectors actually used in some development plans will be helpful. Table 1 reproduces the sectoral titles for thirteen country plans. While the plans are not a random sample, they seem to be reasonably representative. (The provisional Philippine plan for 1966-70 makes the Philippines represented twice. It is a useful example of some unusual sectors and was included for that reason.)

The listing has been divided into three parts. The first lists those sectors which correspond roughly to the industry divisions of the International Standard Industrial Classification.[4] The ISIC division titles

---

[4]Statistical Office of the United Nations, International Standard Industrial Classification of All Economic Activities. New York, 1958. (Statistical Papers, Series M, No. 4, Rev. 1)

Table 1

SECTORS FROM THIRTEEN COUNTRY PLANS

ISIC DIVISIONS	Colombia 1950-59	Ethiopia 1963-67	Turkey 1963-67	Ghana 1963/64 69/70	India 1961-66	Bolivia 1962-71	Venezuela 1963-66
Agriculture, Forestry, Hunting, Fishing	Agriculture	Agriculture, Forestry, Fishing, etc.	Agriculture	Agriculture	Agriculture, Irrigation, (includes Community Development Social Services)	Agriculture, Industrial Crops & Non-Industrial Crops	Agriculture
Mining	Mining	Mining	Mining	Mining		Mining	Mines and Hydro-Carbon
Manufacturing	Manufacturing Industry	Manufacturing handicraft and cottage industries	Manufacturing Industry	Industry	Industry village and small industries, large & medium industries, minerals	----	Industry
Construction	Construction public, urban other	Building and Construction	Construction	----	----	Construction	Construction
Electricity, Gas, Water & Sanitary Services	Electricity	Power	Power	Volta River	Power	Electricity	Energy

Table 1 (Continued)

SECTORS FROM SELECTED COUNTRY PLANS

ISIC DIVISIONS	Colombia 1950-59	Ethiopia 1963-67	Turkey 1963-67	Ghana 1963/64 69/70	India 1961-66	Bolivia 1962-71	Venezuela 1963-66
Commerce, Trade, Finance, Insurance, Real Estate	Commerce	Trade and Commerce	-----	-----	-----	Commerce & Finance	Commerce
Transport, Storage and Communication	Transport	Transport & Communications	Transport & Communications	Infra-Structure	Transport & Communications	Transport	Transport a Communicat warehouse a
Services (Gov't., Community Business, Recreation Personal)	Services	Gov't. Services, community services, financial, intermediaries, catering and tourism	Services: public, social welfare, tourism, housing	-----	Some Services in Agriculture	Other Services	Government Tourism
ISIC GROUPS							
Health	-----	Health	-----	Health	-----	-----	Sanitation
Education	-----	Education and Culture	-----	Education	-----	-----	Education

Table 1 (Continued)

SECTORS FROM THIRTEEN COUNTRY PLANS

NON-ISIC	Colombia 1950-59	Ethiopia 1963-67	Turkey 1963-67	Ghana 1963/64 69/70	India 1961-66	Bolivia 1962-71	Venezuela 1963-66
Housing	-----	Housing and others	-----	Housing	-----	-----	Housing and Urban Renewal
Other	-----	-----	-----	Foreign Trade and Payments	Miscellaneous, others	-----	-----

ISIC DIVISIONS	Ceylon Short Term 1962-64	UAR (Egypt) 1960-65	Nigeria 1962-68	Philippines 1963-67	Pakistan 1965-70	Philippines (Provisional, 1966-70)
Agriculture Forestry, Hunting, Fishing	Agriculture	Agriculture	Primary a) agricultural activities b) agricultural research c) forestry, etc.	Agriculture	Agriculture	Agriculture
Mining	-----	Mines and Quarries	-----	Mining	Fuels and Minerals	-----
Manufacturing	Industry, public and private, small scale cottage industries	Industry food, beverage, tobacco, metallic engineering, ginning & pressing, spinning, weaving, etc.	Trade and Industry	Manufacturing	Industry	Industry

Table 1 (Continued)

SECTORS FROM THIRTEEN COUNTRY PLANS

ISIC DIVISIONS	Ceylon Short Term 1962-64	UAR (Egypt) 1960-65	Nigeria 1962-68	Philippines 1963-67	Pakistan 1965-70	Philippines (Provisional, 1966-70)
Construction	Construction	Construction	----	Construction	----	----
Electricity, Gas, Water and Sanitary Services	Power	Power & Fuel, Electricity	Electricity	----	Water and Power	----
Commerce, Trade, Finance, Insurance, Real Estate	----	----	----	----	----	----
Transport, Storage and Communications	Transport	Transport, Communications and Storage	Transport, Communications	Transport and Communications	Transport and Communications	---
Services (Gov't., Community, Business, Recreation, Personal)	Tourism	Services	Town & country planning, cooperatives, social welfare information, judicial information, water other than irrigation	Other Gov't. Services	Social Welfare	Social Development

Table 1 (Continued)

SECTORS FROM THIRTEEN COUNTRY PLANS

ISIC GROUPS	Ceylon Short Term 1962-64	UAR (Egypt) 1960-65	Nigeria 1962-68	Philippines 1963-67	Pakistan 1965-70	Philippines (Provisional, 1966-70)
Health	Health	----	Health	Public Health	Health	----
Education	Education	----	Education	Public Education	Education	----
NON-ISIC						
Housing	Housing	Housing	----	----	Physical Planning and Housing	----
Other	----	----	Financial Obligations, General	----	Works Program	Public works; Foreign Trade

are given in the first column of the table. The second part lists the sectors which have a corresponding ISIC group instead of division; and the third, those which have no corresponding ISIC class of any sort.

A quick perusal of this table suggests the following sectors to be typical:

1. Agriculture, Forestry, and Fishing
2. Mining
3. Manufacturing
4. Construction
5. Electricity
6. Transportation and Communications
7. Services, other than Health and Education
8. Health
9. Education
10. Housing

The first six are clearly recognizable as six of the nine industry divisions of the ISIC. 7, 8, and 9 combined make up a seventh ISIC division, Services. (The two mission divisions are Commerce and Activities Not Adequately Described.) The last sector, housing, represents a problem which governments in many underdeveloped countries feel must be attacked with some sort of public program. It might be included as part of Construction, but typically it gets separate treatment.

Despite the fact that there is a typical set of sectors, there still is a considerable amount of deviation from the typical pattern. Agriculture is in every plan; transportation is separate in all but one. Electricity is in all but the two Philippine plans. However, mining is missing from four and construction, from five. Commerce and trade is in only four. Health and education appear separately in seven plans. Housing is in only six. Ghana and the Philippine 1966-70 plans have an interesting sector--foreign trade--which does not appear in any of the others. Public works also appears as a sector in two plans. Furthermore, the titles of sectors from individual plans suggest that there may be considerable variation in coverage among roughly equivalent sectors.

We now turn to the main argument of the paper. The discussion will proceed by first presenting an examination of the two types of planning, noted above, and then considering appropriate sectoral breakdowns for the two problems. Finally, an examination of the problem of linking the two types of planning together is presented.

II. PROJECT PLANNING BY SECTORS

A. Reasons for Planning Projects by Sectors

This part will present an examination of the reasons for undertaking the detailed planning of groups of projects together. While, in practice, this grouping does not necessarily produce real sectoral plans, the problem will be treated as though the assembly of such plans is the aim. In this context, the particular set of sectors that is chosen forms the basis for the division of project responsibility. Anticipating one of our conclusions, sectors chosen for this purpose are likely to be quite different from those chosen for purposes of aggregate and sub-aggregate analysis of the economy.

It will be helpful as a first step to consider project planning under certain ideal conditions. A project is essentially the use of currently available resources to obtain a future output. Project selection is therefore a problem in capital allocation. If certain conditions were met, decisions on the selection of projects could proceed on an individual basis, completely independent of the planning of other projects. The necessary conditions which are relevant to this discussion are that all the benefits and costs be measurable, appropriate prices be used to value them, and no interdependencies exist among projects. If these conditions were met,

one would in principle simply undertake all projects whose present value was positive.[5] This selection of projects would, in effect, bring the economy to an optimum allocation of resources. For resource allocation, no grouping of projects for planning would be necessary. If one needed a "sectoral plan" for some other purposes, it would simply be the collection of those projects which had been selected for execution and which would be classified as belonging to the "sector" in question. Further, an aggregative plan would consist simply of suitable aggregates of all selected projects.

Unfortunately, however, the conditions do not exist where individual project planning is sufficient to achieve anything like an optimum allocation of resources. Interrelationships of several types do exist between projects; knowledge of the physical benefit and cost flows is uncertain, and the degree of uncertainty varies among projects; and suitable prices for evaluating these flows are often not obtainable. Furthermore, making a single authority responsible for planning all projects imposes an exceedingly difficult administrative job on that one authority. Some of these complications can be met by dividing the

---

[5]See Tryon and Cookson, 1966, part V.

responsibility for project planning among several authorities and making each responsible for certain types of projects; others require decisions which can best be reached by some sort of aggregative analysis. For planning purposes the end result is a system such as the model one, described above.

Accepting the conclusion that some sort of division of responsibility for project planning is necessary, two questions naturally arise. First, what sort of grouping of projects is best: i.e., how should sectors be chosen for the assignment of project planning responsibility? Second, how can the necessary coordination be achieved among authorities responsible for planning different sectors? These questions have no simple, universally applicable answers. However, a careful examination of some parts of the problem will help to provide guidance for making decisions about sectoral divisions.

The following list gives the principle bases for dividing project planning responsibility. Some are related to the complications noted above; others are primarily administrative problems. Each leads to some sort of grouping of projects, but they do not produce identical groupings. Hence, any set of sectors will be something of a compromise.

1. Similarity of engineering and other skills required for planning certain projects. Roads are a good example of projects with similar engineering. Or at a higher level of aggregation, public construction projects of all types require civil engineering skills. Hence, it may be advantageous to concentrate available engineering skills into a single office responsible for planning all public construction projects. This approach sometimes leads to identifying public works as a separate sector for planning purposes.

Limited availability of skills other than engineering may also make it desirable to plan certain projects together. For example, it may be desirable to group health projects together in order to conserve planners with medical training.

2. Interdependencies among projects. Where there are clear interdependencies among projects, there may be considerable advantages in assigning the detailed planning of interrelated projects to a single authority. Roads again are a good example, for they form an interconnected network. In fact, many projects have interconnections of this sort. Electric power and transportation are two sectors within which projects are often related in this way, and detailed planning of these projects can often best be accomplished by so-called systems analysis.

Another form of interdependency exists when projects are alternative ways of accomplishing the same broad purpose. Transportation happens to provide illustrations of this sort of interdependency also. There may be several alternative modes of transportation to accommodate a given demand, and the comparisons needed to make appropriate choices among these alternatives can best be made by a single planning authority.

Not all forms of interdependencies can be handled at the project level. Some, like the effects of given projects on indirect demands, can better be handled by aggregative methods. This question is taken up in the next section.

3. Common beneficiaries. All projects which are designed to meet the needs of a given group of beneficiaries may be planned together. Examples are all projects benefiting farmers or all projects benefiting rural communities. The corresponding sectors for planning purposes would be agriculture and community development, respectively.

4. Fixed organizational structures. If sectoral planning of projects is to be accomplished by given governmental agencies, the sectors may have to be defined simply along established lines of organizational authority. Given a situation where jealousies exist among government agency heads, it may be impossible to set up sectors in any way that would cross agency organization lines. This particular factor

may override all others in choosing sectors for project planning. Since the organizational structure of any government is to some extent a matter of historical accident, sectors following organizational lines may not be entirely logical by other guides.

5. Similarities in problems of measuring benefits. As noted earlier, if benefits and costs for projects can be measured and valued properly, comparison among projects for selection purposes can be accomplished on the basis of their present values. For many projects, however, benefits or costs cannot be measured or suitable prices to value them cannot be determined. Without adequate cost and benefit information, one cannot know the real resources used up or the nature of the benefits received. And without suitable prices, the benefits and costs of different projects cannot be made commensurable.[6] Under these conditions, satisfactory comparisons among all projects cannot be made.

However, in some circumstances, measurement and valuation problems will be similar for groups of projects, and comparison among projects within a given group may be possible. Grouping together projects which are comparable to each other in this sense may thus be another way of assigning responsibility for project planning.

---

[6] For a full discussion of the pricing problem, see Tryon and Cookson, 1966, p. 86ff.

Two kinds of projects which lead to common problems of measurement are education and health projects. Projects in both areas have benefits which are at present practically impossible to value. However, it is usually possible to compare on a cost basis those education projects which accomplish the same goals. Similarly, health projects may be compared with each other on a cost basis. Comparison among educational projects and among health projects is possible, but neither kind can be compared with projects of other kinds.

In general, the measurement and pricing of costs present far fewer problems than that of benefits. Education and health projects are typical in this respect. Since difficulties in measuring benefits are fairly common, sectors defined on the basis of similar problems of measuring and pricing benefits are quite common. Conceptually, cost measurement problems could also lead to sectoral definitions, but this situation has not proved to be of any practical importance.

6. Regional requirements. The last factor which may lead to the division of project planning responsibility is the need to plan projects on a regional basis. Regional sectors may be only a special case of 3 above, grouping projects for common beneficiaries. They may also be the result of 4, fixed organizational structures, which in this

case would reflect regional government agencies. However, there may also be special regional problems which make it desirable to analyze all projects for a given region together.

Six sets of factors which could lead to the planning of projects for separate so-called sectors have been enumerated above. Doubtless others could be added to the list. One characteristic of these factors is plain, however: they will not lead to the same choice of sectors. Some will reinforce each other and lead to similar sector choices, but there is clearly enough conflict to require a compromise in the choice of sectors. For example, agriculture would be a natural choice as a sector for project planning because of interdependencies, common beneficiaries, and, if a unified agriculture ministry exists, because of the given organizational structure. However, the engineering characteristics of certain agricultural projects such as those for irrigation and flood control might make it desirable to assign responsibility for planning such projects to a public works sector. Other projects which benefit agriculture are essentially educational. Should these projects be the responsibility of the education sector planner?

Clearly, one could examine any proposed set of sectors and find conflicts of the sort illustrated. There simply is no set of sectors which will permit the neat division of responsibility for planning projects.

Furthermore, a set which would be satisfactory for one country could be quite unsatisfactory for another.

Despite the fact that no set of sectors for project planning is perfect, there are several sectors which have come to be generally accepted as appropriate for this purpose. These are agriculture, industry (i.e., manufacturing), power, transportation, health and education.[7] A body of literature now exists on planning in each of these six sectors. The writings on planning for agriculture and industry are exceedingly voluminous; those for education and health are also large and seem to be rapidly catching up with agriculture and industry. The literature on transportation and power is considerably smaller than that of the other four, but these two sectors are clearly accepted.

We will now present a sketch of the planning problem which confronts the planner for each of these sectors.

---

[7] In 1964 the U. N. Economic Commission for Asia and the Far East published Problems of Social Development Planning, Development Programming Techniques Series, No. 4. In this document separate chapters were devoted to planning for the health, education, housing, and social welfare sectors. This document suggests that common assent may lead to the addition of housing and social welfare to the list of generally accepted sectors. It seems to the author, however, that no generally accepted approach to the planning of these two sectors has appeared. Hence, they are not included in the descriptive summaries.

The six sketches which follow should not be interpreted as representing current practice. They are an attempt to capture the main feature of the planning problem for each sector and the proposed best solutions. Needless to say, actual practice is not likely to match the proposed best practice.

B. Project Planning in Six Sectors

The basic procedure for drawing up a project program for a sector is to estimate future demands, compare present capacity or supply with the future demand, and determine what projects are needed to make up the difference between supply and demand. While this procedure is followed in general terms for each of the sectors discussed below, the differences in application among sectors are quite substantial. The problems of planning each sector will be examined within this supply-demand framework.

1. Agriculture[8]

The demands for agricultural commodities can be projected by analyzing three demand categories: domestically consumed foodstuffs, domestically consumed industrial raw materials, and exports. Within each category the method of projecting demand will be similar; however, each commodity must be estimated individually.

The demand for foodstuffs can best be projected on the basis of income. Ideally, consumer budget studies for several points in time will provide income elasticities for individual food products, and these elasticities can be applied to projected incomes. Since in many underdeveloped countries such budget studies are not available, it is fairly common practice to make income elasticity estimates using less refined methods, or even borrowing estimates from countries at similar levels of development. At a minimum the elasticity estimates should be applied to projections of per capita income. A highly desirable improvement is to project certain income groups separately, using appropriate elasticities for each group. A useful classification for this purpose is farm (or rural) and non-farm (or urban) population.

---

[8] An excellent survey of agricultural planning literature is contained in J. Price Gittinger's The Literature of Agricultural Planning: Notes on Its Usefulness, Center for Development Planning, 1966 (mimeographed).

The demand for agricultural products for domestic industrial raw materials depends, of course, on the development of industry. For those products which are raw materials for industries that produce only final demand goods, the raw materials demand can be linked directly to final demand projections. For industrial products that are raw materials to other industries, the intermediate demands as well as final demands must be projected. Input-output is one approach to the problem of intermediate demands. Another approach is to relate intermediate demand to total industrial demand. Whatever method is used, some estimate of total output of each agricultural product using industry will be needed.

Export demand for agricultural products is likely to be the most difficult of the three demand categories to project. Future income levels, income elasticities, and probable price behavior are needed in each of the export markets. In addition, information is needed on alternative supplies of individual commodities and any close substitutes. Projecting export demand is thus a particularly uncertain exercise.

Given projected demands for various commodities, the next step is to estimate commodity outputs without additional projects within agriculture. The difference between projected demand and output will have to be met by projects to increase output or by imports.

The possible projects which can be undertaken to increase output within agriculture include the following:

Credit facilities	Extension
Irrigation	Scientific research
Seed production	Economic research
Mechanization	Farm-to-market roads
Marketing	Land reform
Veterinary services	Cadastral surveys
Fertilizer	

Projects of any of these types can result in greater inputs into agriculture and/or increased productivity of existing inputs. Choosing among them poses difficult problems because each type does not have the same relative impact on each crop.

Ideally each project should be subjected to some sort of social profitability criterion. Unfortunately the social profitability of several of the types of projects listed above, cannot be calculated with any accuracy. It will generally not be possible to balance the projects within agriculture using such a criterion as a guide. Hence, a large element of professional judgment is injected into agricultural project choices.

2. Industrial Sector

The term industrial sector usually refers to the manufacturing industries. Unfortunately, in the parlance of industrial planning, the individual manufacturing industries are also called sectors. Considering

individual industries as sectors is entirely appropriate, since an important part of industrial planning is the determination of relationships between industries at this sub-aggregate level. However, we will try to avoid this semantic problem by referring to the divisions within manufacturing as industries rather than sectors.

Planning for the industrial sector is quite similar to agricultural planning, although it is likely to be considerably more complicated. The complications arise principally because the demand for manufactured goods consists in part of intermediate demands among the producing industries themselves.

As in agriculture, the first step is to estimate the final demand for individual industrial commodities.[9] Final demand consists of consumer goods, exports, investment, and government consumption. Projection of consumer goods and exports is much the same as for agricultural products. Detailed commodity projections of investment goods will be needed only for the domestically produced investment goods, since imported investment goods have no further impact on industrial demand. Government consumption must be estimated on the basis of known government programs.

---

[9] The account, given above, is adapted from United Nations, Economic Commission for Asia and the Far East, Formulating Industrial Development Programmes, Development Programming Techniques Series No. 2, Bangkok: United Nations, 1961.

The projections of final demands, outlined above, serve two purposes. First, when summed up, they give an aggregate final demand for manufactured goods from which approximate total demand can be estimated. Second, they give individual industry final demands which will subsequently be used to estimate consistent intermediate goods demands.

The distinction between total demand and final demand is an important one. Total demand for an industry accounts for its entire output and, therefore, includes the intermediate demands from other producing industries as well as the final demands, such as consumption, investment, exports, etc. Total demand for manufactured goods can be estimated approximately by means of some established relationship between it and final demand only. This aggregate manufacturing demand then becomes the basis for deriving a first estimate of capital and foreign exchange to be allocated to manufacturing. Ideally the capital and foreign exchange requirements will also be used to establish first estimates of accounting prices for the capital and foreign exchange to be allocated to manufacturing. In practice, however, accounting prices are often not calculated, and market prices are used instead.

Given the initial allocation of capital and foreign exchange for manufacturing as a whole, the next step is to establish a consistent plan at the sub-aggregate level, i.e., for the 20 to 30 manufacturing industries which comprise the industrial sector. Several methods for calculating such a plan are available. The most formal method is input-output analysis. It insures consistency, particularly regarding the intermediate demands among the producing industries. However, the data requirements for input-output are very heavy, and less demanding techniques may have to be used. Whatever method is used, the result should be a demand projection for each manufacturing industry. These projections will be of total demand and, therefore, will include consistent intermediate demands from other manufacturing industries plus final demand from outside manufacturing. On the basis of these demand projections, capital and foreign exchange requirements can be estimated for individual industries.

At this point project planning enters the picture. An assortment of projects for each industry should be assembled by considering the demand projections and estimated current productive capacity for each commodity. From the assortment for each industry, projects should be chosen according to some selection criterion, such as social profitability. If accounting prices for capital and foreign exchange were

estimated, they should be used in the calculation of the selection criterion. Next, projects are ranked according to the criterion and those on the list for a given industry selected down to the point where the allocations of capital and foreign exchange for that industry have been fully committed. This step gives an initial set of planned projects for the entire sector.

The process described above will inevitably lead to inconsistencies of various kinds. Hence, adjustments must be undertaken. One of the most important is to reallocate capital and foreign exchange among the sector's industries so that the social profitability (or whatever criterion is being used) will be approximately the same for the marginal project in every industry. If accounting prices have been used, they may also have to be changed in order to balance the supply and demands for capital and foreign exchange. The reallocations in this step will mean adding projects in some industries and dropping them in others. These changes, in turn, imply adjustments in the projections for each industry and perhaps for the entire industrial sector. The final sectoral plan should consist of a set of projects which are consistent with each other and just use up the resources allocated to the sector.

The planning system described here will work satisfactorily for projects which have a marketable output. Since a large share of industrial projects consists of the erection of new productive plants or improving old ones, the system is appropriate for planning of the bulk of projects in the industrial sector. No distinction need be drawn here between private and public investments in productive facilities. However, a significant share of public projects in the industrial sector are designed to increase or improve future factor supplies. Examples are management training programs, productivity centers, etc. The benefits of these projects are real but are usually difficult to quantify. Thus, their social profitability is not measurable, and they cannot be easily fitted into the industry planning system, outlined above.

3. Transportation[10]

The output of the transportation sector is the physical movement of freight and people between points in an economy. This output has two important characteristics which make the planning of the transportation sector different from and in some ways more difficult than agriculture and

---

[10]An excellent general discussion of transportation sector problems is Owen, Wilfred, Strategy for Mobility, Washington, D. C.: Brookings Institution, 1964.

industry. First, in order to plan the sector, quite detailed information is required on the expected movements of goods and passengers between geographic points in the economy. Second, the location of economic activity is vitally affected by the cost of transportation.

The fact that transport cost affects the location of economic activity means that the points between which goods and people move and the volume in which they move will be determined in part by the transportation system. Because of this interdependence between the transportation system and the location of economic activity, the ideal solution would be to plan the two simultaneously. This ideal is, however, impossible. Hence, some means must be used to break the planning process into parts.

The usual procedure to permit the planning of transportation, apart from other detailed planning, is to make projections of freight and passenger loads between the more important points of the economy on the assumption of no essential change in the structure of the economy. Then investment is planned to meet these projected demands. Next, major projects whose location and size are dependent on transportation costs will be considered with the transportation element being explicitly a part of the project analysis. The results of this stage can usually be integrated with the first stage results without too much adjustment on either side.

The projections based on the assumption of no major change require two basic sets of information. First, a survey must be made of present traffic between the important points of the economy. This survey will establish transport loads in relation to the volume of activity at and between the points chosen for study. Second, projections must be made of output of the major transport users, distributed to the areas where the transportation is needed. At a minimum, the important agricultural crop requirements must be established. Other important products may be ore, logs and lumber, steel, etc., as the particular case requires. Combining the traffic survey data and the commodity projections will produce the initial estimates of transport requirements. The problem then becomes one of choosing additions and alterations in the transportation system to service the loads most economically.

Where major projects will require substantial changes in the transportation system, transportation should be planned as part of the project. Examples are the opening of unsettled areas with a road and the construction of a railroad and port as part of a mining project. The measurement of benefits and costs of such projects is an important problem, since the choice of the transportation system constructed will be a major determinant in the level and location of future economic activity. While many of these activities cannot be predicted accurately,

their neglect may lead to serious mistakes in the choice of the transportation services that are established.

The interconnections among the various parts of a transportation system and the possibility of using alternative kinds of transportation make it highly desirable to approach the planning of transportation as a whole and not on a piece-meal basis. While this is not too difficult, it is clear that a fair amount of detail of the plans for other sectors must be available in order to plan the transport sector. Without adequate knowledge of expected loads for principal crops, etc., or of the effects of major projects requiring transportation, satisfactory transport sector planning cannot be accomplished.

4. Electric Power

The planning of the electric power sector is in many respects very similar to planning the transport sector. First, the introduction of inexpensive power, like inexpensive transportation, can have a very strong effect on the location and level of economic activity. In this respect both may contribute far more to development than the revenues collected. Second, a point related to the first, the geographic distribution of demand is an important determinant of the power projects chosen. Third, the most economical servicing of demand requires that

the development of power projects be undertaken as a system. Except for isolated areas, the producing points can be linked in a power grid that will permit considerable economies in meeting total demand.

The projection of power demand can be accomplished in much the same fashion as transportation, although the problem is likely to be easier to solve. Data on demand by current users are relatively easy to collect. Many industries can be lumped together so that the number of individual demand projections that must be made is smaller than the number needed for transportation. The effect of major individual projects on power demand is easier to estimate than their effects on transportation demand. Finally, only a few individual projects, such as aluminum plants, are likely to require enough power for its price to affect the decisions about the project; as long as power is available, most projects can be planned without being critically affected by the rates charged.

The consequences of the conditions, noted above, are that power can be planned much more independently of other sectors than can transportation. Demand can be projected on the basis of rather sketchy data from other sectors, and these data are likely to be available early in the planning cycle for the other sectors. Once demand has been projected, the best system can be designed to meet this demand. The

choices in the system are basically ones of hydro vs. thermal (and now nuclear) power and of plant location.

A common situation in the power sector is for capacity to lag behind demand. This happens because demand grows more rapidly than new generating capacity or distribution facilities can be installed or because insufficient funds for expansion have been available. If this situation exists, it does not change the planning problem significantly. It simply means that past growth is not a good guide to potential demand. What usually happens is that undesirable voltage fluctuations and brownouts occur. These reduce the efficiency of the power users and may lead some users to install expensive independent power supplies. The presence of significant voltage fluctuations and private power supplies may mean that marginal social profitability in the power sector is higher than in other sectors and, therefore, more capital should be made available to the power sector to expand capacity.

The symptoms do not necessarily mean that the marginal social profitability of the power industry is higher than elsewhere. Whether this is, in fact, the case is difficult to determine because charges for power are typically set lower than a free market price. Thus, as in transportation, revenues collected are not a satisfactory measure of the social benefits of electric power.

5. Education

Demand and supply as applied to education must be interpreted in very different terms from ordinary markets. Most educational activities are not valued by a market in any real sense, since they are paid for by the recipient only in part or not at all. In theory, the value of education is the sum of the present value of increases in future income due to the education and the value of the current consumption element of the education. In fact, neither the recipients nor those providing education have any clear idea of its value. Hence, educational planning is performed without reference to demand or supply in value terms. Instead, the specific manpower skills required by the economy are determined and the educational activities are planned to provide these skills when they will be needed. This is the so-called integrated manpower-human resources assessment approach to educational planning.

The following list outlines the steps in the manpower-human resources planning approach.[11]

1. Projection of the future size and age composition of the population.

2. Translation of output projections of the economy into manpower skill requirements.

---

[11] The list is a modified version of the steps found in UN ECAFE, 1964, pp. 10-11.

3. Translation of manpower skill requirements into educational requirements.

4. Additions of education for consumption and social purposes, to the extent not already covered in 3, in accordance with cultural, political, and social goals.

5. Survey of currently available manpower skill resources.

6. Analysis of capacity of the existing educational system to produce required skills and to provide "consumption type" education.

7. Estimation of deficits in education requirements.

8. Selection of projects to eliminate deficits.

The selection of educational projects involves a number of choices which currently do not have any clear guide lines. Broadly speaking, education is of three kinds:[12] (1) general education through the school system, (2) education for specific skills through the school system (professional training and vocational training), and (3) training related to needs of specific employers (on-the-job training and industry training programs). The educational planner must allocate resources to these three types of education when he has at best only a rough idea of how effective each type will be in producing given skills. To

---

[12]Baldwin, George B., "Iran's Experience with Manpower Planning: Concepts, Techniques and Lessons," in Harbison, F., and Meyers, C. A., (eds.) Manpower and Education. New York: McGraw-Hill, 1965.

complicate his job further, he knows that the skill requirements are surely going to change in an unknown way; thus, some adaptability must be present in the manpower supply, or parts will be wasted. He must also make allowances for attrition from the school system and for the failure of a significant share of those trained in particular skills to take jobs requiring those skills. Finally, he must include education to accomplish social and cultural goals. Education for this purpose may have only very indirect influences in providing manpower skills. Education does not have a scientific or technical nature which can provide clear relations between its inputs and outputs. Hence, the choices, outlined above, are largely a matter of expert judgment.

The planning process takes the outputs of the economy and the social and cultural goals, as given, and then determines the educational projects needed to provide the skills and accomplish the other goals. Obviously, however, the resources to carry out the projects may be unavailable, or the time lags--which are very substantial in education--may be too great to accomplish particular goals by the time they are required. If this is the case, adjustments must be made in the economic and social goals which education is to achieve. In this fashion the process of planning will work from the bottom up as well as from the top down.

6. Health

Health, perhaps even more than education, is difficult to fit into a demand and supply type of analysis. A large share of health activities, like educational activities, are not valued by a real market. In theory the value of a health program is the sum of the present value of increases in future income which are due to it and the value of it as current consumption. Estimating the income changes as the reduction in income lost due to sickness has been proposed,[13] but the technique has not proved workable. The value of other aspects of health programs has proved equally elusive. Since the value of health programs cannot be established, health planning, like education planning, must be performed without reference to demand or supply in value terms. Unlike education, however, there is no way to connect the need for health programs to the rest of the economy. A number of specific health problems exist, but little can be said about how they affect the working of the economy.

---

[13]See, for example, Kaser, M. C., "Health Planning as a Part of the National Development Plan," Working Document WHO/PH A4/W.P.7., Geneva: World Health Organization, 1960.

Because of the situation noted in the previous paragraph, it is possible to speak of an accepted approach to health planning only in a rather general way. For planning purposes, health services fall into four categories.[14] These are (1) promotional activities, which are concerned with improving environmental conditions, adopting sound nutritional practices, and arousing interest in good personal health; (2) personal preventive services, which deal with immunization, periodic health examinations, and health education; (3) curative services, relating to the diagnosis and treatment of disease and injury; and (4) restorative services which enable individuals to return to full living and working after an illness. For each activity targets should be established as to numbers of hospital beds, numbers of doctors, area within which mosquitoes are brought under control, etc. These targets can then be translated into total capital and recurring expenditures.

As for criteria for choosing among the possible activities, nothing satisfactory is currently available. It is agreed that all four types of activities should be undertaken, with emphasis on the preventive rather than curative activities.[15] Beyond this sort of general

---

[14]UN ECAFE, 1964, pp. 25-26.

[15]*Ibid.*, p. 28.

advice, few suggestions have been offered for making actual allocations of funds. Hence, like education, planning for the health sector is heavily dependent on the judgment of experts in the field.

C. Conclusions on Project Planning by Sector

One of the obvious conclusions from the descriptions presented in the previous section is the diversity of approaches used in the different sectors. Two, transportation and power, are best planned using a systems analysis approach. Systems analysis requires that each project be considered as part of an integrated network and emphasizes the interdependencies of decisions about each project in the network. In the remaining sectors interdependencies may be important, but the planning of most projects needs to be related only to a few other projects. Other obvious differences exist in the technical skills needed in planning projects for each sector. In terms of the reasons advanced for planning projects by sector, these six seem, in general, to make good sense.

One difference between these sectors which is of particular importance is the difficulty in defining demand--or output--in value terms. In two sectors, agriculture and industry, output is generally marketed and can be usefully measured in value terms. Furthermore,

resources utilized can be meaningfully related to this output. For the remaining four sectors, the relationship between value of output (as it is conventionally established) and the resources used is tenuous or even absent. For transportation and electric power the prices charged are very likely to be less than a true market value of these services. Equally important, a market price would probably significantly understate the social value of these services because transportation and power have very significant external benefits. In education and health, output is conventionally valued at cost, and no effort is made to establish a true value to society. The differences in the value measures of output in these sectors make it difficult to treat these sectors alike in determining resource allocations among the sectors. Certainly any system which relies on the conventional national income definitions of output for determining resource allocations can be seriously in error because of this problem. As will be seen in part III, the national income framework is practically the only framework used for this purpose. Hence, the problem has great practical significance.

The descriptions, presented above, outlined the planning for only six sectors. A real consensus on how planning should be accomplished for the remaining sectors does not exist. The missing sectors are mining, construction, services other than health and

education, housing, and commerce. Presumably, in time, project planning for the activities of these sectors will also be fitted into approaches similar to the ones described above. It may very well happen, however, that activities will be regrouped to form somewhat different sectors. For example, there seems to be some tendency to group the planning of water resource projects. Another grouping is those projects affecting rural development. Still another is all energy source projects, not electric power alone. These groupings suggest that the standard industrial classification system may not be a satisfactory guide for the choice of sectors for project planning purposes, and sectors quite different from the ISIC type may evolve as experience with planning accumulates.

One last question may be raised before turning to the subject of sectors for economic analysis. It is the question of where in the planning system the final responsibility should lie for completing the sectoral plans of projects. Should this responsibility be lodged in the operating agencies or in the central planning office? There are arguments for both treatments, but some of them can be understood better after the discussion of the use of sectors for economic analysis. This latter subject will therefore be considered now, and the question of responsibility for sectoral project plans will be explored later.

III. SECTORS FOR ECONOMIC ANALYSIS

A. Introduction

In this section the problem of using sectors for economic analysis will be considered. This type of analysis is basically for the purpose of determining resource constraints and allocating scarce resources among sectors. As noted earlier, one way to solve these problems would be to operate entirely at the project or individual decision-making level. This procedure is equivalent to solving a complete general equilibrium system. It is not feasible because of data limitations and the physical impossibility of designing and solving such a system. Hence, some sort of simplification is necessary, and the simplification takes the form of aggregative and sectoral analysis.

Earlier a set of sectors was defined broadly as a set of mutually exclusive classes of economic activity. The activities within each sector will have a great many characteristics which would have some economic consequences, but for a given problem only a limited number of these characteristics will be of interest. Consider the sort of industrial sector breakdown used in input-output analysis. Within each sector, such as agriculture and manufacturing, there will be producers making a wide variety of decisions about production, saving, investment,

etc., and there will be households making decisions about consumption, saving, supplying labor, etc. In the simplest input-output analysis, however, only the gross inputs and outputs of each sector are considered. For the manufacturing sector the inputs from and the outputs to agriculture, mining, services, and other industries are the measured variables. Other variables, such as savings and labor inputs, are omitted. In more complicated input-output models some of the other variables can be introduced, but even in the most complicated models there are always many economic activities that are not included in the analysis.

These illustrations show clearly that the choice of sectors and the variables to be measured in each sector depend on the problem at hand. The sectors used and the variables measured will now be considered for several problems. Before doing so, however, an examination of the idea of an optimum allocation of resources is necessary. All types of analysis discussed here reflect some aspect of resource allocation. For some, it is the calculation of an aggregate resource constraint; for others, some magnitude, such as sectoral output, which is relevant to sectoral resource requirements. In any case, the analysis provides some information needed for resource allocation.

An optimum allocation of resources is one which achieves given development goals using the least possible scarce resources. Alternatively it could be defined as the allocation which permits a given set of resources to maximize their contribution to development goals. These definitions beg the question to some extent, for they say nothing about how diverse resources or development goals can be compared. It is assumed here, however, that some appropriate price system is available so that valuing the resources used and the outputs gained is not a problem.[16] Having assumed away the valuation problem, we are left with the economizing problem, how best to use the available resources.

The optimum is for the entire economy, carrying down to the lowest level of resource allocation. The approach to planning which is examined in this section is based on the assumption that the allocation problem can be broken into stages. The stage procedure permits the approach to the optimum to be made in steps. First, the aggregate resources are determined, then their sectoral allocation is made and, finally, the allocation within sectors is made. This final allocation can be an optimum if the assumption is correct.

---

[16]For a discussion of the valuation problem noted in the text, see Tryon and Cookson, 1966, part IV.

Even if the stage assumption is not acceptable, it will still be proper to speak of an optimum allocation of resources among sectors. This sectoral optimum is simply the sectoral division of resources which corresponds to the project level optimum. The discussion that follows is concerned chiefly with this sectoral optimum.

Whether a sectoral optimum can be achieved without reference to project or micro level decisions is the crux of the stage assumption. It is an important question, but discussion of it will be postponed to part IV. For the present, the assumption that an optimum sectoral allocation can be achieved without reference to project decisions will be accepted.

From the definitions given above, one obvious characteristic of the optimum allocation is that it would not lead to wasting scarce resources. Hence, an optimum sectoral allocation should just balance resource needs with available supplies. However, the converse is not necessarily true. A sectoral allocation which just balances resource supplies and requirements is not necessarily an optimum. It would be possible, for example, to plan an allocation which put heavy emphasis on a single sector, such as manufacturing, and, in so doing, use all available resources. If the effectiveness in the use of these resources is low because too much is going to manufacturing and not enough elsewhere, the

outcome is clearly not an optimum, even though all resources are used.

The distinction drawn in the preceding paragraph is an important one. Many of the techniques which are used in development planning lead to the full use of resources but make no pretense of achieving an optimum. This is not to say that such techniques are not useful. On the contrary, they can be very useful under many circumstances. An optimum resource allocation must make full use of scarce resources, and there is a fair presumption that a plan which fully utilizes resources is closer to optimum than one which does not. Hence, full resources utilization is a sensible condition to impose on a planned allocation.

It will be helpful to distinguish two other conditions which can be imposed on a plan or resource allocation. The first is feasibility, and the second is consistency. A feasible plan is simply one which can actually be carried out. The resources for it are available and can be combined to achieve the planned outcome. Feasibility is a weaker condition than full resource utilization, for there can be allocations which will work but which will also waste resources.

Consistency is the requirement that all the individual elements of the plan fit together and not produce internal contradictions. For example, the output levels should imply income to productive factors, which is the same as the income from which savings must be made.

Another example, the value of imports should match the available supply of foreign exchange.

Consistency is perhaps the weakest useful requirement that can be made of a planned resource allocation. It says nothing about whether the allocation is even possible, only that the pieces fit together. Many consistent plans have been drawn up that were well beyond the capacity of the planning country to carry out. Such plans look well on paper because they are internally consistent, but they can mislead a planner regarding the actual development of an economy.

Four possible conditions have been identified which might be required of a planned resource allocation. In descending order of perfection they are (1) optimum, (2) scarce resources fully utilized, (3) feasible, and (4) consistent. The planning methods discussed below vary in the degree in which they attempt to meet any of these four requirements. Unfortunately, consistency is the only one of the four that can be objectively tested. The numbers which represent a planned resource allocation can be checked for consistency with simple arithmetic; but difficulties such as data errors, oversimplified relationships, changing structure, etc., make it practically impossible to test with assurance even for feasibility, much less full utilization or optimality.

B. Two Approaches to Sectoral Analysis

Two basic approaches to sectoral analysis for planning seem to emerge from the literature on this subject. The first is what might be termed the trial-and-error or cut-and-try approach. Basically it amounts to little more than making estimates of growth and resources needed for sectors individually and testing the results for all sectors together against various constraints on the entire system. Inconsistencies and breaches in the constraints are eliminated on a trial-and-error basis; hence, the name. The second is the sectoral model approach. In this approach various relationships between sectors are set out to provide a simplified model of the economy. If the model is constructed properly, the plan which results from its use will be free from inconsistencies and will use resources appropriately. Such a model will remove much of the need for the adjustment process which is necessary for the trial-and-error method.

In practice, there is really no hard and fast line between the two approaches. A model may be used to assist in adjusting a trial-and-error solution and vice versa. Or a partial model may be used to solve a part of an allocation problem, with trial-and-error used for the remainder.

1. Trial-and-Error or Cut-and-Try Approach

a. Economic Commission for Latin America

The earliest full exposition of the trial-and-error approach was given by the United Nations Economic Commission for Latin America (ECLA). In 1955 ECLA published an introduction to the technique of programming.[17] This document and the succeeding country studies which ECLA produced have profoundly influenced the practice of sectoral planning. A summary of the ECLA procedures is given in Table 2. It is rather lengthy, but it is well worth careful study.

The ECLA planning procedure starts with aggregate projections and sector projections being made independently. The sectoral plans are then added up and compared with the aggregate projections, and adjustments are made as necessary.

A number of characteristics of the ECLA system should be studied. The first is the sectors chosen for purposes of analysis. This is actually a relatively unimportant characteristic, but the list will be helpful for later discussion.

---

[17] United Nations, Economic Commission for Latin America, Analyses and Projections of Economic Development I. An Introduction to the Technique of Programming, New York, 1955.

Table 2

Summary of Planning Procedure of
UN Economic Commission for Latin America

Sectoral Projections

I. Estimate individual sector demands

A. Estimate demand for goods divided into exports and domestic consumption of:

1. Agricultural products
2. Intermediate products
3. Capital goods
4. Manufactured consumer products

B. Estimate demand for services divided into:

1. Services for final consumer
2. Intermediate services
   a. Transportation
   b. Energy
3. Government services
   a. Urban improvements
   b. Education
   c. Health

II. Estimate possibility for import substitution.

A. Estimate fixed items in balance of payments

Aggregate Projections

I. Determine possible development targets (growth of GNP or per capita income).

A. Estimate future aggregate demand for goods and services (as function of income).

B. Estimate demand for exports.

C. Estimate demand for imports.

II. Estimate aggregate investment required by applying product-capital ratio to change in GNP.

III. Estimate domestic savings (as function of income).

IV. Determine foreign capital required (as difference between required investment and domestic savings).

A. Estimate requirements for imported goods (consumer, intermediate, capital goods).

Table 2 (Continued)

1. Imports which cannot be replaced.
2. Other fixed items.

B. Estimate possible margin of import substitution (as difference between fixed items in balance of payments and capacity to import).

C. Analyze possible process of substitution on commodity-by-commodity basis.

III. Estimate domestic production by Sector

A. Exports (already made under I.A.)

B. Domestic consumption not met by imports.

1. Agricultural production.
2. Manufactured consumer goods and intermediate goods.
3. Services.
4. Capital goods.

B. Estimate growth in capacity to import (= exports + balance of capital flow).

C. Determine extent of substitution required (as difference between imports and import capacity).

Table 2 (Continued)

IV. Estimate sector investment required by:

A. Utilization of sectoral product-capital ratios where possible.

B. Detailed studies.

Add up appropriate sectoral aggregates and compare with aggregate projections. Adjust both sets of projections until consistency is achieved.

1. Agriculture
2. Manufacturing
3. Final consumer services
4. Transport
5. Energy
6. Urban improvements
7. Education
8. Health

ECLA actually proposes that manufacturing be broken into three smaller sectors--consumer manufactured goods, intermediate goods, and capital goods--and that these in turn be broken into smaller sectors for input-output analysis. The use of input-output analysis for this purpose will be discussed later. For the present, the broad manufacturing sector is all we are concerned with.

The second characteristic of the ECLA system is its high degree of pragmatism. The rule seems to be, "make each projection in the best way available for that projection." This often means simply projecting on the basis of a time trend modified by personal judgment. The techniques actually used are so varied that it would be impractical

to review them here.[18] The nature of these techniques insures that few of the projections will be consistent with other parts of the system. Some projections are common to different parts of the system, e.g., exports; these will, of course, be the same wherever used. Also, when several series are projected by relating them to another single series, the projection used for that single series will be methodologically the same for all. The most obvious example of this sort of interdependency is the use of national income as the basis for estimating variables such as savings and final demands for various goods and services. Otherwise, however, each projection is essentially independent of others. As a consequence, there are bound to be many discrepancies and inconsistencies among the sectoral and aggregative projections. These inconsistencies arise from statistical errors, from the use of aggregates which hide internal changes of importance, from inexact economic analysis and, finally, from real conflicts which must be resolved. The last is most important because it may represent areas where decisions and actions must be taken.

---

[18] The basic techniques are presented in practically any statistics textbook. Numerous examples are given in the ECLA country studies. Another excellent source to consult on projections is the United Nations Economic Commission for Asia and the Far East, Problems of Long-Term Economic Projections, Development Programming Techniques Series No. 5, Bangkok, 1963.

If, for example, imports exceed import capacity, the search for import substitutes must be made. Or, if domestic savings are insufficient, some way must be found either to increase them or to reduce investment financed by them. In the words of the ECLA authors:

> "...considerable margins of difference will exist between the two sets of findings. The only way to reconcile them is by successive approximations, adjusting the figures where necessary, and revising the calculations derived from these corrected figures. This may be a very laborious process, but it is indispensable if the projections are not to contain internal inconsistencies which would deprive the whole system of much of its value."[19]

A third characteristic of the ECLA projection system is its high degree of flexibility. This characteristic is obviously related to the system's pragmatic nature. Practically any sort of effect can be introduced into a part of the analysis, as long as it does not unnecessarily complicate other parts. A good example is the use of input-output analysis for the industrial outputs. Its use may improve industrial demand estimates and does not in any way interfere with other parts of the analysis.

---

[19] UN ECLA, 1955, p. 43.

A fourth characteristic of the ECLA system is that there is no explicit optimization in it. If the adjustment process is completed, a consistent set of projections will result, but there is nothing in the system to lead to the best allocation of resources. In fact, there is nothing that insures that the projections even represent a feasible plan. The ad hoc methods used for making individual projections may have limited optimizing characteristics and the individual planners presumably have some sort of optimization in their minds (though perhaps not consciously) and are using their best judgment to move towards it. However, there is nothing about the overall method that automatically brings the economy closer to an optimum than it otherwise would have been.

The last characteristic of the ECLA system--and a critical one for our purposes--is the lack of direct connection to project planning. A great deal of detailed analysis goes into the projections for each sector, and this analysis is often the sort needed for project planning. However, this detail is eventually aggregated for purposes of obtaining sectoral investment.

A good example of the practice noted in the previous paragraph is the transportation sector of the ECLA study of Colombia.[20] After a very detailed analysis of the transportation system of the country, the investment requirement for transportation was estimated by applying a product-capital ratio to projected aggregate transport demand. As noted earlier, transportation is a sector where the use of the product-capital ratio (or its reciprocal, the capital-output ratio) for determining investment is particularly risky. Information coming from the project planning level is particularly important in this sector.

The ECLA writers might be excused in the Colombia example since they could not be responsible for project planning within the country. However, it seems clear that, at least in the original formulation, the ECLA staff did not consider the connection between the sectoral and project planning to be one which affected sectoral planning. Their introductory work on sectoral planning seemed to suggest that the process of adjusting for inconsistencies was to be confined to the figures for the sectoral and aggregative plans.[21] Once the consistent plan had been

---

[20] United Nations Economic Commission for Latin America, Analyses and Projections of Economic Development III. The Economic Development of Colombia, United Nations, 1957. Chapter V.

[21] UN ECLA, 1955, p. 43.

constructed, projects for given sectors would be fitted into the resources made available to the sector. Doubtless the ECLA writers appreciated the need for coordination of national plans with projects. However, one cannot help feeling that their original formulation of the sectoral projection technique contributed to the practice of drawing up national plans without adequate connection to the projects necessary to implement the plan.

The ECLA authors did not spell out the way in which adjustment of the sectoral plans and the aggregative plan to each other was to be accomplished. For those sectors which consist primarily of government activities, political maneuvering plainly is a major part of the process. This is certainly true of education, health, and any sectors where public works make up a significant part of the resources utilized. At the present time little can be suggested which the economist can contribute to the process.

Much can be said for adjustments within the producing sectors. The major contributions in this area are through the use of models. These contributions are reviewed later. More in keeping with the trial-and-error spirit are two methods which have been proposed for assisting in making demand projections. The first is Chenery's industrial growth pattern approach, and the second is Seers' distortion analysis.

b. Patterns of Industrial Growth

The basic idea of industrial growth patterns is due to Chenery.[22] The hypothesis is that the changes in the structure of industry of an economy will follow predictable patterns, and these patterns are related to two variables: level of development and size. Other factors, such as natural resource endowment and dependence on foreign trade, would be important in some cases, but the factors common to all would be the level of development and size. These two factors would be measured by per capita income and population.

Chenery tested his hypothesis by fitting regressions to cross section observations of a number of countries. The regressions were between value added in individual industries and the two explanatory variables, per capita income and population. With this sort of regression equation it should be possible to predict the output for a given industry on the basis of the aggregate variables of per capita income and population. The deviations of individual countries from the regression lines were quite large, but the patterns were clear and statistically significant.

---

[22] Chenery, H. B., "Patterns of Industrial Growth," American Economic Review, Vol. LI, No. 4 (September 1960), pp. 624-654.

Chenery's original study was followed by a more extensive study by the United Nations Centre for Industrial Development.[23] In this UN study some proposals were made for using the regressions to estimate "normal" outputs for individual manufacturing industries and for adjusting these "normal" estimates to be consistent with an overall projection of manufacturing output. The proposed system thus provides a way to use the "normal" values to adjust projections made in other ways. The details of the technique need not be examined here, but clearly it may be a useful tool in drawing up a set of output projections. These projections are, of course, an essential part of the investment allocation process.

There are three major objections to the Chenery-UN patterns approach. The first is the rather wide band of uncertainty attached to the estimation of sector "norms." The statistical problems involved in the regression analysis make the estimation of sectoral norms very shaky. The second objection is that historical patterns are not necessarily good examples to follow. Why is the path followed by other countries in the past a good one for an underdeveloped country to follow in today's world? Finally, there is the difficulty of taking into account

---

[23] United Nations, Department of Economic and Social Affairs, A Study of Industrial Growth. Document ST/ECA/74. New York: United Nations, 1963.

known special circumstances, such as unusual natural resource endowments, easy access to particular kinds of imports, etc.

Experience in using the industrial pattern approach is limited. The UN study illustrated its use with some calculations for Peru.[24] Papandreau applied the technique in drawing up a plan for Greece.[25] However, these efforts cannot be conclusive since it is too soon to tell whether the adjustments reached in this fashion would have been beneficial. The technique is doubtless being used elsewhere, but its value has yet to be established.

c. Normal and Distorted Growth

In 1964 Seers presented a system for modifying projections of demand in terms of what he called normal and distorted growth.[26] The technique can be used at any level of aggregation, even down to individual commodities. However, it seems to be particularly useful for the sort of sectoral analysis with which we are concerned.

---

[24] Ibid., pp. 29-35.

[25] Papandreau, A., A Strategy for Greek Economic Development. Athens, Greece: Center of Economic Research, 1962. See especially pp. 60-64.

[26] Seers, D., "Normal Growth and Distortions, Some Techniques of Structural Analysis," Oxford Economic Papers (New Series), Vol. 16, No. 2 (July 1964) pp. 78-104.

The basic idea is to establish norms of demand for commodity groups in relation to per capita income and to compare these norms with the prevailing pattern in a given country. A significant difference between the norm and the actual pattern would suggest some sort of structural distortion that would require further investigation. Presumably this investigation would suggest whether the deviation represented a development that should be encouraged and would give insight to the problem of adjusting the projection for the commodity group.

The difficult part of Seers' procedure is to establish the norms. He suggests that the amount of a commodity used in an open economy relative to its per capita income can be considered a rough estimate of normal for that level of income. As Seers readily acknowledges, this sort of norm has objections; he suggests them only as standards of comparison, not as examples of virtue.

Once the norms have been established, the distortions can be assessed by four means. These are comparisons based on time series analysis, cross-section analysis within a similar country, cross-section analysis among several countries, and by studying symptoms such as price movements and physical shortages.

As in the case of the industry pattern approach, little experience is available in applying Seers' approach systematically. Since the method is composed of a number of standard techniques, there is doubtless much piecemeal experience available. It has not been pulled together, however, and we are not in a position to judge the usefulness of his suggestions.

2. The Model Approach

Contrasting the trial-and-error approach to aggregative and sectoral planning is the model approach.[27] In the latter, various economic relationships between aggregative and sectoral variables are used to produce projections which are consistent and, in some uses, projections which have some optimizing characteristics. The best known of these is the input-output system.

---

[27] Two books which present good discussions of the types of models discussed in this section are (1) Chenery, H. C., and Clark, P. C., Interindustry Economics, New York: John Wiley, 1959, and (2) Tinbergen, J., and Bos, H. C., Mathematical Models of Economic Growth, New York: McGraw-Hill, 1962.

a. Input-Output Analysis

Perhaps the earliest effort to relate sectors to each other in a useful fashion is input-output analysis. Input-output can be briefly explained by reference to Table 3.[28] The economy is conceived to consist of a number of sectors--in this case six--which produce for each other and for final demand. Each row represents the distribution of output of a particular industry among the industries and final uses shown at the column headings, and each column represents the purchases of inputs from the sellers shown in the row titles. The figures in quadrant I, Intermediate Production and Consumption, are the purchases of raw materials and services by the six industries from each other. Other inputs are given in quadrant III, Primary Inputs. The final uses of all goods and services are given in quadrants II and IV. With a few minor adjustments, these columns represent gross national product.

---

[28]The table is taken from United Nations Economic and Social Council, "Problems of Input-Output Tables and Analysis," Document E/CN. 3/317, 17 February 1965, mimeographed. This document contains an introduction to input-output analysis and excellent short discussions of the important problems of input-output analysis. A briefer and simpler introduction is contained in UN ECAFE 1960, Chapter V. An excellent treatment, probably the best introduction to input-output currently available, is Chenery and Clark, 1959.

Table 3

SIMPLIFIED INPUT-OUTPUT TABLE (NETHERLANDS 1956)
(unit: million of guilders)

		Intermediate Demand							Final Demand						
		Agriculture, Fishing, Food	Metals and Constructions	Textiles and Apparel	Mining, Chemicals & Utilities	Trade	Services	Intermediate Demand (Sub-total)	Exports	Household Consumption	Government Consumption	Gross Domestic Fixed Capital Formation	Net Increase in Stocks	Final Demand (Sub-total)	Total Demand = Total Output
		I. Intermediate Production and Consumption							II. Final Output of Production Sectors						
Agriculture, Fishing, Food	1.	6,419	-	39	175	1	352	6,986	3,532	5,576	15	-	-33	9,090	16,076
Metals and Construction	2.	422	3,446	62	399	163	856	5,348	2,747	842	903	5,339	302	10,133	15,481
Textiles and Apparel	3.	25	38	1,177	55	21	39	1,355	790	2,146	22	10	94	3,062	4,417
Mining, Chemicals & Utilities	4.	700	1,438	322	2,210	448	704	5,822	2,630	1,722	341	147	47	4,887	10,709
Trade	5.	404	685	131	274	66	89	1,649	1,483	3,833	37	509	10	5,872	7,521
Services	6.	268	516	141	417	1,241	1,046	3,629	3,893	3,735	225	248	65	8,166	11,795
Intermediate Inputs (Sub-total)		8,238	6,123	1,872	3,530	1,940	3,086	24,789	15,075	17,854	1,543	6,253	485	41,210	65,999

Table 3 (Continued)

SIMPLIFIED INPUT-OUTPUT TABLE (NETHERLANDS 1956)
(unit: million of guilders)

		Intermediate Demand							Final Demand						
		Agriculture, Fishing, Food	Metals and Constructions	Textiles and Apparel	Mining, Chemicals & Utilities	Trade	Services	Intermediate Demand (Sub-total)	Exports	Household Consumption	Government Consumption	Gross Domestic Fixed Capital Formation	Net Increase in Stocks	Final Demand (Sub-total)	Total Demand = Total Output
		III Primary Inputs to Production							IV. Primary Inputs to Final Demand						
Primary Inputs	Imports	2,547	3,293	1,161	3,016	348	1,614	11,979	368	1,683	319	1,856	238	4,464	16,443
	Depreciation	403	287	95	623	268	1,128	2,804	-	-	179	-	-	179	2,983
	Net Indirect Taxes	638	525	50	492	1,165	224	3,094	-	-	-	-	-	-	3,094
	Employees' Income	1,385	3,352	807	1,964	1,239	3,238	11,985	-	-	2,766	10	-	2,776	14,761
	Profits	2,865	1,901	432	1,084	2,561	2,505	11,348	-	-	106	-	-	106	11,454
	All Primary Inputs (Sub-total)	7,838	9,358	2,545	7,179	5,581	8,709	41,210	368	1,683	3,370	1,866	238	7,525	48,735
	TOTAL INPUT	16,076	15,481	4,417	10,709	7,521	11,795	65,999	15,443	19,537	4,913	8,119	723	48,735	

Reproduced from United Nations Economic & Social Council, "Problems of Input-Output Tables and Analysis," Document E/CN. 3/317, 17 February 1965, mimeographed, p. 8.

The table as it stands is a helpful way to present a great deal of information. However, with an assumption about the input requirements for the producing sectors, it is possible to turn the table into a very useful prediction tool. The necessary assumption is that the input of goods or services from any industry to a given industry is in a fixed proportion to the total output of the given industry. Let X_j be the total output of industry j, and X_{ij} the input of industry i to industry j. Then the input of i will be some fixed proportion, a_{ij}, of X_j. The relationship would then be:

$$(1) \quad X_{ij} = a_{ij}X_j \quad \text{or} \quad a_{ij} = \frac{X_{ij}}{X_j}$$

The second form of the relationship indicates how the a_{ij} can be estimated from a table such as the one given for the Netherlands. For example, the total production of metals and construction was 15,481 million guilders; and the input from mining, chemicals, and utilities was 1,438 million guilders. The input coefficient of mining, chemicals, and utilities into metals and construction was, therefore:

$$(2) \quad a_{42} = \frac{1,438}{15,481} = .0929$$

Thus the production of 1.0 guilders of metals and construction products required the input of .0929 guilders of materials from mining, chemicals, and utilities. The set of input coefficients for all pairs of producing sectors can be obtained in similar manner.

After the a_{ij}'s have been suitably manipulated, it is possible to take any given set of final demands and calculate the required intermediate or indirect demands for the producing industries. Final demand plus intermediate demand for any industry gives its total demand. Thus we have produced a tool to calculate total output for each industry on the basis of predictions of the final demands. With additional information on sectoral capital-output, labor-output, and import-output ratios, it is also possible to determine investment, labor, and import requirements for each sector.

The utility of input-output as a tool for sectoral planning is obvious. The final demand is essentially gross national product. Application of input-output techniques to projections of GNP, suitably broken down, provides a completely consistent set of sectoral output projections. There is the possibility that some aggregate resource constraints may be exceeded. If this occurs, the elements of final demand can be adjusted in order to achieve the needed balance.

Powerful as input-output analysis is, it has a number of shortcomings which have limited its use as a planning tool in underdeveloped countries. First and foremost is the extremely heavy data requirement that its use imposes. To be useful, the breakdown of producing industries must be much finer than the one shown in Table 3. The number of production sectors will usually range between 20 and 200. Table 3 is a consolidation of an input-output table which originally contained 35 industries. It is difficult, if not impossible, to find satisfactory data for filling in tables of these sizes even in developed countries like the Netherlands or the United States. The existence of input-output tables in a number of less developed countries is evidence that they can be compiled, but for many countries these tables are still out of the question.

The quality of input-output data is as important as its availability. The fact that a country has a table for some particular year tells us nothing about its quality. Many of these tables have been completed by filling in unavailable entries with pure guesses. People unfamiliar with the data problems for input-output are usually quite surprised to discover the extent of guesswork behind the neat rows of figures of a published table. Unfortunately, at the present time little is known about the effect of data errors on input-output analysis.[29]

---

[29]The subject is examined briefly in Morgenstem, O., On the Accuracy of Economic Observations, 2nd edition, Princeton: Princeton University Press, 1963.

A second limitation of input-output analysis is that it covers only the so-called production sectors of the economy. The non-productive sectors, such as education, health, investment, and exports, can only be included in the final demand section. As noted earlier, the final demands must all be predicted by means outside the input-output system. Hence, a good share of economic activity cannot be coordinated with the use of input-output. This is not to say that input-output is useless but rather that it can only be used to provide consistency for part of the sectors with which planners are concerned.

A third problem of input-output analysis centers on the estimation of the input coefficients, the a_{ij}'s. As noted earlier, the basic assumption on which these estimates depend is that each input is in fixed proportion to the output of a given industry.[30] This assumption rules out any substitution among inputs and any economies of scale for an industry. It also rules out technological changes which would alter the proportions in which given inputs are used. Finally, it requires either that sectors be chosen so that all producers in a given sector use inputs in approximately the same proportions for a given volume of output or that the mix of production within a given sector remains unchanged. The success of input-output analysis depends on the degree to which each of these requirements is present.

---

[30] Chenery and Clark, 1959, give a detailed discussion of the problems noted in the text. See particularly their chapter 2.

Unfortunately a developing country is usually undergoing changes which violate to some extent each of these requirements: substitution among inputs takes place continuously; economies of scale are searched for hopefully; new technology is continuously being adopted; and within any sector fairly rapid changes in the mix of output are taking place. Finally, it is doubtful that useful sectors can be chosen so as to group producers with similar input requirements. Thus, except in the relatively short run, the a_{ij}'s cannot be expected to be stable, and projections based on the assumption of their stability are likely to be misleading.

The last characteristic of input-output analysis which is of interest to us is its lack of optimization or, perhaps more accurately, the very limited sense in which optimization takes place. The assumption of fixed input coefficients implies a production function with no possibilities of substitution. With this sort of production function at least so much of each input would be needed to achieve a given level of output in a particular industry. If more than the minimum of each input is put into the sector, it will go unused; i.e., wasted. Input-output simply gives a solution which defines the minimum amounts of each input required to produce a given set of final demands by the methods of the base year. Its significant accomplishment is the identification of indirect demands, something which is impossible to do at the project level. It fails, however,

to account for two other processes required for optimizing inputs: the possibilities of substitution and the possibilities of economies of scale. In a growing, developing economy these last two effects are likely to be important, and the input-output solution is not likely to be an optimum.

Let us now turn to the experience with input-output analysis in developing countries. The basic concept is an exceedingly attractive one; and in spite of the heavy investment required in the way of statistical resources, a number of underdeveloped countries have undertaken input-output studies. A limited check yielded a total of forty countries for which input-output studies have been undertaken.[31] Of these, sixteen would definitely be classified as underdeveloped.

The experience of the developing countries with input-output analysis, at least for development planning purposes, has on the whole been disappointing. They have been used principally as checks on consistency of projections made in other ways and for estimating the import content of the output of certain sectors.[32] For developed countries, the reliability of forecasts based only on input-output analysis has been

---

[31] Chenery and Clark, 1959, gave nineteen; UNESCO, 1965, gave an additional nineteen; the Philippines and Korea, not on either list, are known to the author as having undertaken studies.

[32] See Tryon, J. L., Development Planning in Latin America, Washington, D. C.: National Planning Association, 1966.

usually no better and was often poorer than projections by less demanding methods.[33] Michael Bruno[34] reported fairly good results for Israel on the basis of a 1958 input-output study. However, it is doubtful that the Israeli experience could be duplicated in many underdeveloped countries; the statistical resources in Israel have been substantially greater than in other developing countries. For other underdeveloped countries tests on projections by input-output have not been published.

b. National Income Models

The input-output model adheres strictly to an industrial sector breakdown for the part of the model that contains the economic relationships expressed within the model. We turn now to models which contain relationships between the familiar national income components.

The parent of these models is usually the Harrod-Domar model. There are many of this type in existence. The simplest do not break the economy into sectors at all, as we have used the term, but treat the economy as a single aggregate. The original Harrod-Domar model is of

---

[33] Chenery and Clark, 1959, Chapter 6.

[34] Bruno, M., Interdependence, Resource Use and Structural Change in Israel, Jerusalem, Bank of Israel, 1962.

this type. More complicated models do contain some sort of sectoring. Our purposes will be served adequately by considering a typical model which contains only two sectors. The one to be examined here is that of Schinichi Ichimura, presented in the ECAFE report of the first group of planning experts.[35]

The sectors in Ichimura's model are basically the private and public parts of the economy. The model requires certain variables for these sectors. They are as follows:

Division of national income into goods and services at market prices:

C^p = Private consumption

I^p = Private investment

C^g = Government consumption

I^g = Government investment

E = Exports

M = Imports

Division of national income into factor payments and taxes:

Y^p = Disposable private income

T^i = Indirect taxes less subsidies

T^d = Direct taxes less transfer payments

---

[35] UN ECAFE, 1960, pp. 81-86.

These variables are then related to each other by means of simple relationships. The entire model need not be examined here, but it will be helpful to illustrate the nature of these relationships with two examples. The following equations show how private savings ($Y^p - C^p$) and imports (M) are determined:

(3) $(Y^p - C^p) = s(Y^p)$ where s is the average propensity to save in the private sector.

(4) $M = m(Y^p + T^d)$ where m is the average propensity to import.

The complete model has three definitional equations (national income definitions), one technical relationship (the marginal capital-output ratio), and seven behavioral relationships (covering private savings, taxes, imports, government expenditure, government investment, and government borrowing).

Suitable manipulation of this particular model produces estimates of the necessary private and public investment, savings, taxes, and foreign investment to achieve given growth rates in national income. It provides answers to some other questions, but essentially it is designed to estimate the savings-investment constraints for the public and private sectors and the balance of payments constraint for the whole economy. It solves the problems that in the real economy would come through the capital and foreign exchange markets.

Models, such as the one described, can be criticized on many grounds: dependence on capital alone as a production factor, exclusion of time preference in determining savings, reliance on very simple relationships between variables, and so on. Here we will consider only one criticism, the model's highly aggregative nature. For example, it relates total imports to national income. Experience soon shows that the composition of national income changes radically with growth and development, and these changes affect the volume of imports. Unless use is made of some sort of breakdown of income, estimates of imports are likely to contain serious errors. Similarly, the capital-output ratio is not constant for all types of production. Errors in investment estimates may thus occur because some sort of disaggregation of output has not been used.

The need for disaggregation has led to expanding the sort of aggregative model described above in several directions. Ichimura presents several two-sector models.[36] One has capital goods and consumption goods sectors; a second has export and home-market sectors; and a third has farm and industrial sectors. The farm-industry model distinguishes both production and households in each sector in order to account for different behavior as well as different capital-output ratios in the two sectors.

---

[36] Ibid., pp. 87ff.

Slightly more complicated than those described by Ichimura is the Mahalanobis model for India.[37] The Mahalanobis model contained four sectors: investment goods, factory produced consumer goods, small industry and household produced goods, and services. It was designed principally to determine the sectoral allocation of investment funds. Still more complicated are the models combining the national income and input-output approaches.

c. Combinations of Input-Output and National Income Models

The national income models are usually concerned only with final demand. Input-output analysis, on the other hand, takes final demand as given and attempts to determine interindustry demands. A natural development is to combine the two types of models.

At the conceptual level, the combination of national income and input-output models is straightforward.[38] For example, the investment final demand in each industry can be related to the change in output in that industry through the accelerator or capital-output ratio, and

---

[37] Mahalanobis, P. C., "The Approach of Operational Research to Planning in India," Sankhya, Vol. 16, parts 1 and 2 (December, 1955).

[38] Discussions of this sort of model are contained in Chenery and Clark, 1959, and Tinbergen and Bos, 1962.

consumption final demand can be related to wage income. Usually the only parts of final demand that are left to be determined outside the model are exports and certain types of government expenditures. The elaboration which such a model contains insures that still more of the economy's projections will be consistent with each other.

A good example of the combined national income, input-output model is Tims' long-term model of Pakistan.[39] This model contains seven producing industries:

1. Agriculture, forestry, fishing
2. Consumer goods manufacturing
3. Intermediate goods production
4. Investment goods manufacturing
5. Construction
6. Transport and Communications
7. All other services

In addition to the usual input-output equations, there are equations explaining (usually by sector) the behavior of imports, taxes, consumption, fixed investment, and inventory investment. The only

---

[39] Tims, Wouter, "A Long-Term Growth Model for Pakistan," mimeo (no date, but probably 1965).

exogenous variables (i.e., the ones that must be projected independently) are GNP, gross agricultural production, four kinds of exports, and the agricultural component of Indus Basin Works. An additional refinement is the introduction of slowly changing input coefficients to account for technological change and the introduction of new products.

Complicated models, such as Tims', suffer from the shortcomings of both input-output and national income models. The heavy data requirements make them exceedingly difficult to apply. The relatively simple relations used to explain the behavior of variables, such as savings, consumption, and investment, make predictions based on them hazardous. Moreover, development of the economy is likely to render estimated parameters obsolete fairly quickly.

d. The Introduction of Choice into Models

The models which have been discussed up to this point do not permit choice to enter into the allocation of resources. This approach is equivalent to assuming fixed proportions among inputs for any given output.[40] This is true for all inputs--capital and labor, as well as goods

---

[40] Tims introduced change in the input-output coefficients over time but still did not permit choice of inputs.

and services from other industries. Optimization of resource allocation is not a part of these models. Efforts to introduce choice and, hence, some degree of optimization have resulted in two types of improved models. The first is linear programming, which can be most easily understood as an extension of input-output analysis. The second is the so-called policy model, which is usually an extension of national income analysis.

(i) Linear Programming

The subject of linear programming will be considered here only briefly. Good expositions are contained in Chenery and Clark's Interindustry Economics[41] and Dorfman, Samuelson, and Solow's Linear Programming and Economic Analysis.[42]

In input-output analysis a given product is produced by only one industry, and each industry has only one product.[43] The assumption of fixed input-output coefficients results in only one way to produce a given final demand. In linear programming, on the other hand, industries

---

[41]Chenery and Clark, 1959.

[42]Dorfman, R., Samuelson, P. A., and Solow, R. M., Linear Programming and Economic Analysis. New York: McGraw-Hill, 1958.

[43]The "product" here is actually a composite of several products; e.g., the "product" of the steel industry is actually the aggregate of steel construction bars, nails, G. I. sheets, etc.

are replaced by activities, and a given activity may produce several products; further, several activities may produce the same product. Fixed input-output coefficients are assumed for each activity, as in input-output analysis, but it is clear that a given final demand could be met by different combinations of outputs of activities. Hence, a choice must be made among the possible combinations of activity outputs or levels. The choice for the problem of meeting a given set of final demands is usually made on the basis of least cost; i.e., the most economical use of available resources.

The concept of an activity deserves elaboration. Different ways of producing a given product can be represented in a programming problem simply as different activities. For example, rice might be produced by three possible methods: intensive hand labor alone, labor plus imported fertilizers, or labor plus fertilizers plus irrigation water. Each of these three methods would be an activity, with the total rice production being the sum of the outputs of the three activities. The output or level of each activity would be determined by the total demand for rice and the relative scarcity of labor, imported fertilizer, and irrigation water.

A different sort of activity can be illustrated by a mine which produces several kinds of ore in fixed proportions: copper, gold, and tin.

These two illustrations show that an activity is not synonymous with an industry of the input-output type. If activities are treated as sectors for analysis purposes, the sectors are different from any considered thus far.

Another characteristic of linear programming is the dual nature of the solution. Not only are the quantities of various required inputs determined but also a set of prices for these inputs. These prices are usually called shadow or accounting prices. They play an important theoretical role in the link between project and aggregative planning and, therefore, need further examination.

The process by which a solution to a linear program problem is obtained is essentially as follows. First, a set of prices for each input is assumed. Second, on the basis of these assumed input prices, the least cost combination that will produce the required output is found. Third, the assumed prices are adjusted downwards for those factors which were not all used in the trial solution and raised for those that require more than the available supply. Then a new least cost combination is found. The new combination will have the demand and supply of inputs closer to balance. The process is repeated until a set of prices is obtained which just balances the supply with the demand for each factor.

For some factors even a zero price leaves a surplus; these are left with zero as their price. Some of each zero price factor will not be utilized. These factors are resources which are not scarce and need not be economized. All others are just balanced between supply and demand.

The allocation of resources which the usual programming solution provides is essentially the same as would obtain in a competitive economy which produced the same final demand. It is thus an optimum in the same sense that any competitive or efficient allocation is an optimum.[44] This characteristic explains why the programming model may be called an optimizing model.[45]

The conclusion that a competitive allocation of resources is an optimum is subject to the condition, among others, that there are no external economies of scale. Scitovsky[46] has shown that, when there are economies of scale, investment decisions based on market prices alone will often lead to underinvestment in particular industries. The interdependence among industries which this situation reflects is a common

---

[44]See Dorfman, Samuelson, and Solow, 1958, pp. 408-15.

[45]The assumptions and shortcomings of the competitive optimum are examined in detail in Tryon and Cookson, 1966, part III.

[46]Scitovsky, T., "Two Concepts of External Economies," The Journal of Political Economy, Vol. LXII, No. 2 (April, 1954), pp. 142-151.

one in underdeveloped countries. Chenery[47] has shown that a linear programming analysis can be extended to achieve the necessary coordination between sectors in order to take advantage of sectoral economies of scale. If this sort of interdependence really can be accounted for by a programming approach to sectoral planning, it will be a significant accomplishment. Interdependencies of this kind are surely very common and of significant size in underdeveloped countries, but no satisfactory way is known to incorporate their effects in project analysis. Taking them into account by sectoral linear programming may be the best solution to the problem.

The solution of a linear programming problem of the sort outlined above requires a great deal of calculation, even for a moderately complicated system. However, the methods are known, and solutions for systems with as many activities as a large input-output system are possible with electronic computers. The most formidable problem is not calculation, but data. Programming obviously requires a great

---

[47]Chenery, H. B., "The Interdependence of Investment Decisions," in Abramovitz, M. (ed.), The Allocation of Economic Resources, Stanford: Stanford University Press, 1958.

deal of detailed data, much more than a comparable size input-output. As a consequence, very little practical experience has been gained in the use of this approach for planning purposes. Chenery's model for studying interdependence was based largely on hypothetical data.[48] Another model which he and Kretschmer constructed was for Southern Italy,[49] but it, too, was meant principally for illustrative purposes. A few other experimental studies have been made elsewhere.[50] The technique thus has had little practical application. The difficulties associated with linear programming suggest that its use will be rather limited for development planning in the immediate future.

(2) Policy Models

Linear programming offers choice in the use of available resources to produce a given set of final demands. Policy models are designed to provide choice among various development goals. The typical development goals among which choice is offered are increasing the

---

[48]Chenery, 1958.

[49]Chenery, H. B., and Kretschmer, K. S., "Resource Allocation for Economic Development," Econometrica, Vol. 24, No. 4 (October, 1956), pp. 365-99.

[50]See, for example, Tryon, 1966.

growth rate of national income, absorption of unemployment, redistribution of income, and reduced dependence on foreign investment. Since linear programming is usually concerned only with growth in national income, policy models offer a broader kind of choice.

The policy model approach has been examined extensively by Tinbergen.[51] His work is the basic source for detailed accounts of policy models. One may even speak of him as the father of this approach.

It will be sufficient here to examine a single illustrative policy model, the one constructed by Chenery and Bruno for Israel.[52] As is the case for most policy models, the Chenery-Bruno model is a national income model. The principal variables are GNP, private consumption, investment, exports, imports, savings, capital stock, labor supply, labor demand, government expenditures, and foreign capital inflow. These are related to each other in a standard national income model. The equations of this model were rearranged into so-called reduced form, and the parameters of the reduced form model estimated. The translation of the original model into reduced form is the important

---

[51] Tinbergen, J., On the Theory of Economic Policy (Second Edition), Amsterdam: North Holland Publishing Co., 1955; Tinbergen, J., Economic Policy: Principles and Design, Amsterdam: North Holland Publishing Co., 1956.

[52] Chenery, H. B. and Bruno, M., "Development Alternatives in an Open Economy: The Case of Israel," The Economic Journal, Vol. LXXII, No. 285 (March, 1962), pp. 79-103.

feature of this approach. The reduced form gives the relationships between the target or objective variables which represent development goals and the policy variables over which the government has control. In this particular model, the target variables were GNP, private consumption, government expenditures, foreign capital inflow, and unemployment rate. The instrument variables were government expenditure, foreign capital inflow, unemployment rate, marginal propensity to save, exchange rate, and increase in labor productivity. (The inclusion of some variables in both groups is acceptable.)

The reduced form equations show how changing each of the instrument variables will change each of the target variables. The policy maker considers the range of possible choice in the target variables and chooses the combination which best suits him. Presumably in making his choices he is attempting to maximize the welfare of society. Hence, he is optimizing the system with respect to the broad notion of welfare and not just output. Unfortunately, no simple means of weighing the relative importance of each objective variable is available. A way to complete the optimizing process is not furnished.

As is the case with linear programming models, little experience is available in the application of policy models to concrete problems of development planning. A few models similar to the

Chenery-Bruno model have been constructed elsewhere,[53] but the practical value has not been demonstrated for any of them.

e. Some Conclusions about Models

In this section models of several types have been examined: input-output, national income, linear programming, policy, and combinations of some of these. From this examination a wide variety of sectors was noted. For each type of model the general aims and the contribution of the model to the problems of achieving consistency and optimality in the planned allocation of resources were considered. It will be helpful to summarize the conclusions in this regard.

1. Input-output is a technique which attacks the problem of estimating indirect demands. To the extent that it is successful, it insures that total output of a given industry will satisfy both direct or final demand and any indirect demands which come to it via other industries needing its products as inputs. It should be useful in maintaining consistency of output projections for the producing industries. Extensions of the model permit the estimation of labor, capital, and

---

[53] Antonio Ayala, "The Use of a Policy Model for Analyzing Some Philippine Gross Alternatives, 1963-1966," unpublished Ph.D. dissertation, Department of Economics, Georgetown University, 1964.

import requirements, but these estimates are not necessarily consistent with actual supplies of these inputs.

2. National income models are usually designed to give consistent estimates of savings, investment, and the balance of payments. They can have sectors introduced which are designed to assure consistency between various final demand components. Resource requirements can be included as part of the model, and resources supplies can be included as constraints. A full model of this sort will provide aggregate consistency in output and the use of resources but tells nothing about intersectoral consistency.

3. A combination of input-output and national income models is possible. With such a model, internal consistency of various types can be achieved. However, without choice, it is not generally possible to establish consistency of final demands, indirect demands, individual industry resource requirements, savings, and balance of payments.

4. Linear programming provides a way to introduce choice in the use of resources and imports. This choice permits the establishment of consistency between all sectors with regard to outputs and resource demands. Further, it leads to optimization as well as consistency, at least as far as a fixed output is concerned.

5. Policy models of the Tinbergen type introduce choice among development goals in addition to output. This choice is limited to variables which can be handled with aggregative national income type models. Choice of this sort permits an attempt to achieve a welfare optimum broader than just output, but it is restricted to aggregate level decisions.

Are there major problems of development which ought to be reflected in development planning which the aforementioned models cannot help to solve? There are numerous problems of this sort, and the question is raised only to suggest that still other models, with different sorts of sectors, may be needed to solve such problems. One such model is the Fei-Paauw model for the small, open economy.[54]

The Fei-Paauw model contains four main sectors, or nexi, and some sub-sectors. These sectors are productive, income, financial, and foreign. For the productive nexus, the sub-sectors are industry, agriculture, and government; the same sub-sectors exist in the income nexus. This particular model is designed to analyze the mechanism by which resources are transferred from one sector to another during the process of development.

---

[54] Paauw, D. S., A National Income Accounting Framework for the Open, Dualistic Economy. Center for Development Planning, National Planning Association, 1966 (mimeo).

The Fei-Paauw model attacks a problem with which none of the models discussed earlier are concerned. There are other development problems which also are neglected in these models. Two important ones are (1) how to incorporate policies which affect factor supplies in the future and (2) how to recognize the possibilities of large, non-marginal resource shifts that would be beneficial to future output. A satisfactory solution to the first of these problems would help in allocating resources to education and health; a solution to the second would perhaps help in resolving conflicts over the degree of industrialization. Doubtless if usable models were developed to solve these questions, the sectors chosen would be different from those of the previously discussed models.

One last comment on models is in order here. The models often had quite different purposes. Each might achieve its own limited purposes--but at the expense of hidden inconsistencies or conflicts with the working of parts of the economy that were not an integral part of the model. Some of these conflicts could be solved by combining several models. This approach has limitations, for it introduces complexity and detail with which it may be quite impractical to deal. At the present time it seems clear that no single model can be designed and implemented

which will provide completely consistent projections or plans, however the economy is looked at.[55] Models can help in achieving consistency and, to some extent, in working toward some sort of optimum, but they cannot accomplish the whole job.

3. Concluding Comments on Sectoral and Aggregative Analysis

The review of the two approaches to sectoral planning has left us hanging in mid-air. Neither the trial-and-error approach nor the model approach gives any assurance that the end product will be an optimum. The trial-and-error system practically guarantees that inconsistencies will be present; and while the model approach can help to prevent some inconsistencies, it has serious limitations.

Under these conditions what is one to do? The sensible procedure seems to be to submit a given plan to as many checks as possible and, where these checks identify problems, make adjustments with the best judgment available. Unfortunately, little guidance is available on how to carry out this step. Since most plans are formulated

---

[55] A very useful review of the experience of a number of countries with projections made by models and other techniques is contained in United Nations Economic Commission for Asia and the Far East, Review of Long-Term Projections for Selected Countries in the ECAFE Region, Development Programming Techniques Series No. 5, Bangkok, 1964.

around a national income accounting framework, one obvious set of checks is the various equalities that must be maintained in these accounts.[56] Some others are the examination of the behavior of data like the capital-output ratio, the labor-output ratio, the savings ratio, etc. Each of these ratios can be examined for "reasonableness" against past experience and the experience of other countries. Similar checks of "reasonableness" can be made on many parts of a plan. The difficulty is that no sort of check list is presently available to guide the planner in this procedure. Hence, he is on his own in devising suitable checks.

An illustration of the sort of approach suggested above is given in Reddaway's examination of the Indian Third five-year plan (1961-66).[57] From his account, it appears that this plan had not been made consistent in a number of respects. Hence, he applied only a few relatively simple tests.[58] The most important were made on the savings ratio, composition of output, consumption per capita, the extent of industrialization, and the extent of the move towards self-sufficiency. These were only a few

---

[56] The major checks related to national income accounts are enumerated in UN ECAFE, 1961, pp. 24-28.

[57] Reddaway, W. B., The Development of the Indian Economy. Homewood, Illinois: Irwin, 1962.

[58] Ibid., particularly chapter 13.

of the tests to which such a plan might be subjected. Reddaway's account is useful because he presented a detailed, understandable explanation of exactly what he did and what the results meant. It is therefore particularly instructive as an example of the technique suggested here.

IV. LINKING PROJECT LEVEL PLANNING WITH AGGREGATIVE AND SECTORAL PLANNING

In this section four subjects will be considered. The first is the question of the legitimacy of planning in stages. The second is the theoretical basis on which planning for projects can be linked to aggregative and sectoral planning. The third is the necessity for some sort of device to translate project planning data into data for aggregative and sectoral analysis. The last is the division of responsibility for certain planning tasks among the various planning authorities of a country.

1. Planning in Stages

Should the sectoral planning discussed in the previous section be performed independently or in conjunction with project planning? Some writers urge that as a practical matter the two must be performed together.[59] On the other hand, the ECLA manual strongly implies that

---

[59] See, for example, Walinsky, L. J., The Planning and Execution of Development, New York: McGraw-Hill, 1963, pp. 18 and 44.

project planning should come after aggregative and sectoral planning.[60] The models which were discussed seem to imply independence from project planning. Aggregative and sectoral planning come first and provide the sectoral allocation; then projects for each sector are planned on the basis of given resources for the sector. Assuming that some sort of optimum allocation of resources is our goal, under what conditions can the problem of reaching the optimum be legitimately approached in this stage fashion?

In spite of the widespread practice of planning in stages, very little has been written to justify its use. Tinbergen has provided the principal literature on the subject.[61]

Tinbergen argues that certain macro decisions which are logically the result of the solution of a large system of equations can often be made to a satisfactory degree of accuracy without a solution of the entire system. To determine whether this is the case, the system should be examined to find variables that can be solved on an iterative basis.

---

[60] UN ECLA, 1955, p. 43.

[61] Tinbergen, J., "Planning in Stages," Saertrykk av Statskonomisk Tidsskrift no. 1, 1962, and less completely in Tinbergen, 1955, Chapter VIII, and Tinbergen and Bos, 1962, Chapter 1.

An iterative solution in this case is one which can be found by successive trials, with each trial coming closer to the correct value. If the solution converges rapidly for some variables, these variables are insensitive to the rest of the system; and they may be estimated first. If the structure of the economy is of this nature, it may mean that the planning problem can be broken into the macro stage, sector stage, project stage, and regional stage. Planning then takes place by going through each stage successively, testing for consistency after a round of stages is completed, and repeating the process with adjustments each time until a consistent outcome for all levels is achieved.

As an example, consider the aggregate growth rate. The growth rate depends on the savings ratio and the capital-output ratio. If the sectoral capital-output ratios are not very different from each other and if the savings ratio does not depend on the sectoral distribution at all, the growth rate can be estimated reasonably well without knowing the sectoral distribution. Knowledge of the sectoral division of output would improve the estimate of aggregate growth but would not change it much. This is exactly the condition needed for the iterative solution for the growth rate to converge rapidly. According to Tinbergen's criterion, the growth rate could be satisfactorily estimated before the sectoral distribution of output or investment. Furthermore, successive rounds of

the planning stages would result in little adjustment to the growth rate.

Tinbergen concludes that the conditions where macro planning can be undertaken before sectoral planning are quite likely to exist. For sectoral planning, he suggests that industries be divided into two groups, those concerned with internationally traded products and those concerned solely with domestically traded products. The international group can be adjusted by trade; hence, they can be planned on a one-by-one basis. The domestic group has interdependencies; they must be planned together by some device like input-output analysis.

Tinbergen's analysis of stages is a very suggestive one. Unfortunately, however, he relies entirely on hypothetical examples, and he does not spell out methods for establishing the validity of stages in operational situations. The validity of the stage approach can be established only by empirical work, little of which has been done. The savings ratio example used in the previous paragraph is a good case of this point. At the present time considerable controversy exists over the question of whether the pattern of investment will affect the savings ratio. Galenson and Leibenstein[62] argue that the more capital intensive projects

---

[62] Galenson, W., and Leibenstein, H., "Investment Criteria, Productivity and Economic Development," The Quarterly Journal of Economics, Vol. LXIX, No. 3 (August, 1955), pp. 343-370.

are, the higher will be the future level of saving. If this is true, the aggregate savings ratio cannot be estimated accurately without simultaneously working at the project level. Practically all macro and sectoral models, on the other hand, implicitly assume that saving depends only on aggregate income or, at most, on the division of income into aggregate labor and profit income. Which position is correct simply has not been established empirically.

The conclusion of this discussion is rather negative. At the present time it can only be said that we do not know how valid the use of the stage system of planning is. This is indeed unfortunate for, as will be seen below, a major proposal for linking project planning and sectoral planning requires the use of planning by stages with shadow prices, and we do not know whether the use of stages in this manner is acceptable.

2. The Links between Project Planning and Sector Planning

The following chart shows the relationships between sector and project analysis. It is adapted from a similar chart presented by an ECAFE-sponsored group of experts.[63] The procedure is suggested for

---

[63] UN ECAFE, 1961, p. 31.

industrial programming only. The reasons for leaving out other sectors will become clear later.

SECTOR ANALYSIS	PROJECT ANALYSIS
First Stage: Initial Sector Plan	Second Stage: Initial Project Evaluation
1. Estimation of sector demands.	1. Screening projects.
2. Preliminary estimate of outputs.	2. Selection of best projects based on accounting prices.
3. Initial allocation of resources.	3. Detailed consistency check of projects selected.
4. Calculation of initial accounting prices.	
5. Adjustment of sector plans for consistency.	
Third Stage: Revised Sector Plan	Fourth Stage: Revised Project Evaluation
1. Revision of production and import proportions.	1. Selection of best projects based on revised accounting prices.
2. Revision of sector projections.	2. Detailed consistency check of projects selected.
3. Revision of accounting prices.	

Further rounds repeat third and fourth stages.

The chart shows the planning process in stages as described earlier. Only two planning levels are shown, sectoral and project. Aggregate planning could be considered to be an earlier stage or simply part of the sectoral stages.

The links between the two levels of planning are of two sorts. The first is the use of accounting prices found in the course of sectoral planning to evaluate projects in the succeeding project analysis stage. The second is the testing of the consistency of project plans for each sector with the resources allocated to the sectors by the sectoral plan.

The use of accounting prices was considered earlier in the discussion of linear programming. They are essentially the prices for inputs which will balance supply and demand for each input.

If the conditions for planning by stages are met, the system would operate as follows. In the first stage accounting or shadow prices would be found for the inputs of each sector by linear programming. These prices would be used in the second stage to value the inputs of the projects for each sector. Projects would be selected on the basis of their social marginal productivity (essentially their present value based on the accounting prices for benefits and costs [64]). The resource requirements would be totaled for the projects selected in each sector and these totals compared with those given by the sectoral plan. Since the two totals very likely would be different, some adjustments would have to be made. The third stage consists of revising the sectoral plans in order to adjust the

---

[64] See Tryon and Cookson, 1966, parts IV and V.

balance of domestic production and imports and of revising the accounting prices. The prices must be reduced for inputs which are in surplus and raised for those whose supply is inadequate. This provides the information necessary to re-evaluate projects in the fourth stage. Presumably the projects selected on the basis of the revised accounting prices would require total resources which are closer to balancing the supplies calculated in the sectoral plans. Thus the process would be converging to a consistent set of project plans and sectoral plans. Further rounds would reduce the discrepancies between the two levels.

In theory this system would require accounting prices for all inputs to projects, and these prices should be found by a programming solution. As a practical matter, however, it might suffice to determine the accounting prices for only a limited number of inputs. The second ECAFE expert group suggested that the inputs for which accounting prices should be computed would "normally include capital, foreign exchange, different qualities of labour, and a few commodities."[65] Furthermore, the estimates of these accounting prices should be made by ad hoc methods giving approximate values. The remaining inputs should be valued at market prices.

---

[65] UN ECAFE, 1961, p. 18.

The system described here does provide the sort of connection which would be highly desirable between sectoral and project level planning. Unfortunately, practice is far from this ideal. As noted earlier, there is some question whether the system of planning by stages converges to a solution reasonably fast. If convergence were slow, the system would not operate satisfactorily. However, this question has never really been tested. There simply has been very little experience in applying the method.

Why should this situation exist? A great many reasons can be found. Some of them are problems of public administration and are beyond the inquiry of the economist. A few others can be presented here.

Perhaps the greatest difficulty to overcome is the almost universally poor quality of project analysis.[66] Without good project analysis, the system obviously cannot work. Good project analysis requires that benefits and costs be known with fair accuracy and that appropriate prices be known. It also requires technical skills on the part of the project evaluator. Finally, good project analysis requires an abundant supply of projects among which choice can be made.

---

[66]See Tryon and Cookson, 1966, and Tryon, 1966.

Of this set of requirements, the need for prices is perhaps the easiest to satisfy. The system described above relies heavily on the use of accounting prices. Accounting prices are certainly a useful concept, but the system should work without them, although not as well. Certainly careful project analysis based on market prices would be a great improvement over present practice in many underdeveloped countries. The most difficult problems seem to center on the other requirements. They are almost never met in an underdeveloped country. Projects are presented with sketchy knowledge of benefits and costs; few officials are trained in project evaluation; and a real stock of projects among which a choice can be made almost never exists.

On the sectoral planning end of the problem, the difficulties are perhaps not so great. The main problem seems to be data limitations. The necessary technical skills are usually available, and the need does not exist for a supply similar to the supply of projects.

A somewhat different factor that probably contributes to the failure to use the linking system described above is the fact that the system is really appropriate for only certain types of projects. Its use requires the estimation of benefits and costs on a basis which permits comparison among all projects. This requirement rules out health, education, and similar projects which do not have an output which can be

valued. Serious valuation problems also arise for water resource, transportation, and similar projects which may have revenues which are quite different from their value to society. Thus a large share of public projects cannot really be satisfactorily fitted into a system which depends on prices to lead to the appropriate selection of projects. With such a large share of public projects not susceptible to this type of analysis, it is not surprising that government officials would have small interest in applying it where it is appropriate.

Since a large share of public projects do not have an output which can be valued satisfactorily, the question naturally arises, how can such projects be linked to sectoral and aggregative planning. Lacking a measure of the value of output, there is in theory no way that this link can be established. In practice, however, the planning of these sectors can be fitted into the stage system quite satisfactorily. The only difference is that the allocation of resources to the sectors which do not have value measures of output must be performed on a judgment basis. Within such sectors, the choice of projects can be made on the basis of least cost once the goals have been established. Adjustments to make the planned projects consistent with the sectoral and aggregative plans should be made by either adjusting the projects chosen or altering the targets. There can be no changes in projects on the basis of changes in

social profitability; but where the removal or addition of projects is necessary, it must be done on the basis of expert judgment. Thus we find that individual judgment is the key to allocation of a large share of publicly expended resources. The judgment can be exercised in stages, and the planning for these sectors fits into the stage system of planning. It is well to recognize that it is expert judgment which is the basis for these decisions and not impersonal valuations reflecting the tastes of society.

3. Relating Project Planning Data to Sectoral Planning

The third subject to be considered is the practical problem of translating project data into a form that fits into sectoral and aggregative analysis. The examination in Part III of sectoral planning techniques revealed a bewildering assortment of sectors that are used for analytical purposes. Furthermore, as was shown in Part II, the sectors which are used for assigning project planning responsibility need not match any particular set of sectors which would be useful for analysis purposes. It is clear that some means must be available to translate the project planning data into data that can be used for different types of sectoral planning. Without such a device the connection between the two levels of planning cannot be made.

What sort of device is needed for this purpose? Basically the problem is one of classification. The expenditure and other data for a given project must be classified in ways that permit aggregation of different sorts.

A suitable classification system would permit details of a project to be assigned to some sector for each sectoral breakdown used. For illustration, assume that analysis requires the following sectoral breakdowns: (1) public-private; (2) industrial-sectors (including sectors for intermediate and final demands); (3) domestic-foreign; (4) consumption-investment; and (5) regions. Each project would include data, by time period, on all inputs and outputs. The inputs would give details such as investment goods, labor, raw materials, etc., and outputs would include detail on products and end uses. With this amount of detail each item would be classified into some sector for each sectoral breakdown. Let us now see how a project to erect a private cement plant might have its data classified. (The following classifications are hypothetical; a cement plant could have different classifications for some items, depending on the particular circumstances.)

Public-private:	All inputs and outputs private; none public.
Industrial:	Raw materials from various industries; investment input from investment goods industries; wages, taxes, capital consumption, etc., in cement industry; outputs to various industries and final demand.
Domestic-foreign:	All inputs except capital domestic; capital input foreign; all output to domestic, with no exports.
Consumption-investment:	Output only, divided between consumption and investment, depending on actual use.
Regions:	All inputs and outputs assigned to region where plant is located; sales assigned to regions where sales take place.

The cement example is fairly straightforward and uncomplicated. Other kinds of projects, however, will provide a great many problems, many of which can only be handled arbitrarily. Water resource projects, for example, are likely to be particularly difficult. They may be multi-purpose, with outputs such as power, irrigation, flood control, navigation, and recreation. Valuation of these outputs is often completely arbitrary. One solution is to divide costs between the five classes in whatever seems to be an appropriate way and then equate output to cost. As noted earlier, this may be unsatisfactory for some types of analysis.

In addition to the sort of difficulty noted in the previous paragraph, there is the problem of covering sectors where project data are lacking or incomplete. This would typically be the case for sectors which are predominantly private. Unless surveys were conducted which yielded the necessary information or the data were submitted for license or credit purposes, detailed data for private projects would generally be missing.

The problem of the absence of project data is a crucial one. If significant gaps in project data exist for a particular sector, quite obviously it is not possible to tell whether aggregate resources allocated to the sector are equal to the requirements determined by individual projects or whether projected sectoral output and the outputs of projects will be equal. The data gaps thus effectively break the link between project planning and sectoral planning.

One solution to the data gap problem is to estimate the missing pieces, at least in aggregate, for each sector. If this is done independently of the projects actually planned for the sector, many of the tests for consistency will still be valid. If it is done by residual, however, most consistency tests would be met automatically and it would be pointless to make them.

Why is it so desirable to be able to perform analyses using a number of different sectoral breakdowns? Throughout this paper the point has been stressed that no single way of looking at the economy will be sufficient for development planning purposes. An integrated plan, one containing both a sectoral-aggregative plan and a set of sectoral project plans, can be consistent from one point of view but be seriously unbalanced from some other. For example, it may be completely consistent in its consumption-savings and balance of payments implications and yet be seriously out of line for regions of the country. In order to analyze a plan from different points of view, projections must be made for a number of different sets of sectors; and these projections must all be examined for consistency and reasonableness. Relying on only one or two types of sectoral analysis inevitably means that the inconsistencies that would be revealed by other types of analysis will be ignored, and these inconsistencies can be of considerable importance.

The Pakistan plan for 1965-70 is a good example of the sort of analysis suggested in the previous paragraph. In this plan the following sectoral analyses of investment are presented.[67]

---

[67] Government of Pakistan, Outline of the Third Five-Year Plan (1965-70), August, 1964, pp. 36-41.

Public-Private

Economic sectors (agriculture, mining, etc.)

East and West Pakistan

Three cross-classifications (the three possible pairs of the one-way classifications)

Each of these reflects some potential problem for the Pakistan economy which might not have been apparent if, for example, only the economic-sector breakdown had been undertaken.

The need to be able to undertake several different types of analysis underscores the need to be able to reclassify project data readily. Without the means for reclassifying project data, the sectoral data will have to be rough estimates. More important, unless the sort of reclassification described above can be accomplished, the connection between sectoral analysis and project planning will be lost except for the original classification. Thus we return to the point made earlier that a good classification system is needed in order to make a strong connection between sectoral analysis and project planning.

The classification system which has been outlined here is in many respects a descendant of program and performance budgeting. Abraham[68] has shown the development of annual budgeting from the conventional or administrative budget to the program budget and the performance budget. He discusses the next logical step, a comprehensive economic-functional classification system that would provide much of the data for classifying public expenditures into the sorts of sectors needed for economic analysis.

The basic ideas for presenting projects so that they can be classified for sectoral analysis purposes are straightforward. However, the reluctance of government officials to accept program and performance budgeting[69] suggests that similar resistance may be met when an elaborate system of cross-classification is added to the requirements of project presentation. The situation for project planning is perhaps not quite the same as for annual budgeting since in most countries project presentation is of very poor quality by comparison with annual administrative budgets. Perhaps in the process of improving standards of project presentation, the necessary cross-classification systems could be painlessly introduced.

---

[68]Abraham, William I., Annual Budgeting and Development Planning, Planning Methods Series No. 1, Center for Development Planning, National Planning Association, Washington, D. C., 1965.

[69]Ibid.

4. Assignment of Responsibility for Planning Tasks Among Planning Authorities

The last subject to be discussed is how the planning tasks that have been mentioned earlier should be assigned among the various planning authorities of a country. This subject is basically a problem of public administration and, as such, is outside the central interest of this paper. However, it is critical to the practical operation of any system which attempts to link sectoral project planning and sectoral-aggregative analysis. A brief discussion is included here.

The principal tasks to be performed within the planning system are given below. They have been presented earlier in the discussion of planning by stages; hence, they are repeated here without elaboration.

1. Draw up an aggregative plan to establish overall growth goals and resource constraints.

2. Draw up comprehensive plans for the economy on the basis of several different sets of sectors.

3. Draw up a supply of feasible projects from which the projects to be executed can be selected.

4. Make selections of projects for execution and assemble them into sectoral project plans.

5. Test the sectoral project plans and the aggregative-sectoral plans against one another for consistency and reasonableness and, to the extent possible, for feasibility.

6. (a) Re-do steps 1 and 2, adjusting the aggregative-sectoral plans as necessary to the sectoral project plans, and

(b) re-do step 4, adjusting the sectoral project plans to the aggregative-sectoral plans.

The nature of tasks 1 and 2 are such that they clearly should be the responsibility of the central planning office. The central planning office may require considerable assistance from the operating agencies, even to the extent of borrowing personnel. The aggregative-sectoral plans are the essential ingredients of the so-called "plan frame" which is to be given to the planners responsible for drawing up project sectoral plans.

The third and fourth tasks produce the project-sectoral plans. Wherever the planning of projects is involved, there is an overriding need for the operating agencies responsible for executing the projects to participate to the maximum extent possible in planning them. This need stems from the very human characteristic of government officials to be motivated to carry out plans that they themselves have helped draw up. When they are not part of the planning phase, these officials

are far more likely to drag their feet and do a poor job of carrying out the plan. The involvement of the agencies responsible for executing projects should be at as many points of the planning process as is practical: conceiving projects, shaping them, working them up for presentation, defending them in comparisons among projects and, finally, selecting projects for execution. Clearly, the operating agencies cannot be given final responsibility for all of these phases of project planning; yet, the more responsibility they can assume, the more likely the successful completion of projects.

The need for the participation of operating agencies in the project planning activities suggests that it would be highly desirable to assign the responsibility for drawing up sectoral project plans to the operating agencies which correspond to planning sectors. This proposal is highly desirable where it can be implemented, but there are unfortunately a number of obstacles to its implementation. The most important are the fact that operating agencies are seldom organized along lines suitable for project planning and the lack of competence in planning at the operating agency level.

The difficulty of matching a sector with a suitable operating agency is well illustrated by the position of agriculture in the Philippines. Acceptance of agriculture as a sector for planning projects is

practically universal. One would expect that it would naturally be the responsibility of the Department of Agriculture and Natural Resources. However, this was not the case in 1965. The reason was simply that there were over forty agencies engaged in activities related to agriculture, and less than half of them were subject to the authority of the Secretary of Agriculture and Natural Resources. The picture was practically the same in terms of expenditures related to agricultural development. Under these conditions it is not surprising to find that the plan being developed for agriculture came from the central planning body (the Program Implementation Agency) and not the Department of Agriculture and Natural Resources.

The treatment of agriculture in the Philippines illustrates one response to the problem; i.e., to retain the responsibility for drawing up a sectoral-project plan in the central planning agency. The treatment of public works in the Philippines neatly illustrates another quite different response; i.e., to define the sector to fit the organization. The Department of Public Works in the Philippines is responsible for all construction undertaken by the national government. In 1965 this department happened to have a well organized planning staff which had a backlog of projects. It was a simple matter to assemble these into a logical plan of projects for the "public works sector." Thus the sectoral

project plan was essentially the project plan for the one department, Public Works.

These agriculture and public works cases happen also to illustrate a second reason why the operating agencies often cannot assume responsibility for the sectoral project plans: lack of trained personnel. The Department of Public Works in the Philippines had an organized planning unit which was staffed with some people trained in project planning. Although the Program Implementation Agency closely supervised the work of this group, the final product was clearly that of the Department of Public Works. The Department of Agriculture and Natural Resources, on the other hand, had no such planning unit and would have had difficulty in staffing such a unit from its own resources. It is not surprising that the P.I.A. was obliged to do the bulk of the work in assembling the agriculture sector's project plan.

The organizational and personnel problems, noted here, are common to practically all less developed countries. They point up the need for reorganization of many government activities and the need for training programs to provide qualified personnel. Of the two, the training problem seems to be the more tractable solution. Training programs to teach project planning techniques or, more broadly, to provide government officials with an understanding of economic development have

been organized in a number of places. In time the shortage of development planners should be eased, and attitudes of responsible officials should become sympathetic to the sort of work needed to undertake successful planning.

On the other hand, the reorganization of government activities seems to be an exceedingly slow process. Many factors besides development planning must be considered in reorganizations, and the problem cannot be considered solely in terms of planning. However, the planning needs can often be met within organizational structures which are designed simply to provide adequate executive control. If government activities can be organized into a relatively small number of logical operating departments, these departments can serve well as the basis for sectoral-project plans. All that is needed is an effective means for translating the plans of these departments into the sort of information which the central planning authority requires for its planning activities. The classification system discussed in the previous section is such a device. The real difficulty is not accommodating the planning within departments organized along noneconomic lines to the needs of the central planning agency. Rather, it is the problem of trying to delegate planning responsibilities to a large number of small, quasi-autonomous government agencies. Practically all less developed countries--and

many developed ones--suffer from this problem, and progress on it seems slow.

After this brief digression on organization and training, let us return to the subject of assignment of responsibility for the planning tasks listed above. For the remainder of the discussion, it will be assumed that the sectoral project plans are compiled by operating departments, i.e., at the desirable level, uncomplicated by organizational problems and shortages of trained personnel. The last two tasks are to make the consistency checks between the aggregative-sectoral plans and the project level sectoral plans and the adjustment of both types of plans to each other. The responsibility for the consistency checks must lie with the central planning office. It is the only planning agency which can take the sort of over-view of the economy necessary to make these checks.

On the other hand, the adjustment of the various plans to each other will have to be accomplished cooperatively by the central planning office and the operating agencies. One proposed way to accomplish this step is for the central planning office to revise the accounting prices for capital and other resources and let the sectoral planning agencies adjust the sectoral project plans on the basis of these prices. This system can work only for projects which are selected on the basis of some sort of

social profitability criterion. As we have seen earlier, only industrial and some agricultural projects are suitable for this type of selection procedure. Hence, most of the adjustments will be a matter of give-and-take, based on best judgment. The central planning office will have to have final responsibility for the adjustments, but it can only make its decisions by knowing what a cut in one sector or an addition in another will produce in terms of projects dropped, postponed, added, etc. This sort of information can be developed only by close cooperation between the central planning office and the planning offices that have drawn up the sectoral plans of projects.

The discussion of part IV has proceeded with few references to planning for regions. For very small countries, the country can be properly treated as a whole. However, a country need not be very large before regional distinctions become important and must be introduced into development planning. Regions will affect planning procedures in two ways. First, some sort of sectoral analysis will be needed where the sectors are defined on a regional basis. Conceptually this introduces no serious problem, but it is, of course, an additional type of analysis which the central planning agency will have to undertake. Second, there may be regional planning agencies of various sorts which must be integrated into the entire planning system. Again, there is no

conceptual problem in bringing the regional planning agencies into the system. However, there are inevitably many practical problems. These range from the physical separation of most regional agencies from the central planning office to the fact that many regional agencies represent levels of government other than the national. A high degree of cooperation between the agencies involved is required to overcome these handicaps. Unfortunately, in most actual situations, cooperation is not sufficient to provide reasonable coordination between regional and national levels of planning.