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THE ROLE OF PRICES IN DEVELOPMENT PLANNING DECISIONS

by

Bruce Edwards

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September, 1965

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Traditionally, the role money and market prices play in the development and allocation of resources has been at the center of the subject matter of economics. Money was assumed to serve both as a medium of exchange and as a standard of value. The value of a good, expressed in monetary equivalents, was its price.

Recently, however, it is no longer unusual to encounter papers and discussions concerned with economic development which pay little, if any, attention to money or to existing market prices for goods and services. The substance of such analyses is expressed in terms of physical quantities or similar equivalents. Any references to the market tend to treat it as an instrument to be manipulated for other ends or as an unwelcome hindrance to be overcome. The mere existence of a development plan is itself tantamount to the rejection of existing market forces as a sufficient guide to developing the economy. Although contemporary plans differ in practice in the extent of their reliance on traditional market forces, it is recognized that the extent of such reliance is subject to conscious choice rather than being one of the uncontrollable givens.

It is important to comprehend the broad significance of this paradox. This study originated as an investigation of the appropriate role of price policy within the development planning process. It soon became apparent, however, that there was little agreement on what the price system in a mixed economy was supposed to do, let alone disputes over how it should function to achieve those ends. Before the state of the art could be surveyed, the various underlying concepts had to be arranged in some suitable order.

This paper attempts to introduce such an order and to provide some rough guidelines into the literature. On some questions a survey of the state of the art is primarily a bridge between literature on development planning and

development policy in practice. In this case, however, the bridge is triangular. Basic price theory and price concepts which were evolved outside of the development field permeate both the development literature and applied development policy. In many cases the relationships are accepted so readily that no conscious effort is made to evaluate them explicitly in an organized fashion. Hence, even though our main interest is in development planning practice, the most reliable reference points are frequently found in the general literature on economic theory.

In the past, data on market prices have served two different roles. In the first role, existing price series for inputs were combined with quantity series to produce a measure of the past flow of real incomes through the society and as a basis for expectations of future patterns of distribution. In the second role, past prices were used as indicators of the expected future relative value of goods - values which were then accepted as governing guides to efficient allocation of resources. Failure to distinguish between these two roles is at the root of the price paradox and has significantly contributed to the problems which we will be investigating.

The source of the difficulty is that two different functions are performed by a single entity - money. Its primary role has been, and is, as a medium of exchange. In this role it is half of every transaction which takes place in a money-using economy. Its secondary role evolved as it became common to express the value of an object in terms of its monetary equivalent or price.

However, money has not always been an acceptable measure of value since the value of money may keep changing. This has had two secondary effects. Monetary policy has become a function of the state and money management an

instrument of social policy. Meanwhile, the fluctuations in the historical series on observed market prices has led to a concept of constant prices and a literature on how to construct them.

The development of constant price concepts is but one step in the separation of price and value theory from the analysis of market prices. The accountants have developed valuation techniques for items which never enter into observable free market transactions, and economic theorists found relative prices useful even though conceptually they are more relevant to barter economies than to money-using market economies.

As the production units have become larger, the non-market approach to decision making and the engineer's perception of managerial restraints have come closer together. As a result, techniques have been created for handling very large projects. The initial separation of decision-making theory from market theory turned into a full-fledged divorce about the time of World War II.

With value theory following an independent path, market analysis has turned towards a more realistic approach to the market. Monopolistic imperfections have been recognized and incorporated into the theoretical framework. Issues of market policy assume the ability to affect price rather than accepting prices as given data. Problems in monopoly regulation are increasingly phrased in terms which all but abandon perfectly competitive norms in selected fields.

The implications of abandoning a laissez-faire approach to markets are more extensive than is usually realized. Laissez-faire is one of the key simplifications in the first course in principles; and after many years of studying and experience, such basic assumptions, even though greatly modified, persist in our subconscious. Dropping the laissez-faire assumptions creates a very strong potential role for market price policy. This can be most easily, though less rigorously, shown in a micro-economic context.

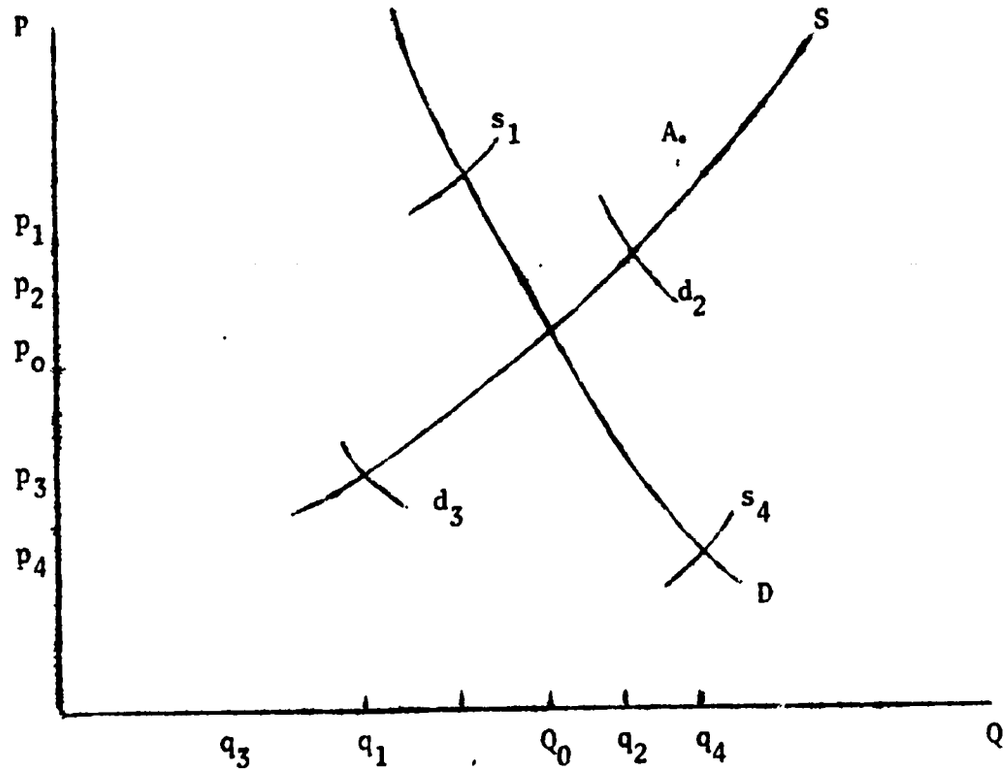

FIGURE 1

Figure I is a conventional price-quantity diagram. The demand curve, D, is defined in terms of quantities which can be sold in the market rather than in terms of utility, intrinsic value, or purely competitive equilibrium. In a like fashion the supply curve, S, indicates the quantities which will be offered for sale at each of the prices. It presumably is related to the cost of production and scarcity of resources, but we carefully avoid including such considerations in the definition. Thus, these curves represent a model of market behavior rather than a model concerned with efficient decision making. By conventional analysis the price will be P_0 and the quantity bought and sold will be Q_0.

We assume there is at least one organization operating in the market which is large enough or influential enough to affect the market by independent action.[1/] If this organization is a buyer, it can reduce its willingness to purchase so that the governing demand curve becomes d_3 or it can offer to increase its purchases so that the governing demand curve becomes d_2. A selling organization can reduce the quantities it makes available to the market so that effective supply is at s_1, or it can flood the market so that supply is at s_4.[2/] To the extent the supply decisions are private, but affected by costs, a government can indirectly influence them by taxes (shifting S towards s_1) or subsidies (shifting S towards s_4). Similar results may be possible within large corporations which have some discretion over how indirect costs are assessed against subsidiary producing and marketing units.

Treating P_0Q_0 as a reference point, by choosing the correct policy (from among those that can be implemented) the price and quantity in the market can be manipulated independently of each other. For example, take any arbitrarily chosen price-quantity combination, A, in the diagram. At a glance we see that for this to be a market-clearing combination it will be necessary to cause a large increase in effective demand and a modest reduction in supply.

Using this same simple diagram we can briefly consider three cases, each involving a different interpretation. In case I, the S and D curves represent what supply and demand would be in a purely competitive economy. In this case,

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1/ This obviously is only one of several possible ways of dropping the key assumption that the market is perfectly competitive.

2/ In each case the options have been drawn so that the curves were shifted without changing their shape. This is a convenience only. Most policies will also affect the shape of the curve. This will not make the theoretical issues any more difficult.

monopolistic behavior might be represented by s_1 or by a horizontal supply curve at price P_1, at least out to supply curve S. Curve s_4 might represent dumping or cutthroat competition. Curve d_3 could be a partial boycott or monopsonistic behavior and d_2, a program of price supports designed to expand the gross income of suppliers. All of these represent deviations from perfect competition.

In case II, we assume that one or more of the above shifts has previously taken place and has been incorporated into expected typical market behavior. Thus, the S and D curves, since they pertain to existing conditions, no longer represent the competitive norm. In this case shifts such as are represented by s_1, d_2, d_3, and s_4 can be instituted or encouraged as public policy in order to achieve the theoretical competitive norm. Such shifts may take the form of countervailing power in which labor unions are justified as offsets to monopsomy power of corporate employers, or cutthroat competition in an industry is replaced by cartelization, or a program of public regulation.

Finally, in case III it is recognized that the first two cases are special examples of a general possibility of introducing artificial demands and supplies for any objective of social policy. Thus, the shift may be initiated directly in the name of the society to promote other social goals, such as an equitable distribution of income and wealth, a rapidly expanding industrial capacity, national self-sufficiency, etc.

In the third case the shifts necessarily come from using non-commercial criteria. Governmental programs which increase quantities moved will typically cause a drain on the public treasury as costs rise and the use value of the marginal output falls. Other programs which decrease the quantities bought and sold may provide funds for the treasury as high cost production is abandoned

and the reduced output is rationed among the most critical users at higher prices. If the entire system is to be in some sort of balance, some sectors will be expanded as others are contracted. Hence, the funds produced in one sector will partially offset the losses in one of the other sectors. Since there will also be real costs of engaging in market activity, presumably there will be an overall net deficit which must be financed out of general tax revenue if inflation is to be avoided. This net expense is the cost to the society of carrying out the desired social goals. Presumably the cost is less than the expected benefit, or the market activity would be abandoned.

The arguments against such a program are usually based on an assumption that market participants are neutral regarding income effects on other parties or on an assumption that at a zero administrative cost income redistribution could be carried out by direct transfers financed from an income tax. In practice, a full-cost calculation might easily show that market intervention is the most efficient (lowest real cost) program of redistribution.[1/]

In none of these three cases was the shift dependent on a change in the perceived physical usefulness or cost of the last unit bought or sold. On the contrary, there was always a conscious awareness that the change in offers to buy and sell would produce a change in price, revenue, and/or income distribution. In the first case the changes were introduced by groups seeking to promote their own benefits at the expense of others. In the second case the society permitted

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1/ An intriguing welfare question arises if the intervention program turns out to be a net revenue producer so that other taxes would have to be reduced to avoid a deflationary impact on the aggregate economy! This is quite possible. The Federal Reserve Banks usually earn a positive return on their stock even though they are not managed so as to maximize profits.

and/or encouraged similar tactics in defending disadvantaged groups while also serving to further the broad social goal of efficiency. In the third case the shift was introduced by an agent representing the society to carry out a broad social objective other than efficiency.[1/]

In the implicit comprehensive model behind this paper market prices may function as intermediate variables similar to intermediate goods. Both are manipulatable as means to accomplish other ends. In both cases there are restraints on what can be accomplished. The restraints on intermediate goods are primarily imposed by physical or engineering limitations. The restraints on market price manipulation arise from the ability of the autonomous buyers and sellers to act independently of plan directives.

Sometimes the market prices can be forced to reflect both the effective forces of supply and demand[2/] and the desired decision-making prices. Then the market will be a useful communication medium between the development planner and the operating units. When this is not the case, steps must be taken to isolate the decision-making process from the market mechanism. The assessment of market price policy within this context is complicated, important, and promising; but in further detail it is a topic for another paper.

1/ The adoption of other social goals does not arise from rejecting efficiency. It arises from rejecting laissez-faire and from refusing to perpetuate certain existing institutional patterns. This permits the society to pursue other social goals simultaneously. The society now seeks to promote social progress efficiently rather than to perpetuate the status quo efficiently. The concept of efficiency is uniquely definable only in connection with other objectives.

2/ A clear distinction should be made between effective and natural market forces. Many artificial programs of subsidized costs or artificial demands are effective in controlling market prices.

The existence of two disconnected ideas with the same name, "price," is very inconvenient. We will refer to them respectively as decision-making prices[1/] and market prices. The refusal to have a blind faith in free market forces[2/] and the recognition of market policy as a potentially important intermediate variable has greatly tamed the wild sovereignty of the existing price system. Caution is necessary to avoid going so far as to abolish this essential and useful tool. While intentioned abandonment of price policy is unlikely, it may indirectly result from a failure to realize how pervasive the effects of the market price system are and how complicated a task it is to control it.

1/ We are not completely happy about introducing a new term when there are two close substitutes extant. The concept of shadow prices was developed in connection with the mathematical dual of the problem of directly programming physical activities. Conceptually it is closely related to the market prices concept in perfectly competitive models. The second alternative is accounting price. As used by Papanek and Qureshi, it is almost a perfect synonym for our term decision-making price. It should be emphasised that in this usage there is no necessary connection between the concept of accounting prices and the standards of accepted accountancy practice in the developed countries. To avoid this danger we have used the term decision-making price, implying only that this price has been accepted as the correct one for purposes of making decisions. How such prices are determined is an extremely important question of technique, but the issues involved are intentionally excluded from the definition. For shadow prices see R. Dorfman, P. A. Samuelson, and R. M. Solow, Linear Programming and Economic Analysis, McGraw Hill Book Co., Inc., New York, 1958. On accounting prices see G. F. Papanek and M. A. Qureshi, "The Use of Accounting Prices in Planning," Organization, Planning and Programming for Economic Development, Science, Technology and Development. United States Papers. Prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas. Vol. VIII, page 95 ff. See also, A. Qayum, Theory and Policy of Accounting Prices, Amsterdam: North Holland Publishing Co., 1960, for a discussion of different types of accounting prices and various issues which arise in estimating them directly.

2/ This rejection permeates the literature, usually in a mild form. For some examples see E. C. Higgins, Economic Development, Chapter 17; Meier, Leading Issues in Development Economics, Part VIII.

It has been widely recognized that in a free market system the selection of final goods, the relative prices of final goods, the prices of factors, and the distribution of income within the society are all mutually interdependent. What is not quite so obvious is that this interdependence persists when parts of the freedom in the market system are rejected. The rejection of historical market forces at least allows the rejection of market-determined output patterns, market-determined prices for final goods, market-determined factor prices, and/or market-determined income distributions.[1/] In most cases consistency conditions will require the rejection of many components in each of these areas.

Moreover, what is rejected is not a single price or a single physical output projection but a complex multi-variable pattern. This introduces multi-dimensional opportunities for setting targets on an essentially unrestrained basis,[2/] and a system is needed for setting relative values on the various targets. Historically, a basic function of the theoretical price system which was assumed to consist of decision-making prices was to reduce otherwise incommensurable variables into comparable additive value equivalents by relying on choice expressed in markets. The modern development planner must still provide

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1/ For example, see J. M. Henderson and R. E. Quandt, Microeconomic Theory, New York; McGraw-Hill Book Co., Inc., 1958, page 219. "The fundamental difficulty of compensation principles is that they refer to potential, rather than actual, welfare since they do not require that compensation actually be paid. In general, nothing can be said about the social preferability of A over B in the absence of actual compensation unless one is willing to make additional value judgments."

2/ The opportunities are multi-dimensional but not so numerous as the variables in the system. Much of the interdependence remains but not enough to define a unique efficient system.

for this basic function but has more freedom in choosing how it is to be fulfilled.[1/]

The rejection of the free market mechanism has transformed the relevance of historical prices for this purpose. We now have some confidence that the set of historical prices is the one group which should not be used since they would be expected (unless there is explicit evidence to the contrary) to encourage a pattern of economic stagnation which has already been condemned as unsatisfactory.

In classical economic theory, the consumer had a wide range of choices in which he was guided by internal hunches and preferences. The modern development planner has an equally broad range of quite different options. He may fail to realize this because he has accepted as inescapable restraints certain conditions which he can and must consciously reject. Such action will not permit the impossible, but it should open new options for maneuver and compromise in removing non-economic (e.g., political or cultural) obstacles to economic development.

While recognition of these new options broadens the opportunities open to the development planner, it also greatly complicates the task of identifying both the actual restraints on his actions and the true policy choices remaining open to him. This paper is an attempt to make a first step in bringing these general theoretical propositions into a form which is operationally useful

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1/ On the problem of making such measurements see A. Pepelasis, L. Mears, and I. Adelman, Economic Development Analysis and Case Studies, (New York: Harper & Brothers), 1961, pp. 11 ff. Their discussion of the difficulties of measuring degrees of development builds on the pioneering work by M. Gilbert and I. G. Kravis, "Empirical Problems in International Comparisons of National Product," Income and Wealth, International Association for Research in Income and Wealth, Series III, London, 1955.

to the development planner.[1/]

Many of the decisions made by development planners can be made within a micro-economic framework using essentially micro-economic techniques. Furthermore, many of the preliminary or subordinate planning operations lend themselves to treatment with micro tools. However, the rationale for such procedures can be adequately developed only in some sort of general equilibrium context. Unfortunately, the general equilibrium models which underlie most such discussions rapidly become quite complex.

In Part I of this paper a theoretical model is developed in a general equilibrium context. Some readers may be primarily interested in the policy implications. If they can accept unfamiliar economic principles without rigorous proof, they might merely skim the first section for vocabulary and concepts. They then can proceed to the discussion of policy principles which is in Part II.

1/ Few, if any, of the results in this paper are completely new although they are not all readily accessible. For example, one problem is the choice between current consumption and saving to provide for expanded future consumption. S. Chakravarty, in a recent article, "The Essence of an Optimum Savings Program," Econometrica, Vol. XXX, Number 1, January, 1962, begins his conclusion as follows:
"The upshot of the above discussion has been to indicate that the various optimal infinite programs that have been discussed in the literature suffer from either an improper formulation which may render the solutions economically irrelevant or from the restrictiveness that arises from crucial dependences on certain arbitrary assumptions. A functional criterion such as Max $\int_0^\infty U dt$ does not impose any ordering on the policy space except in the sense of pointwise dominance because, with the usual qualitative specifications on the admissible utility and production functions, the integral does not converge, and thus the results obtained from this procedure in these cases are not economically meaningful."
Some readers will not instantaneously recognize the significance of these conclusions nor, if they read the article, would they easily see why the conclusions followed. It is primarily such people to whom this paper is addressed.

It includes references both to the theoretical model and to the institutional environment surrounding actual decision-making in development planning.

PART I: THE THEORETICAL FRAMEWORK

The theoretical details in this part will be most useful on a second reading of the paper or for those who prefer to resolve all theoretical issues before embarking on policy discussions. The model developed here and used as a basis for the policy discussion in Part II makes use of a linear programming framework. The exposition will proceed simultaneously in three different modes: verbal, graphical, and with algebraic inequalities. Although the linear programming type model being used is not inherently difficult, it will be somewhat unfamiliar to many readers. For this reason we begin by establishing certain basic concepts within a two-product, two-factor model. After this review the necessary complications in technique are gradually introduced as the analysis becomes more detailed.

A useful first step in simplifying the model is to abstract from all intermediate goods.[1/] Thus, these models include only factors, each of which is assumed to be in fixed supply and final goods which can be produced with these factors.

A second simplification used throughout most of the analysis is to deal with only two products, product X and product Y. No claim is made that this

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1/ This can be done simply as an assumtion, although where the production function in a model is precisely stated, it is frequently possible to specify how the effects of the intermediate goods can be eliminated. For the distinction between factors, intermediate goods and final goods or targets as used in this paper, see page 51.

is realistic. It is adopted primarily as a device which permits the use of simple two-dimensional graphs. Readers adept at handling the algebraic formulations should have little difficulty in extending the argument and finding the equivalent results for the multi-product case. The precise definition of a product is always a somewhat arbitrary invention. We have chosen to divide the entire output of a society into two groups of the same order of magnitude, product X and product Y.

A SIMPLE TWO-FACTOR, TWO-PRODUCT MODEL[1/]

In Figure II the amount of product Y produced in the society is measured on the vertical axis and the amount of product X is measured on the horizontal axis so that all points within the space represent conceivable combinations of total national output. In a like fashion, any conceivable output combination can be represented by a single point within the plane. Initially we can assume that there is a single factor, F_a, which is in short supply so that all other inputs are abundant and free. By assumption, if all of factor F_a is devoted to producing product Y, fifteen units of Y can be produced. At the other extreme, if there was no production of product Y and production of X was maximized, fifteen units of product X could be produced. Thus, the line F_a crosses the Y axis at Y = 15 and crosses the X axis at X = 15.

1/ Readers completely familiar with linear program models might easily skip this section. Besides a review of basic technique it covers two points: (1) the amount of a factor available in the economy is the unit in which that factor is measured and (2) the unit of value in the economy is the sum of the values of all of the factors.

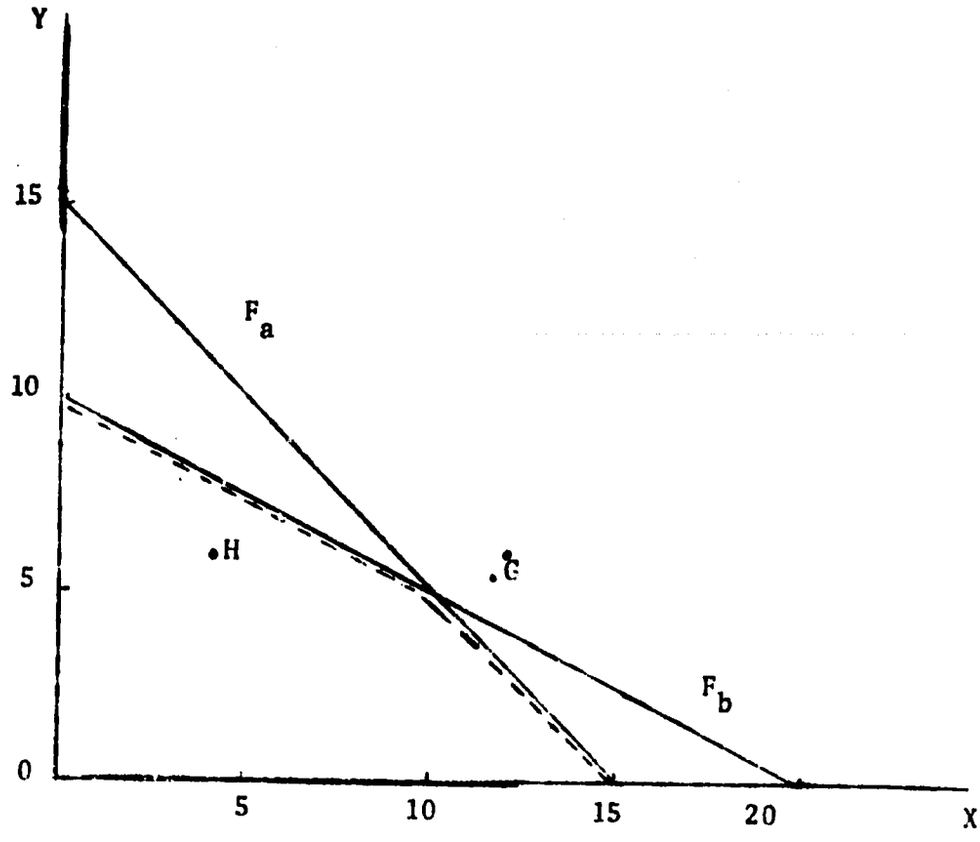

FIGURE II

Since the production functions have been assumed to be linear[1/] and all inputs are proportional to outputs, a straight line can be drawn between these two points and labelled F_a, as is shown in Figure II. Line F_a is a single-factor production possibility curve for the two-product economy. Production at a point upward and to the right of the line F_a, such as at point G, would be desirable but impossible,

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1/ The assumption of linearity can be relaxed somewhat by using more advanced mathematical notation (see the footnote on page .). Nevertheless, the argument can be rigorously developed only for a restricted class of production functions.

since there would be an inadequate supply of factor F_a. Production at a point within the triangle, such as at point H, would be possible but inefficient since it is possible to have more of both product X and product Y by moving out to the production frontier on the line itself. Until more information is given about the economy, any point on the line F_a can be regarded as efficient.

Turning now to a two-factor model, we assume, as an alternative, that factor F_a is so plentiful as to be a free resource but factor F_b is in short supply. If only product Y is produced, the total output would be ten units. In contrast product X is not so demanding of factor F_b; and if Y production is held to zero, twenty units of X could be produced. Following the same reasoning we used with factor F_a, we generate a different production frontier which runs from Y = 10 on the Y axis to X = 20 on the X axis. This line has been labelled F_b.

The combination of factor F_a and factor F_b produces a kinked production possibility curve convex to the origin[1/] with the kink occurring at the point Y = 5, X = 10. In output combinations involving more than five units of Y and less than ten units of X, factor F_b is the effective restraint; in output combinations involving less than five Y and more than ten X, factor F_a is the effective restraint. This is indicated by the dotted line in Figure II and by the combination of possible outputs given in Table I.

1/ Where there is more than one factor in the model, they are assumed to be complementary to each other so that no factor substitutability is possible. Where two items are perfect substitutes for each other in all uses, they, of course, constitute two examples of the same factor.

Table I: Possible Output Combinations in Figure II

X	0	2	4	6	8	10	11	12	13	14	15
Y	10	9	8	7	6	5	4	3	2	1	0

Factors F_a and F_b can be measured in any unit which we choose. It simplifies the explanation to use as a unit the total supply of a factor available. Therefore, the total supply of factor F_a will be equal to one, and the total supply of factor F_b will also be equal to one. The symbol D_{ax} indicates the amount of factor F_a used in producing product X. Since, if only product X is produced, fifteen units of X are possible, we infer that each unit of X demands one-fifteenth of a unit of factor F_a. Hence, $D_{ax} = \frac{1}{15} X$. In a like fashion, one-fifteenth of a unit is used for each unit of Y produced so that $D_{ay} = \frac{1}{15} Y$.

Turning our attention to factor F_b we find that each unit of product X requires one-twentieth of a unit of factor F_b and that each unit of product Y requires one-tenth of a unit of factor F_b. Thus, $D_{bx} = \frac{1}{20} \cdot X$ and $D_{by} = \frac{1}{10} \cdot Y$. Finally, we note that under-utilization of a resource, although undesirable, is possible but that over-utilization is by definition impossible. Combining these together we get the equation.

1.a) Factor F_a: $D_{ax} + D_{ay} = \frac{1}{15} \cdot X + \frac{1}{15} \cdot Y \leq 1$

1.b) Factor F_b: $D_{bx} + D_{by} = \frac{1}{20} \cdot X + \frac{1}{10} \cdot Y \leq 1$

We can now turn our attention to the question of a price system. The price of factor F_a, represented by symbol π_a, also is equal to the value of factor F_a within the society since the total available supply has been taken as the basic unit in which each factor is measured. In a similar fashion, π_b represents both the price of factor F_b and at the same time the value of the entire supply of the factor. It is well recognized that in a price system the basic unit of value may be arbitrarily specified. We will take the total supply of all factors as the basic unit of value so that:

2) π_a (Supply of A) + π_b (Supply of B) = $\pi_a + \pi_b = 1$

The value of the two products X and Y is equal to the value of the factors needed in order to produce these commodities. Since we have previously discussed the determination of these product-specific demands for factors, we have the following:

3.a) $V_x = \pi_a \cdot D_{ax} + \pi_b \cdot D_{bx} = \frac{x}{15} \cdot \pi_a + \frac{x}{20} \cdot \pi_b$

3.b) $V_y = \pi_a \cdot D_{ay} + \pi_b \cdot D_{by} = \frac{y}{15} \cdot \pi_a + \frac{y}{10} \cdot \pi_b$

Next we note that the price of an output is simply the value of the total output divided by the number of units and we have:

4.a) $P_x = \frac{1}{x} \cdot V_x = \frac{1}{15} \cdot \pi_a + \frac{1}{20} \cdot \pi_b$

4.b) $P_y = \frac{1}{y} \cdot V_y = \frac{1}{15} \cdot \pi_a + \frac{1}{10} \cdot \pi_b$

Equations (2), (4.a), and (4.b) combine to form a set of three equations in four unknowns. Eliminating two equations, two of these unknowns can be eliminated so that one of the remaining unknown prices is expressed as a function of the other remaining one. This can be done in a wide variety of ways and the end results summarized as follows:

5.a) $P_x = \frac{1}{20} + \frac{1}{60} \cdot \pi_a = \frac{1}{15} - \frac{1}{60} \pi_b = \frac{1}{10} - \frac{1}{2} P_y$

5.b) $P_y = \frac{1}{10} - \frac{1}{30} \pi_a = \frac{1}{15} + \frac{1}{30} \pi_b = \frac{1}{5} - 2 P_x$

5.c) $\pi_a = 1 - \pi_b = 60 P_x - 3 = 3 - 30 P_y$

5.d) $\pi_b = 1 - \pi_a = 4 - 60 P_x = 30 P_y - 2$

We can now return briefly to Figure I and see what these algebraic results mean in terms of verbal and graphical exposition. If the output of the society is designed to produce less than ten units of X and more than five units of product Y, then the production possibility frontier is determined by the line

F_b, representing the availability of factor F_b. Factor F_a is in excess supply and becomes a free good so that $\pi_a = 0$. Since factor F_b is the only scarce resource, $\pi_b = 1$. It then follows that $P_x = \frac{1}{20}$ and $P_y = \frac{1}{10} = 2(P_x)$. A unit of Y is deemed to be twice as valuable (i.e., twice as expensive) as a unit of X because it uses twice as much of the scarce resource factor F_b.

If the output is at a product mix involving more than ten units of X and less than five units of Y, the production possibility frontier is determined by the availability of factor F_a. Factor F_b becomes a free good, the price of $F_b = 0$ and the price of $F_a = 1$. As a result, $P_x = \frac{1}{15}$ and $P_y = \frac{1}{15} = P_x$.

If production takes place exactly on the kink so that $X = 10$ and $Y = 5$, it is likely that both factor A and factor B will be given a positive value. Depending on the particular relative values for the two factors which have been chosen, the price of X will be between .050 and .067 and the price of Y between .067 and .100. Alternatively, if the relative prices of product X and Y are set at a specific point within these ranges, it is possible to solve for the correct prices of factors F_a and F_b. It is on the corner, therefore, that the price system becomes somewhat indeterminate although the quantities are fixed. At points off the corners the price system becomes determinate, but the choice between outputs becomes indeterminate within a specified range. It is this interesting feature of the linear programming system which makes it attractive for certain economic problems; in the system as a whole both price relationships and the quantity mixes are variable; but as changes are made within the system, prices change only when the quantities are stable and quantities change only when the prices are stable rather than having everything in a constant state of flux. We turn now to the question of how the society decides where on the efficiency frontier it wishes to operate.

SOCIAL PREFERENCES AND INCOME DISTRIBUTION

We have started with the assumption that both product X and product Y were desirable and useful economic goods, and we have concentrated on the fact that there are certain limitations on how much of these goods can be produced. In this way we have developed in Figure II a simple production possibility frontier. We now turn our attention to a different question, the matter of relative importance. Aside from the question of what it can have, how does a society decide what it wants.

The most familiar approach to this question is to settle first the question of income distribution. When that has been settled, attention is focused on the marginal rate of substitution implicit in individual consumer preferences. Finally, the two are combined to give a set of social indifference curves indicating the preferences of the society as a whole. This approach will not be completely ignored here, but it will be introduced fairly late in the analysis for comparative purposes rather than being adopted as a first principle. A certain amount of confusion can be avoided if this break with tradition is explicitly recognized and understood from the beginning.

As an alternative to the use of a set of indifference curves, social preferences may be expressed simply as specific output targets. "We want six units of Y and twelve units of X" or "We want six units of Y and three units of X." In Figure II the first target is impossible, and the second would leave many resources unutilized. Since nothing is said about the second best alternatives, the entire system is undetermined. More information is needed.

A third alternative is the assumption that products X and Y are desired

in a fixed proportion.[1/] For illustrative purposes we assume that the proportion is nine to one, so that nine units of Y are desired in the society for each unit of X. This amounts to an assumption of strict complementarity in which there is no substitution between output X and output Y. In Figure III this has been illustrated by constructing a set of L-shaped indifference curves, I_{11}, I_{12}, I_{13}... etc. Consider a typical curve I_{15}, involving a three units of X and twenty-seven units of Y. The vertical arm of the curve asserts that if output of product X is held at three units, further increases in production of Y, above twenty-seven units, leave a recipient (i.e., the society) completely indifferent. Likewise, if the production of product Y is held at twenty-seven units, the horizontal part of curve I_{15} tells us that the recipient is completely indifferent to further increases in product X. Only by simultaneously increasing both product X and product Y can the society move to a higher indifference curve such as Y_{16}.

As long as both product X and product Y have positive prices, all price lines will be tangent to the indifference curves at the kink. For this reason the entire curve can be reduced to a single point and the entire set of curves to a set of points. Connecting these points forms a line, labelled U_1, which

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1/ The formal structure of this part of the model is similar to and indirectly owes much to an article by R. S. Eckaus, "The Factor Proportions Problem in Underdeveloped Areas," AER, Vol. XLV, No. 4, September, 1955. The Eckaus model varied the output mix by using different production processes and maximizing output. The model used here uses a variety of different income distributions. In this fashion there are several different output mixes each of which maximizes social welfare. The two models are developed along quite different lines, partially because of problems in measuring utility and welfare.

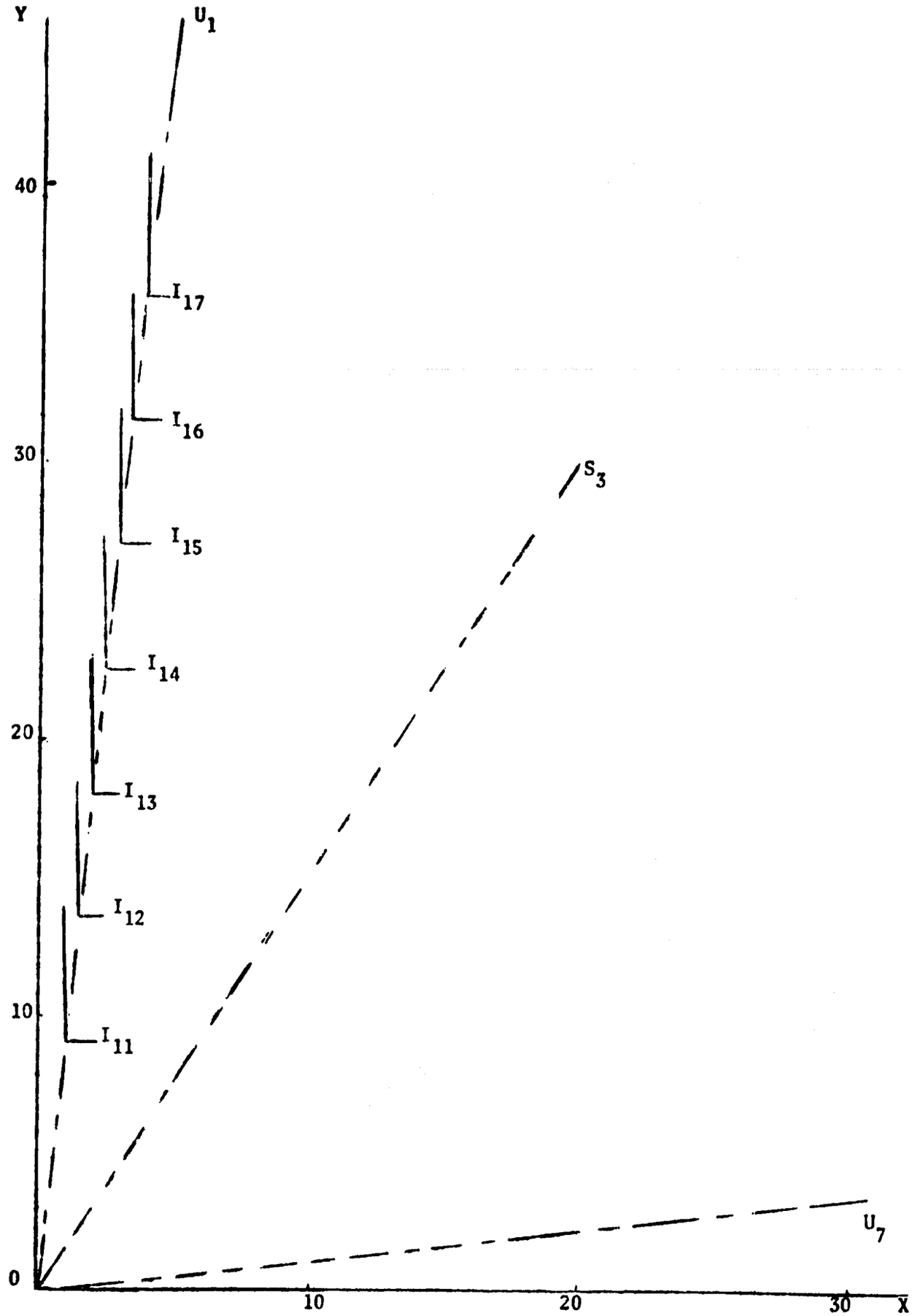

FIGURE III

represents the entire set of indifference curves.[1/]

We should note that the proportions as specified in U_1 are in no sense structural or restricted by physical limitations. They are strictly a matter of preference. For this reason there is no rational reason why the preferences might not be completely reversed so that the preferred proportions would be nine units of product X for every unit of product Y. Under this new assumption the complete procedure carried out for U_1 can be repeated and will result in a new line which has been represented in Figure III by the line U_7.

It is well to consider briefly the relationship between U_1 and U_7. The difference may or may not be a matter of income distribution. If U_1 were the dominating preference in a society, considerable income redistribution could take place without changing the total output mix. The new "haves" (who were the former "have nots") would move into the mansions, and the expropriated ex-elite would move into the slums. As long as both groups have the same set of tastes, the effects of redistribution of income will be confined to the question of who gets the benefits, although the nature of the benefits available in the society would not change.

1/ The assumption that the two products are demanded in a constant proportion means that U_1 will be a straight line which passes through the origin. These two characteristics are primarily a matter of convenience to simplify the exposition; the important assumption is that the underlying indifference curves have the L shape.
A line of the form U_1 should not be confused with either an indifference curve or a production curve. It is most similar to the contract curve in an Edgeworth box diagram. The principle is that the society wants to travel along the curve and prefers to get as far away from the origin in the diagram as possible. A similar construction is used in K. E. Boulding, "Welfare Economics," Survey of Contemporary Economics, ed. by B. F. Haley (Homewood, Illinois: Richard D. Irwin, Inc.) Vol. II, page 14.

In contrast, a shift from U_1 to U_7 amounts to a change in the national tastes. This conceivably could come about without involving a redistribution of benefits. As a result of some sweeping sociological or religious movement, all levels of society might simultaneously abandon old desires and habits and replace them by a new set of ideals. It is more likely, however, that the change in national tastes will occur because the increased incomes of one group enable them to demand effectively certain services and goods even though this means a sacrifice of items regarded as essential by the formerly dominant groups.

Whether the vectors U_1 and U_7 in Figure III include the impact of redistribution of benefits or whether we net these out so that the vectors represent only preferences as to the essential components of a good society,[1/] we can treat these two vectors as polar positions. If the first group were dominant, U_1 would represent the effective social preferences in the society. If the other group were dominant, U_7 would represent the effective social preferences.. Since both groups will likely have some influence, the effective

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1/ It is difficult to overemphasize the extent to which preference theory has assumed individuals are completely indifferent to the welfare of their fellowmen. Income distribution decisions have been assumed to be dictated only on the basis of increasing the direct benefits to the decision-makers at the expense of others. In addition, consumer market behavior presumably is governed entirely by considerations of which items the consumer prefers to have for his own personal use. We propose to abandon these narrow assumptions and assume that individuals have some conception of a desirable society, of what is good for other people. Psychologically it is closer to an attitude of paternalism than to one of altruism. At the level of pure theory we are tempted to pose the social preference question in terms so that each individual necessarily expected his own personal direct benefits to be completely unaffected by the overall social choice. On these terms the choice between U_1 and U_7, for example, would be entirely governed by what he thought would be good for other people. To keep the model from being subtly destroyed we assume that each voter has no way of determining what other people would prefer for themselves.

Table II: Relationship Between Illustrative Preference Vectors*

Preference Vector	One Unit X	Y	Equation	Weighted Average
U_1	1	9	$9x = y$	$U_1 + 0.U_7$
S_2	2	8	$8x = 2y$	$\frac{7}{8}U_1 + \frac{1}{8}U_7$
S_3	4	6	$6x = 4y$	$\frac{5}{8}U_1 + \frac{3}{8}U_7$
S_4	5	5	$5x = 5y$	$\frac{1}{2}U_1 + \frac{1}{2}U_7$
S_5	6	4	$4x = 6y$	$\frac{3}{8}U_1 + \frac{5}{8}U_7$
S_6	8	2	$2x = 8y$	$\frac{1}{8}U_1 + \frac{7}{8}U_7$
U_7	9	1	$x = 9y$	$0.U_1 + U_7$

* The representation of a social vector S as a weighted average of two polar vectors, U_1 and U_7, is not completely unique. The effect of the weights will depend somewhat on the basic units in which U_1 and U_7 are measured. We have chosen to define a unit on U_1 as consisting of one unit of product X and nine units of product Y; whereas, a unit on U_7 has nine units of product X and one unit of product Y. On this basis Table II has been constructed showing the relationship between the two polar vectors and five different social preference vectors, S_2 to S_6. The last column in the table shows the weights used in this particular example.

preference will lie in between, such as at S_3 in Figure III.

Depending on the relative strength of the two polar positions, the governing social preference vector will be closer to U_1 or U_7. Table II presents five illustrative combined vectors, as well as the two polar positions. Although they serve only as an example, they are the same vectors which are used later in the analysis of the seven-factor model.

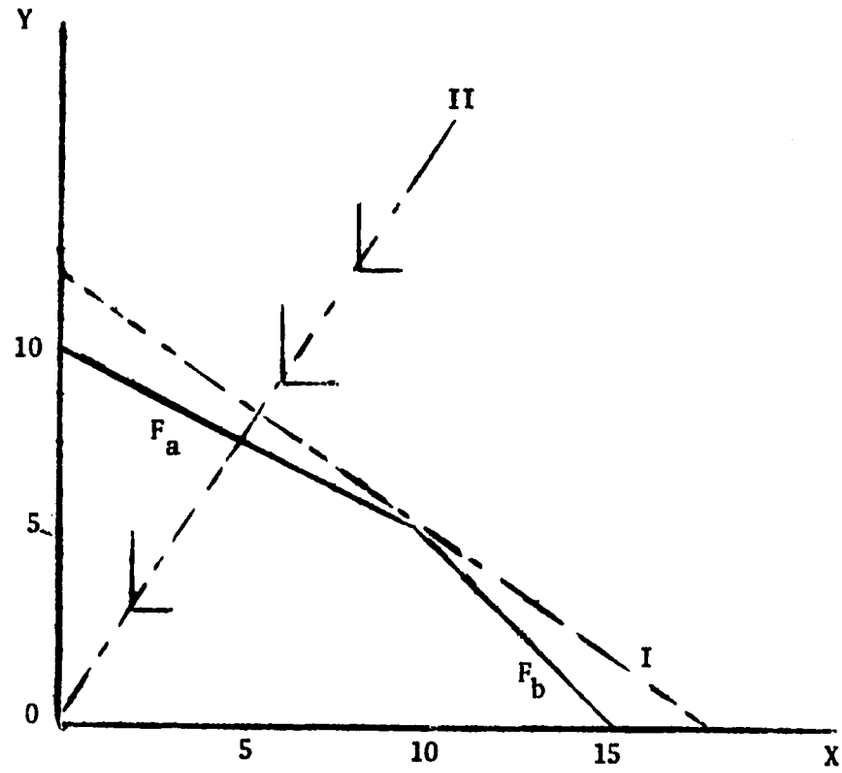

FIGURE IV

Before leaving the topic of social preference functions we might compare the assumptions which have been made here with those which are more usual in this type of analysis. Figure IV shows a simple two-factor production possibility

function relating outputs X and Y. In the usual analysis the kink in the production possibility curve will determine the outputs of good X and good Y. Through that point a variety of price lines can be passed, one of which is indicated by the dashed line I. This line is some times determined by simply asserting that the price line shown is the correct one and drawing a family of straight line indifference curves parallel to it. Then welfare is maximized by attempting to get on the highest curve.

A more sophisticated analysis will allow the actual indifference curves to have a more complex form. Even so, it is highly likely that the same values of X and Y at the kink of the production curve will constitute the most efficient output decision in the society. In this case a straight line is drawn tangent to the indifference curve through the output point so that I is a derived function rather than being independently asserted. As we have seen, once the price between the two outputs has been given, it is possible to derive the factor prices and the distribution of income between factors.

When the social preference functions involve no substitution between products, we get a set of L-shaped curves represented by the dotted line II. In this case the social preferences have a dominant role in determining the efficient output mix for the society which is very unlikely to coincide with a kink in the production possibility curve. In this situation the output decision will determine the relative scarcity of the factors and, hence, the factor prices. Out of these the relative prices of the two commodities will follow.

A SEVEN FACTORS MODEL[1/]

We have used the term factor in a very broad sense to cover any input into productive processes which is in absolutely fixed supply.[2/] It is well known that a commodity or service which may be in fixed supply in the short run can usually be made more or less plentiful if enough time is given to accomodate the adjustment process. Nevertheless, for practical purposes there are usually several inputs which cannot be varied during the planning period. In this model each of these is considered to be a factor.

We turn our attention now to a model in which there are more than two factors. For convenience we assume that there are seven, which have been labelled F_1 through F_7. They are shown graphically in Figure V and listed in algebraic form as inequalities below:

6.a) F_1: $\frac{y}{100} + \frac{x}{2000} \leq 1$

6.b) F_2: $\frac{y}{105} + \frac{x}{350} \leq 1$

6.c) F_3: $\frac{y}{117} + \frac{y}{195} \leq 1$

6.d) F_4: $\frac{y}{141} + \frac{x}{141} \leq 1$

6.e) F_5: $\frac{y}{195} + \frac{x}{117} \leq 1$

6.f) F_6: $\frac{y}{350} + \frac{x}{105} \leq 1$

6.g) F_7: $\frac{y}{2000} + \frac{x}{100} \leq 1$

1/ As with the footnote to Section I on page 14, readers completely familiar with the technique and willing to skip step-by-step details might look at Figure VI. If it seems to be self-explanatory, they could proceed directly to the section beginning on page 40. The first part of this section discusses the attributes of the seven-factor model. The second part includes a discussion of dividing changes of total value into price and quantity components. This is followed by a discussion of how the degree of factor utilization for each factor is measured.

2/ The distinction between factors, final goods, and intermediate goods is made on page 51.

We retain our earlier assumption that the unit in which each factor is measured is the total available supply of the factor. Therefore, $Dl_x + Dl_y$ is less than or equal to the total supply of factor one which is equal to the number one.

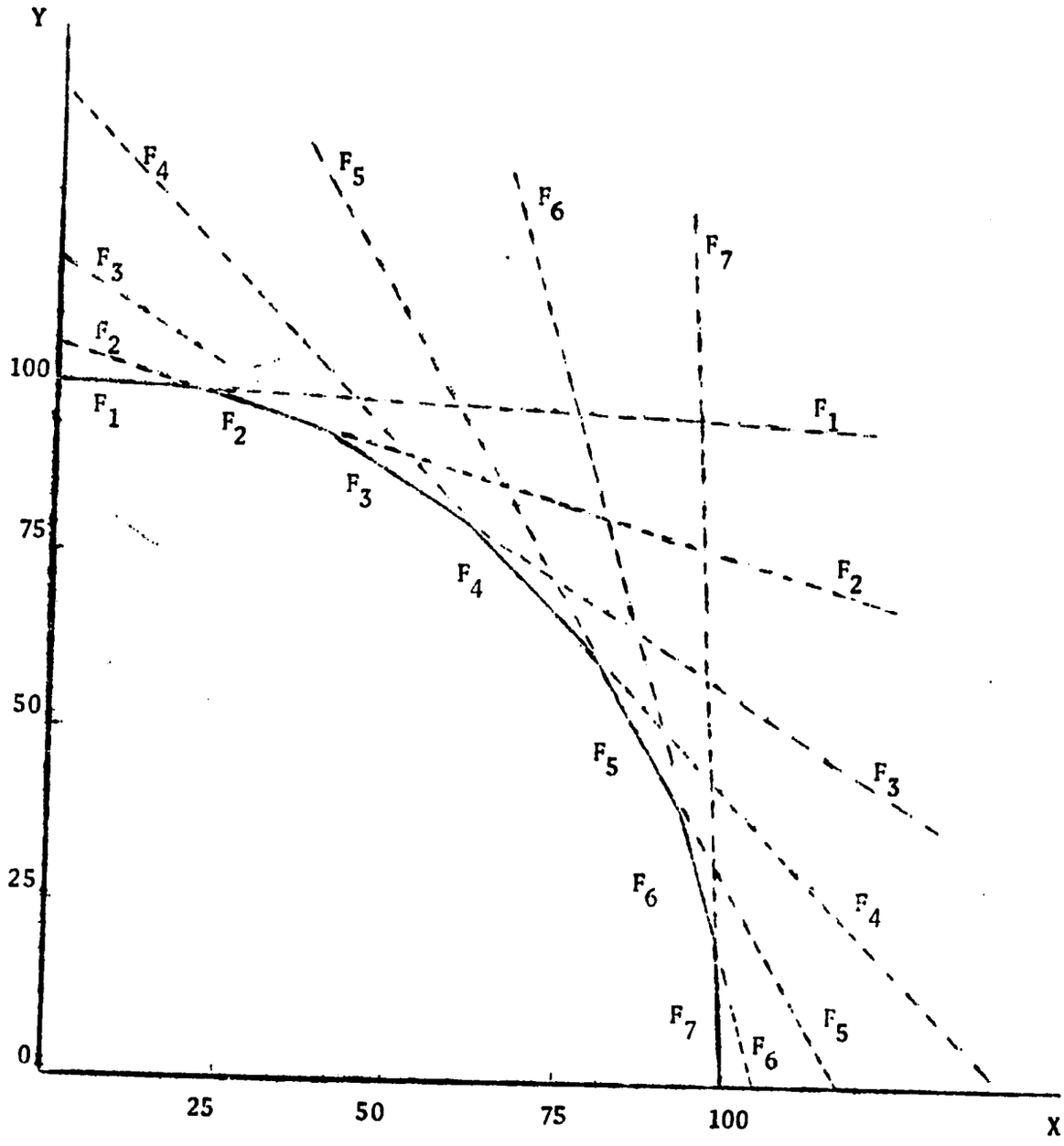

FIGURE V

In the seven-factor price system we also retain the notation in which π_1 is simultaneously both the price of factor one and the total value of all of factor one in the economy. The basic unit of value is again the value of all of the resources in the society, as indicated in equation (7.a). Since the price of the individual output is equal to the sum of the value of the required inputs, the price of commodity X and commodity Y are given in equations (7.b) and (7.c).

7.a) $\pi_1 + \pi_2 + \pi_3 + \pi_4 + \pi_5 + \pi_6 + \pi_7 = 1$

7.b) $P_x = \frac{1}{2000}\pi_1 + \frac{1}{350}\cdot\pi_2 + \frac{1}{195}\cdot\pi_3 + \frac{1}{141}\cdot\pi_4 + \frac{1}{117}\cdot\pi_5 + \frac{1}{105}\cdot\pi_6 + \frac{1}{100}\cdot\pi_7$

7.c) $P_y = \frac{1}{100}\cdot\pi_1 + \frac{1}{105}\cdot\pi_2 + \frac{1}{117}\cdot\pi_3 + \frac{1}{141}\cdot\pi_4 + \frac{1}{195}\cdot\pi_5 + \frac{1}{350}\cdot\pi_6 + \frac{1}{2000}\pi_7$

So far, the price system consists of three equations and nine unknown prices, leaving six degrees of freedom. At least five of the factor prices will also be equal to zero, reducing the number of degrees of freedom to one. This can be expressed as a reduced system of three equations in four unknowns. If the chosen output <u>is</u> <u>not</u> on one of the corners of the production possibility frontier, the factor prices will be set and this will determine the product prices. If the chosen output <u>is</u> on one of the corners, two factor prices and the two product prices will be variable. As soon as any one of these four is set, the other three are simultaneously determined.

If equation sets six and seven are combined, there are eleven variables (two output quantities, two product prices, and seven factor prices) and two degrees of freedom. Further specifying that at least one of the factors must be fully utilized so that an efficient economy results leaves only one degree of freedom. It would be more appropriate to call it one-and-a-half degrees of freedom. Specifying one of the eleven variables completely determines some of

TABLE 3

15 EFFICIENT SUB-SETS IN THE 7-FACTOR MODEL

VARIABLES

Sub-set	X	Y	π_1	π_2	π_3	π_4	π_5	π_6	π_7	P_x	P_y	P_y/P_x	Sub-set
1	0	100	1	0	0	0	0	0	0	0	$\frac{1}{100}$	∞	1
2	?	?	1	0	0	0	0	0	0	$\frac{1}{2000}$	$\frac{1}{100}$	20	2
3	20	99	?	?	0	0	0	0	0	?	?	?	3
4	?	?	0	1	0	0	0	0	0	$\frac{1}{350}$	$\frac{1}{105}$	$3\frac{1}{3}$	4
5	40	93	0	?	?	0	0	0	0	?	?	?	5
6	?	?	0	0	1	0	0	0	0	$\frac{1}{195}$	$\frac{1}{117}$	$1\frac{2}{3}$	6
7	60	81	0	0	?	?	0	0	0	?	?	?	7
8	?	?	0	0	0	1	0	0	0	$\frac{1}{141}$	$\frac{1}{141}$	1	8
9	81	60	0	0	0	?	?	0	0	?	?	?	9
10	?	?	0	0	0	0	1	0	0	$\frac{1}{117}$	$\frac{1}{195}$	$\frac{3}{5}$	10
11	93	40	0	0	0	0	?	?	0	?	?	?	11
12	?	?	0	0	0	0	0	1	0	$\frac{1}{105}$	$\frac{1}{350}$	$\frac{3}{10}$	12
13	99	20	0	0	0	0	0	?	?	?	?	?	13
14	?	?	0	0	0	0	0	0	1	$\frac{1}{100}$	$\frac{1}{2000}$	$\frac{1}{20}$	14
15	100	0	0	0	0	0	0	0	1	$\frac{1}{100}$	0	0	15

Note: A question mark indicates that the variable may be arbitrarily set within the range including the numbers immediately above and below it in the column. Once one of the "arbitrary variables" (indicated by a ?) has been set, all other variables in the sub-set become determined and may no longer be set arbitrarily. The numerical values for these newly determined variables can be determined from the equations in the text.

the other variables and restricts the remaining ones to a very narrow range. A further specification within this range of any one of the remaining variables completely determines the whole system.

The result is that the production frontier in the seven-factor model can be completely described in terms of fifteen efficient sub-sets. These are given in Table III. The even-numbered sub-sets correspond with the short-line segments on the efficiency frontier in Figures V and VI, where the values of the output in physical terms of X and Y are narrowly constrained but not completely determined; the nine prices, on the other hand, are completely determined. The odd-numbered sub-sets in Table III correspond to the corners on the production frontier in which the quantity decisions are determined but the prices are indeterminate within specified ranges.

It is instructive to transform the production possibility curve of Figure V into a more conventional supply curve. This has been done in Figure VI. Output Y has been made the unit of value by setting its unit price equal to one. The quantity of X is measured on the horizontal axis, and the price of $X = P_x/P_y$ is measured on the vertical axis. We see clearly how the production function in this model separates into two types of line segments: (1) price changes without quantity changes and (2) quantity changes without price changes. Where the supply curve is vertical, a changed demand becomes merely an income redistribution device which treats factor returns as quasi-rents. In the horizontal sections of the supply curve the primary effect is on the allocation of resources between good X and good Y. When production of X is low, at low prices, increased demand can be expected to cause significant changes in physical production; when the production and price of X is high, the revaluation effect seems to dominate.

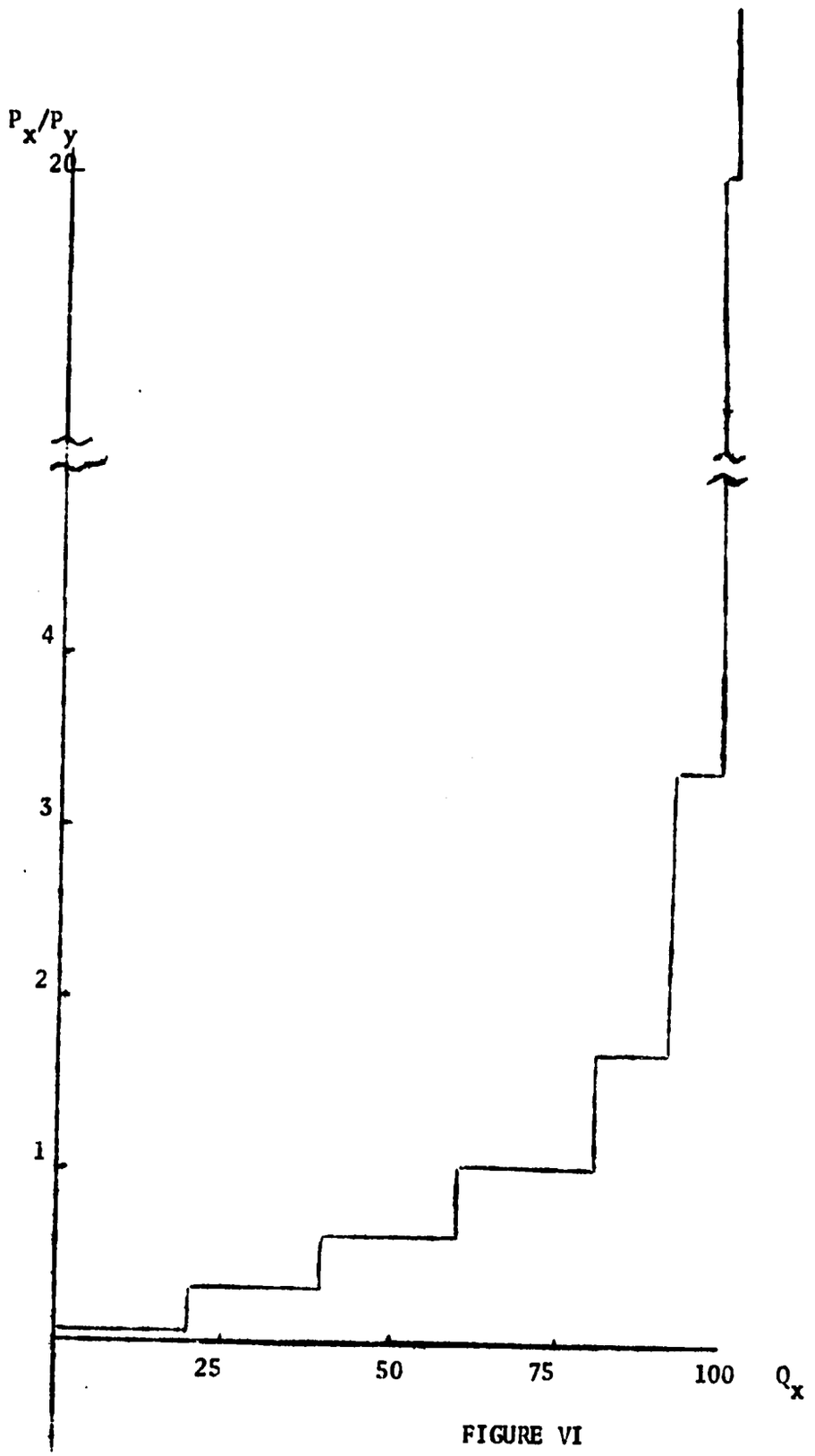

FIGURE VI

Price of X with $P_y = 1$

In Figure VII the seven-factor production model has been reproduced, and the social preference vectors from the preceeding section have been superimposed on it.[1/]

If the prevailing preference vector is U_1, the society will attempt to expand output along that vector until it runs into the restraint imposed by F_1, the first factor. Thus, the intersection of U_1 and F_1 determines the quantities of X and Y which could be produced efficiently within the society. Once the output decision has been determined, it is apparent that only factor one is in scarce supply and all other factor prices go to zero. This, in turn, determines the relative prices of products X and Y.

TABLE IV

Physical Quantities and Relative Contribution to GDP for Seven Different Efficient Plans

Intersection	X	Y	V_x	V_y
F_1 U_1	11.0	99.4	.005	.994
F_2 S_2	24.4	97.6	.070	.930
F_3 S_3	55.7	83.6	.286	.714
F_4 S_4	70.5	70.5	.500	.500
F_5 S_5	83.6	55.7	.714	.286
F_6 S_6	97.7	24.4	.930	.070
F_7 U_7	99.4	11.0	.994	.005

1/ The specific details of these social preference vectors were developed in the footnote to Table II on page 25 above.

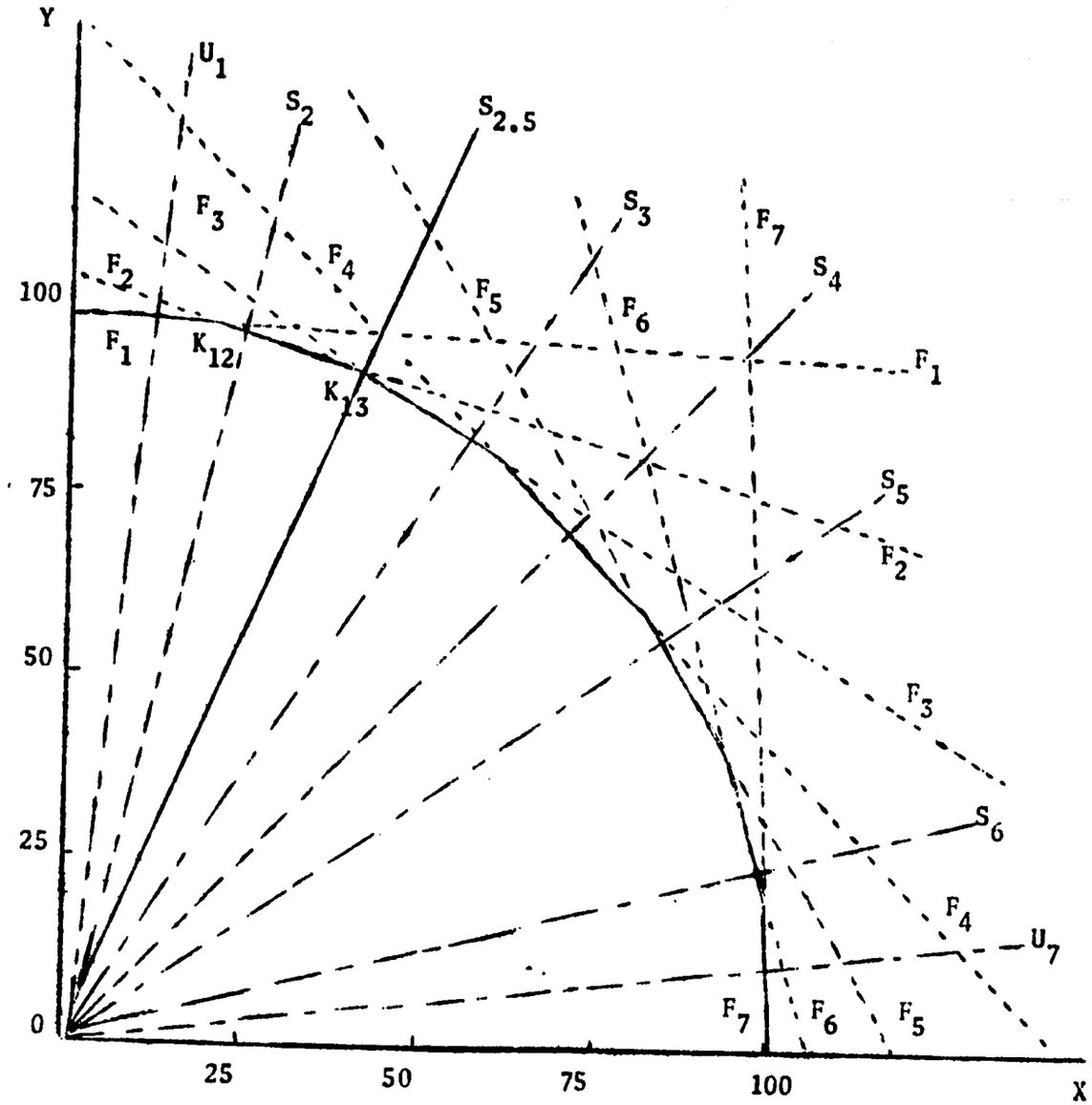

FIGURE VII

To insure continuity in sequence of numbers, this blank page 36 has been inserted. Pages were erroneously numbered leaving out page 36.

In a similar fashion, if S_2 is the prevailing preference vector, the efficient solution will exist where vector S_2 intersects the line F_2, since at this point on the production possibility curve the second factor is the limiting resource. Again all prices are determined. In this way again there is a single efficient determinant solution which corresponds with each of the preference vectors. These seven efficient solutions have been indicated in Table IV. The values of X and Y are easily obtained by solving two equations and two unknowns. The total value of commodity X in the column headed V_x is obtained by multiplying the quantity of X produced by the prevailing price of X. The value of the total quantity of good Y produced is obtained in a like fashion. As the value of the output in a society is equal to the value of the inputs, $V_x + V_y$ will always equal one.

It is instructive to study Figure VII in some detail by first assuming that the society was producing a hundred units of Y and zero units of X and then following along the efficiency curve as the social preferences shift so as to require more X at the expense of Y, all the time maintaining maximum productive efficiency. Initially all of the national production is accounted for by product Y. As product X is increased, Y is gradually decreased until corner K_{12} is reached where both factors F_1 and F_2 are fully utilized. In the example this occurs when the production of X is equal to 20 and the production of Y is equal to ninety-nine. Using factor F_1 prices, the value of output X is $\frac{20}{2000} = .0100$, and the value of product Y, $V_y = .99$.

At corner K_{12} both factor F_1 and factor F_2 are fully utilized; but if production of X is to be further expanded, factor F_1 will become in excess supply. As a result, a prior condition to such expansion in the production of X is that the output of the two products be revalued, even though the

quantities do not change. Using factor F_2 prices, the value of product X, V_x, is increased to .057, whereas V_y is reduced to .943.

Once this has been accomplished, production of X can again be expanded at the expense of a lowered production of product Y, although on less favorable terms. Thus, at corner K_{13}, where factor F_2 and factor F_3 are both in short supply, forty units of X will be produced with a value of X = .114, and ninety-three units of Y will be produced with a value equal to .886. Again, to expand production of X beyond this point a revaluation of the output will have to take place. If more than forty units of X are produced, both factors F_1 and F_2 are in excess supply and factor F_3 becomes the governing restraint. The revaluation process increases V_x from .114 to .205.

Eventually, when the shifting of quantities and prices is completed, the society is functioning so as to produce a hundred units of X and zero units of Y. V_x will equal 1.000 and V_y will equal zero. Of the gain in V_x from zero to 1.000 slightly under half is attributable to changes in the quantity of X as the equilibrium point is moved along the possibility curve. Slightly over half of the change in value can be attributed to the increase in value from the change in prices of X and Y which occurs at the corners. This result is true only for this particular example and would likely change somewhat if different restraints were used. We suspect, however, that this would not affect the order of magnitude of the results.

We may return our attention to the point where preference vector S_2 intersects F_2, the restraint imposed by the second factor, F_2. From Table III we find that 24.4 units of products X will be produced. We now raise the question of what would happen if there was a large increase in the availability of both factors F_1 and F_2. On the graph both of the lines F_1 and F_2 would be shifted

upward while maintaining their slope, and F_3, representing the third factor, would become the effective restraint on the governing preference function S_2. This would constitute an outward shift of production possibility curves, and the new equilibrium would be where F_3 and S_2 intersect, which would give a figure of 25.4 for the new production of commodity X.

Thus, the production of product X with factor two as a governing restraint was 96 per cent (24.4 ÷ 25.4) of what it would be if factor F_3 were the governing restraint. Since the demands for all inputs are assumed to be strictly proportional, we thus find that if S_2 is the governing social preference function, factor F_2 will be 100 per cent utilized and factor F_3, 96 per cent utilized. From the graph we infer that factor F_1 will also be almost 100 per cent utilized with increasing under-employment of factors F_4, F_5, F_6, and F_7, in that order. The actual percentage of utilization under these conditions has been computed and is given in Table V.

TABLE V: PERCENTAGE OF EACH FACTOR UTILIZED UNDER PREFERENCE S_2

Factor	F_1	F_2	F_3	F_4	F_5	F_6	F_7
Percentage Utilized	99%	100%	96%	87%	71%	51%	29%

In this fashion it is possible to compute the percentage of any factor which will be utilized under any of the given preference functions or under any other adequately defined preference function. However, for discussion purposes it is sufficient to work with visual approximations based on figure VII.

After the values of the final goods and/or the values of the factors have been set, the values (and the prices) of any intermediate goods could be easily derived from the underlying production functions. This can be done either by estimating the "marginal value product"

of the intermediate good in producing final output or by estimating the cost of the intermediate goods as the sum of the values of the factor inputs. If the economy is highly inter-connected (e.g., so that there would be few zeros in an input-output matrix describing it), the computations would be lengthened but could be handled. This is the reason that dropping intermediate goods as a simplifying assumption does not introduce critical weaknesses in the over-all analysis.

FACTOR RETURNS AND INCOME DISTRIBUTION

We turn now to the question of how the governing social preference vector in a society is determined. As mentioned, one conventional solution has been to assume that the distribution of income among factors is given and that this then leads to a set of social indifference curves based on consumer sovereignty. Usually the basic income distribution is determined by ownership of productive factors, each priced according to its marginal productivity. This income distribution can be and usually is modified by a variety of transfer payments.

Much less is known about the results when the income distribution is not given. We see clearly in this model, however, that the above technique will not provide a unique efficient over-all economic program.

If the social preference vector is shifted from S_2 to S_4, this shifting will change the value of some of the factors. As long as the factors are owned in different proportions by different groups in the society, it will inevitably follow that the shifting of the preference functions will lead to a shifting of the distributions of income. Assuming that the society includes people with a variety of tastes, it is almost inevitable that the new income distribution will lead to a different social preference vector.

The effect of this simultaneous redistribution of incomes and social preferences is, in general, completely indeterminate. In some cases the incomes may be spent so as to reinforce the planner's decision to shift to a new preference vector. This will be the case, for example, if the owners of factor F_4 desire social preference vector S_4 but had previously been rather uninfluential because the society had been dominated by the owners of factor F_2 who had preferred vector S_2.

It is also possible that the owners of factor F_4 desired a product mix containing large amounts of commodity Y. Then, even though the preference vector had been artificially shifted to S_4, reliance on a market-determined income distribution and consumer sovereignty would lead the governing preference vector back towards S_2.[1/]

One of the difficulties in accepting the income distribution implications of the seven-factor model we have used is that so many of the factors have a zero price. Relatively small shifts in the preference functions or in the availability of particular factors transform previously free goods into scarce commodities, and items which had formerly been accepted as having inherent wealth become as useless as a dollar bill on a desert island. This apparent difficulty can be easily overcome at the cost of a slight further increase in the complexity of the model.

1/ It may be that there is no stable solution. This will happen if all groups in a society want product mixes which incidentally lead to a reduction in their share of income and, hence, a reduction in their influence in determining broad social objectives. In that case stability would require either an imposed preference function or income redistribution transfers. These are the same policy options which are useful but not necessarily essential in cases where there are a multitude of stable solutions or where the existing stable solutions have been rejected for reasons outside the specified problem.

We have treated the seven factors as completely independent restraints on the society's production possibility curve. It is perfectly possible to retain this assumption and at the same time drop the assumption that the factors are traded in a pure form in the markets in the society. We can assume that the "factors" exist only as attributes of various inputs, and that each input accounts for a particular mix of these attributes, and a fraction of the total supply of each factor.

In Table VI we have assumed that there are only three inputs in the society which have been labelled v, w, z. Each input can be thought of as a physically identifiable resource, as a particular type of service, or perhaps as a particular group of people within the society which plays a relatively homogeneous role or function. The important feature is that every small unit of an input contains within it a certain amount of each of the seven factors in a way which cannot be physically separated out. Thus, by purchasing a unit of input v the buyer has available a certain amount of factor F_1, another amount of factor F_2, another amount of factor F_3, etc. He uses the scarcest of these factors to full capacity and under-utilizes the rest. As a result, the relative values of inputs v, w, and z are determined by their contribution of the scarce factor.

TABLE VI: PERCENTAGE OF TOTAL SUPPLY OF EACH FACTOR IN EACH HYPOTHETICAL INPUT

Inputs	F_1	F_2	F_3	F_4	F_5	F_6	F_7
v	70	60	45	30	20	10	5
w	25	30	35	40	35	30	25
z	5	10	20	30	45	60	70

If the social preference vector is S_2, the price of factor F_2 will be equal to one ($\pi_2 = 1$), and all other factors will have a zero price. We can define the price of the inputs as π_v, π_w, and π_z. Since input v provides 60 per cent of factor F_2, input z provides 10 per cent of factor F_2, and input w provides 30 per cent of factor F_2, the prices will be $\pi_v = .60$, $\pi_w = .30$, and $\pi_z = .10$. If the social preference vector is shifted from S_2 to S_3, factor F_2 becomes a free good with a zero value and $\pi_3 = 1$. This shifts the basis on which the inputs are valued so that π_v is decreased to .45, π_w is increased to .35, and π_z is doubled to equal .20. It should be noted that as the preference vector swings over the possible range and different factor prices govern, the relative values of inputs v, w, and z will change, but all input values will always remain positive. This, of course, corresponds much better to our intuitive perceptions of the real world than the original assumptions in which slight changes produce zero prices for some factors.[1/]

1/ The technique used here has certain similarities to the concept of factor analysis as used by the educational psychologists. A major difference here has been that the number of factors outnumbers both the number of end products and the number of observable inputs. This, however, is important only for expository purposes, since both the number of inputs and the number of outputs in our model can be expanded without changing the number of factors.
The psychologists also infer the existence of non-observable factors by applying statistical techniques to observations on observable variables. A quite similar technique could be used if an attempt was made to statistically implement the model in the discussion here. In that case the linearity of the production function is built into the model as an assumption inherent in the statistical estimation procedure. The end results would be determined on the basis of the best fit which is obtainable subject to that assumption. How such results would appear on tests of statistical significance is, of course, a completely different matter.

II. POLICY AND PRICES

The preceding careful step-by-step development of the technical apparatus has served to review some selected tools that have come into vogue in the literature on planning economic development. Even more important, it has enabled us to make certain assumptions explicit and to discuss some of the technical ramifications of these assumptions. Everyone must judge for himself how adequately a particular set of assumptions approximates reality and there is always room for disagreement on subjective matters and on interpretations of empirical facts. The main objective in Part I has been to avoid misunderstanding on technical points.

We turn now to the problem of utilizing this technical apparatus in discussing some critical policy problems in development planning. To avoid bogging down in disputes of whether a particular assumption corresponds to the situation on a particular occasion in a particular country at a particular point of time, we will carry on this discussion in terms of an imaginary economy. We are content to assert simply that non-trivial parallels exist in the real world.

A DEVELOPMENT PLANNING EXAMPLE

In the country we picture there exists a sociological or cultural dualism. In the most fundamental sense there is a disagreement within the society as to what constitutes a good life. For example, in terms of Figure VII the Y axis might be an index number of the physical quantities of goods and services which are identified with Western or industrialized cultures. This index would be based on implicit emphases on consumer durables, on education and orderliness as values in and of themselves, on wide ranges of choice among consumer products, on heavy capital investment, etc. In contrast, the X variable might represent products and services closely connected with traditional, nationalistic, or local

values. These might represent particular dietary habits, heavy emphasis on particular artistic forms, freedom from industrial discipline, social security and stability for the extended family, etc.[1/]

It should be noted that no one is likely to feel that product Y is preferred absolutely to the complete exclusion of product X or that product X is preferred to the exclusion of product Y. All reasonable people would judge some mix or combination of the two to be most desirable. However, we find one group within the society strongly emphasizing the importance of the Y products typical of Western industrialized countries. Their preferred mix is illustrated by factor U_1 in Figure VII. At the other extreme, another group, strongly nationalistic, proud of their cultural heritage, prefers that indigenous values should be stressed as much as possible and Western style processes be adopted only where there is unmistakable evidence of their superiority under existing local conditions. In short, this group prefers a product mix represented by U_7.

It is the rare society in which any group completely gets its own way. All governing social preferences are a mixture of the various viewpoints existing within the society. In particular, we assume that, although preference vector U_1 may govern in some other countries which have been long industrialized and although it may correspond to the mix which used to govern the strictly expatriate

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1/ A similar but not identical distinction would be to identify the Y variable with the product mix connected with intensive participation in international trade. This would mean a heavy production emphasis on exporting goods and services and a large import component in consumer and other final goods and services. In contrast, the X variable would be an index of products and services connected with a high degree of national self-sufficiency with an emphasis on local production and consumption of locally produced goods. For the purposes of this paper, the existence of the dichotomy is more important than its nature.

sector of the economy, it was never completely dominant here. The responsible administrators always showed respect for local values and a compromise vector S_2, in fact, was controlling.[1/]

As a result of the newly independent status of the country, a team of development advisors has been called in. Since independence there has been a drastic redistribution of income (benefits) from the former colonial powers into the hands of various indigenous groups, many of whom have adopted Westernized values. The product mix S_2 has not been strongly affected, but the particular products themselves have been going into indigenous hands rather than accruing to the benefit of citizens of the industrialized countries.

It is widely recognized that the Westernized values will be somewhat de-emphasized and that new nationalistic forces are at work. As a result, the expected preference vector is shifted by the advisors even further in the direction of product X so that $S_{2.5}$ is assumed to be governing.[2/]

Turning again to Figure VII, we see that under these new conditions factor F_2 is still in very short supply, but secondary emphasis has been shifted from factor F_1 to factor F_3 which is now almost completely utilized in comparison with its previous four per cent under-employment. Previous emphasis on long-run expansion of availability of factor F_2 is maintained. The more sophisticated

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1/ We note that vector S_2 resulted in twice as much product X being produced as the ruling classes actually thought was either desirable or necessary. Thus, in their eyes they were being quite generous, or tolerant, with regard to indigenous viewpoints. Fortunately production of product Y did not have to be restricted severely. Factors one and two were both utilized at near 100 per cent capacity, although there was some unemployment of factors three and four.

2/ We do not suggest that either the advisors or the officials think and communicate in these formalistic terms, only that their words and actions are consistent with the formal description given.

analysts recognize that the excess capacity in factor F_3 which existed in the historical statistics under governing preference vector S_2 is likely to rapidly disappear if it has not already done so. What used to be an excess factor may now become a potential bottleneck and is watched carefully.

One astute observer notices that the pressure on the first factor has slackened although, if factors F_2 and F_3 are both expanded, factor F_1 may again become crucial. He also notices that factor F_4 which was previously utilized at the 87 per cent level (see Table V on page 39) now tends to be utilized more intensively. He suggests that a series of statistical data on factor F_4 be compiled so that it can be studied.

In attempting to advise the new government, the experts focus the officials' attention on factors F_1, F_2, and F_3. Historically these have been the crucial bottlenecks, and they have been monitored by the previous administrations. To the extent that the statistics on these three factors are not good, this fact alone is deemed important evidence that the statistical data collection agency needs strengthening.

In contrast, factors F_5, F_6, and F_7 are likely to have been largely ignored. Since over a quarter of each of them previously were unutilized, it is likely that these factors or resources were treated as free goods.[1/] Even when statistics had been collected on these variables, they were seldom treated as economically significant series. Since the accepted ideal production vector had been on U_1, primary concern had been over the fact that the first factor, which

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1/ This would coincide with the treatment of fresh water in many parts of the United States or the treatment of lumber and buffalo meat on the American frontier.

"should" have been the crucial bottleneck was, in fact, slightly under-utilized.

The development planning advisors are reporting to a new "revolutionary" leadership. If the Prime Minister had his way completely, he would prefer to have vector U_7 adopted with its strong emphasis on indigenous values.[1/] However, he recognizes that some reasonable compromise is essential. Some of his most trusted subordinates have acquired Western tastes and, unfortunately, the skilled workers have been exposed to Western demonstration effects. On balance he feels that it would be fair and equitable for the society to "settle" on preference vector S_6.

With his attention focused on expansion of product group X, he listens to the advisors explain why it is necessary to expand and conserve factors F_1, F_2, and F_3; but somehow he doesn't understand since other restraints really seem to be standing in the way of progress. From our omniscient vantage point we know that these other restraints can be identified in Figure VII as factors F_5, F_6, and F_7. At this point in time, however, no one in the country has even attempted to make quantitative measurements of these factors or to relate such information as is available to the problem of making intelligent economic decisions.

The failure to focus attention on these crucial bottleneck factors has subconsciously contributed to the new leadership's growing suspicion that much of the former colonial administrative decision-making apparatus is completely

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1/ We repeat that he doesn't know that he wants vector U_7 because he doesn't think in these terms. We assume only that if a Western-trained social scientist tried to discover what he really wanted, a long and understanding investigation would lead to the conclusion that U_7 is a good approximation to the leader's dominant objectives.

useless for developing the country in the direction which they would like to see it go. The main impact of the accepted techniques seems to be to strengthen the hands of those subordinates who have sold out their heritage for a group of modified Western colonial values.

It is interesting to note that even the most sophisticated of the technicians may be falling into a trap. Factor F_4 which previously had been in excess supply was becoming more critical and was nominated as a potentially crucial bottleneck. This increasing importance came because the preference was shifted from S_2 to $S_{2.5}$. However, such a shift of the preference function is completely inadequate. If the forces favoring vector U_7 continue to assert their importance and gain an increasingly strong voice, the governing social preference curve will shift not only to $S_{2.5}$ but beyond that to S_3, S_4, and even to S_5. Factor F_4 is a temporary bottleneck, crucial only when the two polar positions are in some sense equally important. Once the society has adjusted to the new vector S_5 or S_6, the previously unrecognized factors became critical and once more factor F_4 will be under-utilized.

We must not conclude this example on a note seeming to advocate primitive values over those of a civilized society. The argument is neither anti-modern nor anti-scientific. The Western values being threatened could be those which are non-essential fads. The important part of the analysis is that preference vector U_1 represents the historical ideal and vector S_2 represents the historical reality. In contrast vector U_7 represents the new ideal and vector S_6 represents in some sense what is regarded as a reasonable compromise with historical precedent. Within this framework we have been using as an example the problem of a newly emerging country making an adjustment to the rest of the world in

which it exists. But it is possible to turn the problem inside out.

Consider the problem of the new revolutionary leadership in the capital and its relationship to the traditional ruling elites holding sway in the hinterland. In this case we would assume that Y represents the traditional rural country values which are mixed into social preferences U_1 and S_2 and restrained by factors F_1, F_2, and F_3. At the other extreme product X, preference vectors S_6 and U_7, and factor restraints F_5, F_6, and F_7 are those which govern the attempts of the new national leadership to modernize the country. As in the previous case, both groups feel that they are making reasonable compromises. Both feel that the other's attitudes show a complete lack of comprehension of certain fundamental values. Neither group understands why the other one prefers to worry about one set of restraints imposed by the availability of certain resources or services while completely ignoring what seem to the doubter to be much more critical bottlenecks urgently demanding attention.[1/]

The main lesson to learn from surveying this imaginary society is that scientific techniques cannot solve the problem. Everyone is being reasonable, showing a willingness to compromise and perhaps even showing an interest in using objective scientific analysis. The real difficulty is that if each protagonist understood his opposite number he would accuse him of attempting to use techniques which will produce completely accurate answers to irrelevant

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1/ Even the techniques of finding a national consensus may be misunderstood. See G. A. Almond in the Introduction to the Politics of the Developing Areas, Ed. by G. A. Almond and J. S. Coleman (Princeton: Princeton University Press, 1960) p. 24, on the difference between the internal workings of Western and non-Western parliaments.
Both of the interpretations used here have been phrased in terms of internal conflicts. Similar problems occur between aid givers and aid receivers. See J. D. Montgomery, "Political Dimensions of Foreign Aid," in Tradition, Values and Socio-Economic Development, ed. by R. Brailanti and J. J. Spengler (Durham: Duke University Press, 1961) p. 243.

questions, precise solutions to imprecise problems, or efficient means to achieve undesirable ends. In the next sections we look at some policy implications inherent in trying to find our way out of this dilemma.

SIMPLE TARGETING OF NATIONAL DEVELOPMENT GOALS

A national plan is always under-specified. Every policy-maker has a subjective, intuitive, idea of what he is trying to accomplish. Given adequate time and analytical resources, it might be possible to describe these policy objectives in excruciating detail, listing quantities, prices and other relationships for literally millions of component parts. In practice, attention is focused on a relatively small number of variables on the assumption that if these are achieved, many of the other objectives will also be approximately satisfied. This discussion is concerned with both the targets which are explicitly specified and with some of the more important variables which are left unspecified on the assumption that they will incidentally fall into the proper ranges. We are primarily concerned with the question of which of these targets should be explicitly specified and which left to vary freely, even though the latter are also very important in the overall economy.

As a first step it is useful to distinguish between three types of economically significant goods and services: final goods, intermediate goods, and factors. The definitions used here parallel but are not identical with general usage. In particular our definitions are intimately related to the length of the planning period.

A final good is assumed to have only inherent value as an end in itself since it contributes nothing to this period's productive potential. It may be an individual or collective consumption good or an activity expected to contribute to production in the future.

An intermediate good functions both as an output absorbing resources and as an input contributing to production. Like a factor it has no inherent value except as a means to other ends. It is assumed to be variable over the relevant range.

A factor has no inherent value except as a means to achieving other ends. It is assumed to be in a fixed supply which cannot be significantly varied during the planning period. The bottleneck idea essentially belongs to the factor concept.

Throughout the paper it is assumed that intermediate goods have been netted out. This reduces the comprehensive model to a simpler but equivalent one in which factors are directly converted into final goods.[1/]

Because of the importance of the time dimension in these definitions, the choice from among feasible targets or sets of final goods can always be made on an "arbitrary" basis. An item which is a target in a short-term plan may become a dependent intermediate variable in medium and long-term planning, thereby losing its arbitrary quality. The choice between feasible long-run targets is always arbitrary in the sense that it can only depend on criteria outside of economics.

A good development plan results from a dynamic tension between what is feasible and what is desired. One approach is to emphasize the set of desired combinations of targets by ranking them according to desirability. Those which are not feasible are then eliminated and the highest remaining one is used. The other approach is to consider the set of feasible combinations of targets

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1/ The netting out of intermediate goods has advantages beyond mere simplification. Forrest Cookson has pointed out that even some production functions which are non-linear and/or involve variable coefficients involve linear demands for prime factors. For example, see T. C. Koopmans Ed., Activity Analysis of Production and Allocation, New York, 1951, pp. 142-173.

and officially adopt that combination which is most desired. Under conditions of perfect knowledge the two procedures should give identical results. In the real world the two procedures are likely to produce different results because of inevitable errors in the technical measurement processes.

In the models used here the set of feasible plans is defined by the area inside of the production possibility curves developed in Figures II and V. The question of desirability is reflected in the choice of the governing social preference curve or the specification of targets.

Figure VIII uses the production possibility curve which was first developed in Figure V and was adopted as a feasibility restraint in Figure VII. However, it has been simplified by including only those line segments in each factor supply equation which are directly relevant in limiting production. In the discussion of technique based on Figure VI, various social preferences of the same type were used. We now turn our attention to a variety of alternative targets constructed for comparative purposes and represented graphically in Figure VIII. In most cases a given target reflects not only a new social preference, but also a different way of expressing it. Thus we are simultaneously considering both different development goals and different ways of expressing any one goal as a specific operational target.

The fact that Figure VIII is a two-dimensional figure implicitly permits the adoption of two policy objectives. At first glance we are tempted to set the output of both commodities and let it go at that. However, an earlier professional claim has pre-empted one of the policy options. The requirement that a plan be both efficient and feasible leaves only one policy dimension to handle the two final goods. This provides the creative tension within the model which makes flexibility possible and significant in the choice of how targets are set.

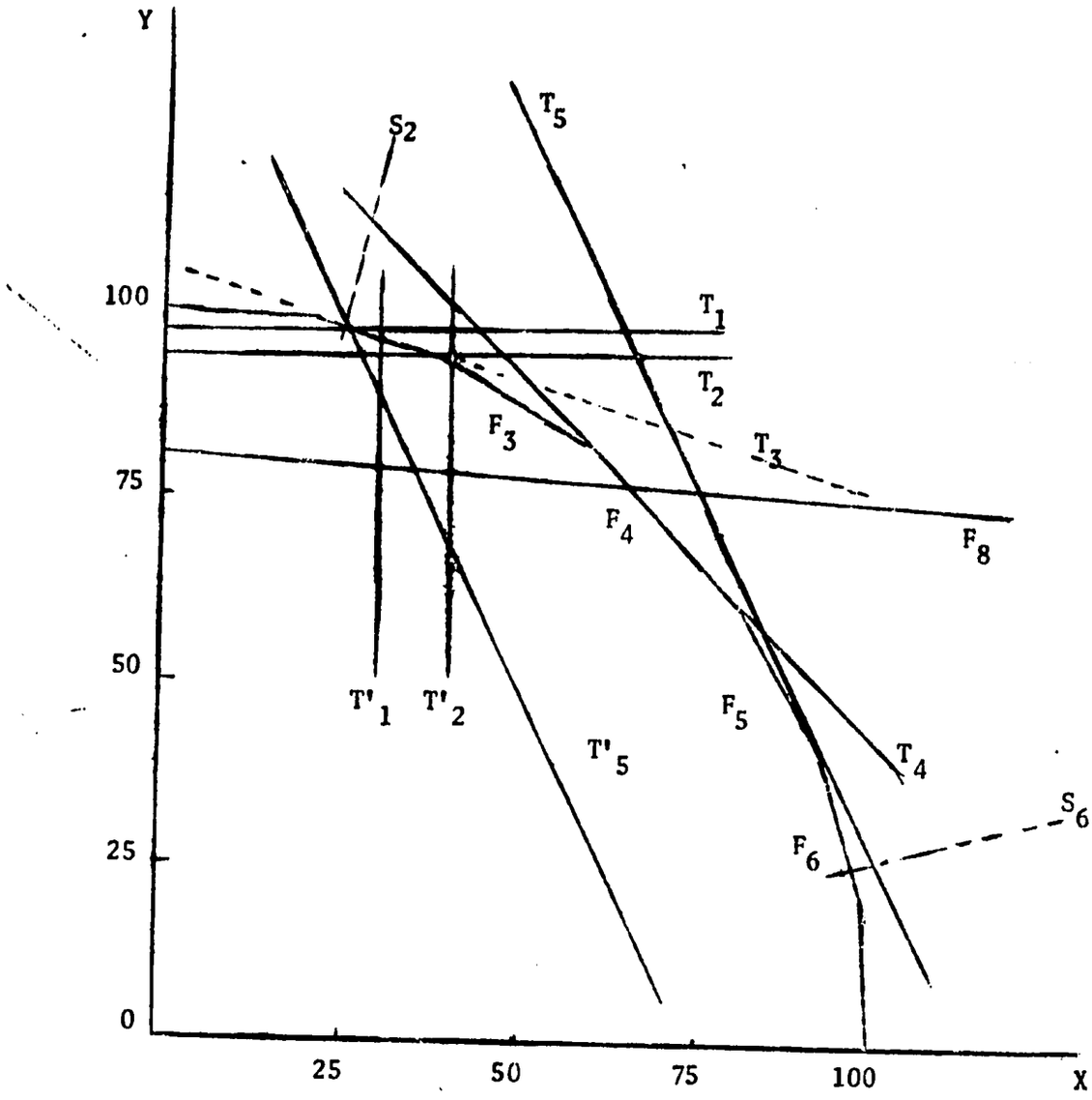

Figure VIII

As a <u>first</u> approach to targeting we consider the effects of targeting the Y variable. Let the first target T_1 be set at Y = 96, as shown. The planner is probably aware that this is less than a maximum output of product Y and implicitly assumes that the remaining resources will be devoted to producing product X. Maximum efficiency requires that at least one of the factors be

fully utilized, and if this goal is reached we see that thirty units of X will be produced where the line T_1 crosses the line F_2. If the Y target is reduced to ninety-three units as indicated by the line T_2, the full factor utilization value for X will be forty units. Thus, a little more than a three per cent decrease in the Y target is accompanied by approximately a 33 per cent increase in the quantity of X. If both the quantity of X and the quantity of Y are important targets, it might be more prudent to specify the T_i target in the form T_1' at X = 30, and T_2 target as T_2' at X = 40. Relatively minor variations in the achievement of these X targets will be accompanied by even smaller variations in the obtaining of the projected production of Y.

Our <u>second</u> approach to targeting assumes that prices based on historical data can be used to enable both X and Y to be targeted. The dangers in this procedure are illustrated in target T_3. Retaining our earlier assumption that preference vector S_2 historically has been the one which has governed in the society, the scarce factor will have been factor F_2 and the price of a unit of Y will have been $3\frac{1}{3}$ times the price of X. At the micro level this implies that three units of Y have a value equal to ten units of X and substitution can be made on these terms according to preference. If this rule is applied uncritically at the macro level, the planner may conclude that he can shift from the former level of $97\frac{1}{2}$ units of Y and $24\frac{1}{2}$ units of X to T_3 involving 81 units of Y and 80 units of X as indicated.

From our vantage point, involving full information, it is obvious this is an unobtainable goal even though according to historical prices it does not seem to require any expansion in the value of national output. The trade-off of one unit of X for $\frac{3}{10}$ units of Y is possible only in the range where 20 to 40 units of X are produced as was the case when the historical

prices prevailed. Attempts to increase production of X above 40 units run into a bottleneck created by factor F_3. This new shortage causes a price change so that an additional unit of X "costs" $\frac{3}{5}$ of a unit of Y, a doubling of the former price. This new price governs trade-offs in the range where 40 to 60 units of X are produced. Further expansion of production of X above 60 units again changes the critical bottleneck. Factor F_4 becomes the governing restraint and X and Y are traded even on a one for one basis. This price applies where 60 to 81 units of X and 60 to 81 units of Y are produced.

However, any attempt to achieve target T_3 is doomed to failure. If the Y target of 81 units is reached, the maximum possible X production is 60. If the X target of 80 is reached, the maximum possible Y production is 61 units. Most likely the failure will be divided between the two components and the actual output will lie somewhere on the line segment F_4.

It is interesting to note that if the new output is valued on Laspeyre's index terms, it represents a decline in national output. However, even partial fulfillment of target T_3 will mean that factor F_4 becomes the scarce resource and π_4 the positive factor price. On these terms a unit of X and a unit of Y are equally valuable and using a Paasche-type index the new output is considerably superior to that which has historically prevailed, even though the original target T_3, has been seriously under-fulfilled.[1/]

1/ Laspeyre's price indices measure price changes by using base year weights. Paasche price indices are the same but use current year weights. In this case we are measuring quantity changes. The differences between the two indices is whether the changes are valued in base year (historical) or current year prices. We have assumed both types are equilibrium prices. We have also considered only the change in the output mix. Where both output sectors are growing over time in a free market economy, the Laspeyre's gives the more favorable result. See S. Kuznets "Some Conceptual Problems of Measurement" in Studies in Economic Development, ed. by B. Okun and R. W. Richardson, (New York, Holt, Rinehart and Winston, 1961) p. 238.

It is not necessary for the development targets to be specified in terms of either the output of product X or the output of product Y. A third approach is to require that a particular factor be fully utilized. Such a requirement is particularly likely to be imposed with regard to the full employment of labor. In Figure VIII we have indicated this by labelling as the fourth target, T_4, the entire line showing a limited supply of factor F_4. This is F_4 in Figures V and VII. In this case the production of X must lie between 60 and 81 units and the production of Y must also lie in the same range. Acceptance of this target still leaves a certain amount of indeterminancy so that other objectives can be considered. However, it severely restrains both the output decisions and the freedom to arbitrarily specify a social preference vector. Working backward through the decision-making process even further, consistency with this full employment choice may require the acceptance of a predetermined income distribution and, as a corrollary, certain transfer payments which would not be justifiable on any other grounds. If these predetermined choices are rejected, the alternative is to abandon the principle of consumer sovereignty.

In addition to the connection between the income distribution and the social preference function, there is the other connection between the income distribution and the marginal productivity of the various factors. The requirement that labor would be fully employed necessarily requires that some of the other factors be under-utilized. This drives the other factor prices to zero and will affect the distribution of income within the society. Such an effect may be either desired or undesired depending on how groups controlling the dominant property rights to the redundant factors have been identified. Those wishing to justify the new order will tend to ignore the unfavorable repercussions on the disadvantaged groups while those opposing the new preference

function are likely to protest. Both attitudes tend to obscure the fact that the change in factor values may be only a side effect due to the complex interdependence of the economic system.

If both the output decisions and the choice of a social preference function were subordinated to other ends, it would be possible for the economy to settle down at one end or the other of the short F_4 segment where it intersects the line representing factor F_3 or factor F_5. Then an additional factor would be fully utilized and a certain amount of arbitrariness can be introduced into the pricing of output, the choice of the fully utilized factors, and the distribution of income without seriously affecting the efficiency of the economy.

A fourth approach is to set as a target the price of X in terms of the price of Y. An example of this would be a decision that the price of X should be twice the price of Y because it is believed that one unit of X inherently has a value equal to two units of Y. This decision has been introduced into Figure VIII as two parallel lines, T_5 and T_5', since only the price ratio has been established.[1/]

In this particular case a fully efficient output will take place at Y = 40, X = 93, where price line T_5 touches the production possibility curve at the intersection of F_5 and F_6. Since both factor F_5 and factor F_6 are fully

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1/ This target is closely related to the usual formal linear programming problem in which all of the output variables are reduced to a single objective function which is to be maximized. This single function assumes that the relative values of the outputs are given either through consumer sovereignty in a free market or from some source outside of the problem. A more restrictive example is to maximize the level of GDP as measured by a given set of prices. (Usually these are historical, but see target T_3.) We have referred to the 2:1 ratio as an inherent value to emphasize that it is frequently treated as a built-in scientific fact to be discovered rather than as an option to be adopted as a conscious choice.

utilized, there are four unknowns in the price system: P_x, P_y, π_5 and π_6. All the other factors have zero prices, since they are in excess supply. There were originally three equations in the price system, and the addition of the requirement that $P_x = 2P_y$ makes the entire system determinant. When this is solved,

$$P_x = \frac{1}{113}; \quad P_y = \frac{1}{226}; \quad \pi_5 = \frac{78}{113}; = .690; \quad \pi_6 = \frac{35}{113} = .310$$

Thus, the income distribution which would result from remunerating factors on the basis of their marginal productivity is fully determined as the residual variable. If this distribution will not support the target which has been imposed, it will be necessary to institute a program of income transfers so as to increase or decrease the demand for products X and Y as necessary or else to abandon the principle of free consumer choice.

Price line T_5' has been drawn parallel to price line T_5 but passes through the historically governing position where S_2 intersected F_2. T_5' represents various outputs which by definition have equal value. It is apparent in Figure VIII that there is a rather large area between the line T_5' and the fully efficient governing production possibility curve. If the price ratio is to govern, as has been assumed, any point within this area will be perceived to be an improvement over the historical position even though there is considerable inefficiency and none of the factors are actually fully utilized. This shifting of the accepted governing prices is very likely, therefore, to give the appearance of creating substantial progress although the question of whether the society would really be better off is at least debatable and is highly dependent on many assumptions which must be imposed from outside of the system of economic analysis.

A final possible approach to consider is to target a certain distribution of income which will result from allowing the market to compensate factor owners according to the marginal productivity of the factors. In terms of the example in the previous section, this amounts to specifying the distribution of income between inputs v, w, and z. Without getting into the detailed qualifications, it should be apparent that in many cases this can be done rather arbitrarily and the desired factor prices obtained as a dependent variable. Recognizing that not more than two of the factor prices can be non-zero, again a targeted price line would be determined which could be imposed on Figure VIII. This in turn will enable the planners to determine the necessary values for x, y, P_x, P_y, etc. This particular approach to targeting is not directly illustrated in Figure VIII, but it does suggest some interesting policy possibilities.

For example, assume that income receiving group z is believed to have a set of social preferences such as those represented by vector S_5 or S_6 in Figure VII. Moreover, assume that the historically prevailing preference vector has tended to be S_2 so that the second factor has governed the income distribution in the economy. The intention is to increase the return to group z at the expense of group v. It is felt that if this is successfully done, it will lead to factors F_5 and/or F_6 becoming the governing bottlenecks rather than factor F_2. Once accomplished, the shift of the social preference function will thus be self-perpetuating.

In this situation the leadership might consider imposing an artificial factor restraint which we have labelled F_8 in Figure VIII. The result of this new bottleneck is that factors F_1, F_2, and F_3 all become redundant and their equilibrium price is pushed to zero. Attempts to follow social preferences

U_1, S_2, and S_3 simply mean that F_3 is the governing restraint and π_3 would be critical factor return equal to 1. Ownership of F_8 may be vested in the government or privately in the new leadership. In either case, these funds can be readily transferred so as to create effective demands for product X, thereby reinforcing the movement of the social preference function.

Once the preference has been sufficiently shifted, the governing factor restraints will be F_4, F_5, F_6, or F_7, which will now merit positive factor prices. If the artificial factor F_8 is a sort of permit, successful shifting of the social preference makes the demand for the permits impotent and the permits themselves become in excess supply.[1/]

MULTIPLE TARGETS

We turn now to consider the implications of increasing the number of targets in a realistic situation. Up to this point this paper has been structured in two dimensions involving two outputs and two degrees of freedom. The combined effects of all of the factor restraints and the attempt to be on the efficiency frontier is to reduce the number of degrees of freedom by one. Thus, it has been possible to target either the amount of X or the amount of Y but not both. We have seen, however, that this single remaining free choice need not be used in setting either of these quantities. The choice can be used instead to target full utilization of a factor, a particular price ratio, or an income distribution goal.

1/ We might also notice in Table IV that although, historically, self-interest might have tended to unify groups w and z in opposition to group v, from the standpoint of earned shares of total national income, the imposition of the artificial restraint means that only the right half of the Table is operationally relevant and group w now finds itself allied with v in opposition to group z. This, of course, is strictly illustrative and depends on the way in which the particular Table has been drawn up.

The analysis could be repeated on a three-dimensional graph involving three final outputs. Then the factor restraints would be planes instead of straight lines, and the efficiency frontier would be represented as a complex surface instead of as a broken line. The effect of requiring full efficiency is again to reduce the number of degrees of freedom by one. This time two choices will remain.

In this case, two of the three output variables may be set arbitrarily but not all three. As in the two-dimension case each of the free choices may be used in other ways to set a price ratio, an income distribution goal, or to specify full utilization of a factor. In the two-dimensional model we found that setting a single target sometimes left a residual partial degree of freedom within a restricted range. A similar phenomenon will occur in the multi-dimensional cases.

It is difficult to show graphically but the analysis can be extended by analogy to any number of dimensions. Each dimension constitutes a degree of freedom. Each target which is set "uses up" a degree of freedom. As in the simpler case, the "target" can be in any of a variety of forms and is not restricted to quantity goals.

Expanding the number of dimensions in order to make the analysis more realistic not only makes the analysis more complex but it also makes a unique efficient plan more remote. The increased number of dimensions permits an increased number of targets, raising the question of how to measure development in terms of target achievement.

All societies have many goals, and either the concept of development is defined so as to include all goals or there will necessarily be arbitrary

choices to be made between economic development and other important (and legitimate) non-developmental goals. Choice is inevitable since there will be some cases where more of "X" is obtainable only by accepting less "Y." This key assumption forms the cornerstone of this paper.

The existence of so many goals and the desire for a measurement of development or achievement can be reconciled only by expressing the overall development as a function of the achievement of the various basic target components. Mathematically, most such functions can be closely approximated by other functions which take the form of weighted arithmetic averages. The major difference between any two such functions is in the arithmetic weights used.

In the two-product model, targets T_1 and T_2 gave weight only to the Y variable, and T_4 counted only the utilization of factor F_4. T_3 and T_5 gave positive weights to both X and Y, the former using historical prices as weights but the latter setting their relative importance independently. Alternatively, targets T_3 and T_5 could also be interpreted as giving specific weights to the employment of various factors or as arbitrarily imposing predetermined factor prices. The treatment of income distribution goals was suggested although not pursued rigorously.

When the basic model has been translated into a multi-dimensional construct, the same economic principles prevail at a more complex level. Instead of the weighted average of two variables, the measurement of development becomes a full-blown index number problem involving many variables and a consistent set of weights.

As a first step, we can assume that all targets are set in terms of physical quantity goals. Then the weights function very much as prices

indicating the relative values of the different output units. Such prices (or weights) have two extremely significant characteristics.

First, they are set "arbitrarily" in the sense that they reflect what the official planning technicians believe to be the relative contributions to effective economic development. They are not and should not be determined solely on the basis of analyzing historical price patterns.

The second characteristic is related to the first but not identical. Almost any meaningful development program assumes that changes will be necessary and/or desirable. This is equivalent to rejecting the historical market prices as being unsuitable.[1/]

There is no reason why such a scheme should be limited to output goals except for illustrative purposes. If other goals or targets are included as meaningful for development, they will enter into the measurement of development with non-zero weights. This is equivalent to giving them implicit valuation prices. Like all other weights (prices), these are "arbitrarily" assigned on the basis of expected contribution to successful economic development. Leaving such non-physical output goals and targets out of the index of development is equivalent to assigning them zero weights. Since this implies that they make no autonomous contribution to successful development, an efficient plan would attempt to minimize the scarce resources used to pursue such targets.

A general principle, applicable to both simple and multi-dimensional models can be illustrated by reference back to Table III which lists twelve different characteristics of each of the fifteen efficient sub-sets in the seven-factor model. Usually six or seven of these characteristics are non-zero, and an

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1/ See the discussion of target T_3, above.

efficient solution (ergo, an efficient plan) can be identified (as distinct from other efficient solutions and plans) by setting one or two of these characteristics as targets. Thus, two segments of a society may be pursuing quite different targets[1/] but supporting the same economic development goals. Groups pursuing over-all goals in the same or adjacent sub-sets (as presented in Table III) are likely to be able to find a common ground for a united front.

In contrast, groups pursuing drastically different goal patterns, such as U_1 and U_7 in the economic example, are locked in basic conflict - the equivalent of a zero sum game in which one group's gain is the other's loss. Both groups can adopt efficient but conflicting plans, each of which uses the most modern techniques available to pursue its own concept of economic development.

A major problem in many development plans is mobilizing broadly-based and whole-hearted support. This can most easily be done by dealing with each group on its own terms. The choice of which groups to appeal to and the terms on which to appeal to them is basically a political choice. However, when it comes to the economic development plan, the economist can be of major assistance in identifying which groups can be accommodated on a relatively costless basis. Their objectives will be consistent with the plan goals even though they are expressed in other ways.

The treatment of other opposing groups involves the development planner in an unavoidable political dilemma. Where two imcompatible visions of development priorities (on final targets) occur, the planner must either arbitrarily impose a balance between them or ally himself with one in opposition to the other.

1/ These targets will generally not be directly comparable to each other. The uncertainty arises from the absence of a positive proof that the different targets are mutually consistent.

Every plan will have at least an indirect effect on the distribution of economic power (through income effects), as well as of political influence. No responsible official will ignore these effects in setting national policy. Scientific planning should recognize these conflicts as potentially both creative and disruptive and build them into the plan. Abstracting from such basic political realities would be wishful thinking, not scientific objectivity.

CONCLUSION

The problems and principles in economic development exist at several levels of abstraction. At one extreme is the purely theoretical economic approach of general equilibrium. Here it is common knowledge that everything depends on everything else and that there are unresolvable problems in welfare economics.[1/] At the other extreme the individual decision-maker must say "yes" or "no" to thousands of individual proposals. His superiors have the task of giving him rules of thumb which will help him make the correct decision as frequently as possible.

Most of the rules of thumb which govern policy applications have evolved from an inter-action between selected principles from economic theory and experience gained in trying to apply these principles in practice in the real world. For example, a variety of project and program planning tools which modified the micro-framework to take some account of the inter-relationships between the parts of the project or program were found to be particularly efficacious where the desired ends were clearly defined in physical terms.

1/ For an outstanding example see K. Arrow, Social Choice and Individual Values, A fairly extensive literature has developed based on Arrow's work.

These tools were usually applied in a milieu where the long-run surrounding socio-economic relationships were accepted, with their gradual accommodation to change. Even though the planned program loomed large in the short run, the basic secondary objective was to disrupt the society as little as possible.

For the conditions in which they were first used these programming techniques had tended to produce single plans which approximated efficient resource utilization patterns. But a single pattern can be described in a wide variety of ways, and it can be discovered in many other ways. Furthermore, when the historical milieu has been consciously rejected, the concept of a unique efficient pattern of resource utilization itself becomes indeterminate. Economic analysis cannot discover a unique solution when none exists. Hence, a new dimension of freedom has resulted.[1/]

To develop the most appropriate plans and policies the economic planner needs more information - decisions about what the society wants to accomplish. It is widely agreed that this choice is essentially political rather than a

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1/ This is not a new discovery but a re-assertion of a recognized fact which sometimes is overlooked. For example, see M. F. Millikan, "Criteria for Decision-Making in Economic Planning," in Organizing, Planning and Programming for Economic Development. Carefully distinguishing between efficiency criteria and value criteria, Millikan says: "Value criteria are those that are concerned with how to make choices among the various alternative goals which are technically and economically feasible." (p. 28) Near the end of the article he adds: "If current prices were an adequate guide to social valuation, the choice among consistent plans would be based on a simple criterion. The plan which produced the maximum rate of growth of gross national product measured in current prices would then be the plan that maximized welfare. But for all the reasons already discussed, as well as others there is no space to go into, current prices are a poor guide."

matter of technical economics.[1/] However, the new freedom is multi-dimensional, a freedom to be arbitrary within limited ranges, not an opportunity to choose with reckless abandon. Because the restraints are technical and the freedom is political, communication between the disciplines is a sine qua non for intelligent policy.

Either the political leader must express his goals in technical jargon or the planning technician must devise his techniques so that politically determined choices can be received and used in any one of a wide variety of forms without requiring that they be expressed in the language most convenient and useful to the development planner. Neither the political leaders nor the planning technicians can or should be expected to abdicate the authority and responsibility which accompanies his particular job.

Most individuals in practice have a mixture of roles to play and the language of economic policy has always ranged over a continuum between the political and the economic. The development planning field is no exception. This paper has attempted to discuss the technical nature of some of the basic choices open to political decision.

The reason we have found the approach summarized in Figures V and VIII so useful is that it enables us to consider simultaneously several significant economic parameters which are more frequently dealt with sequentially one at a time. An adequate economic development program necessarily specified many different attributes of the economy. While it is difficult to keep an eye on

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1/ This is almost tautological. After the technical questions have been isolated and answered, there will remain additional degrees of freedom. The statement asserts that these must be answered through political processes rather than on technical grounds.

all of them, it is very dangerous not to do so.

These attributes of an economy can conveniently be divided into two groups. The first group of attributes are primarily useful in specifying the possible alternatives open to a society. Ignoring the many intermediate goods,[1/] these alternatives are essentially determined by the quantity of resources which are given and are in fixed supply.

The second group of attributes are more directly related to specifying what the society's priorities are. Many times issues in this area have been assumed away behind a vague oath of allegiance to "achieving economic development." We have tried to show that either achieving economic development is not precisely defined or that there are other major considerations which make such an oath rather useless. Real opportunity for arbitrary choice is inherent in this policy area. These choices tend to be expressed as targets, and we have concentrated our attention on three attributes which seem to be suitable for targets.

1. The attribute of an economy which is most frequently chosen for target setting in a development plan is the specification of selected physical outputs.

2. A second attribute which may be equally suitable for targeting is the set of value-coefficients or prices placed on the various outputs and resources within the system.

3. A third attribute which enters targets is the distribution of

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1/ Again we must emphasize that we have abstracted from all problems connected with intermediate goods. (See footnote on p. 52). Such problems are completely intractable until the issues raised in this paper have been resolved either by conscious political choice or by acceptance of a deterministic view of the options. We argue that the latter alternative is a scientific error.

income.[1/] The concept of income distribution is two-sided, and it is not clear whether or not the two sides are separable. One side relates to the receipt of benefits through remuneration of factors. The other side relates to control over the channeling of income so as to influence the social preference function which guides society.[2/]

It is apparent, and has always been implicitly understood, that these and other attributes of an economy are not independent of each other. Every society has a certain pool of arbitrary administrative discretionary authority which it can impose on its internal social structure in any way it pleases. However, imposing a policy in one way has a variety of accumulated indirect effects which reduce the range of arbitrary administrative discretion in other parts of the social structure. For this reason certain combinations of policies are impossible even though each of the policies independently would be permissible as an instrument of pure administrative discretion.

In the introduction (in Figure I) we considered the possibility of shifting the demand for a commodity or factor (from D to d_2), thereby increasing both the quantity clearing through the market and the unit price. Directly or indirectly this particular shift is certain to increase both the amount and the share of National Income (wages, profits, etc.) originating in this particular part of the economy. Even if the output is stockpiled, it will involve an increase in

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1/ In this connection it is most useful to think of income as a flow of money or credit related to the accumulation and expenditure of influence in the determination of social policy. This avoids issues of whether the accounting concept of earned income is universal or peculiar to Western cultures.

2/ There is an extensive literature on this topic in all of the developed countries. It could be sub-sumed under a broad title, "The Divorce of Ownership and Control Within Economies."

this component of measured GDP either as inventory accumulation or as Government Expenditures.

If the primary aim of such a market policy is to effect the distribution of buying power, the physical quantity of output will function as an intermediate variable. Its derived usefulness may be completely independent of any value it has as a physical input or as a final good.

This is by no means a trivial or academic proposition. As noted earlier, the same item may be a targeted final "good" in the short-run plan but an intermediate "good" in the intermediate or long-run plan. This distinction is particularly pertinent with respect to income distribution criteria. What may in the short run seem to be windfall gains or confiscatory tax payments may eventually prove to have important incentive effects (on the grandchildren?) or may rechannel funds into human and non-human capital formation rather than into habitual or modern conspicuous consumption.

The result is that the concepts of final output, intermediate goods, and scarce productive factors become ambiguous. If these terms are defined in terms of economic function, the limits of each category are conceptually a matter of socio-political decision making and may have little resemblance to everyday definitions in physical or engineering terms. If accepted common-sense definitions are merely sharpened and refined, their economic usefulness depends on an assumption that only the physical characteristics of production and output are of significance. In practice, this latter assumption is socially and politically acceptable for only an extremely narrow group of problems. It has been universally rejected as too restrictive for issues of overall social policy.

The interdependencies between prices, quantities, and income distribution are widely recognized both in theory and in practice. The point which tends to

be overlooked is that the basic arbitrary discretionary authority in a society to a very large extent also includes the ability to arbitrarily choose where the substantive arbitrary administrative decisions will be introduced into the system. Arbitrary price ratios, arbitrary income distribution goals, and arbitrary choices of particular factors to be fully utilized are fully legitimate as targets of development policy as are arbitrary specifications of particular quantities of output.

Under conditions of full knowledge it would make little difference which form the targets took since they could be readily transformed into any of the other forms. In the real world, however, none of the variables can be exactly measured and none of the functional relationships are precisely known. To insist, for example, that income distribution goals must always be translated into targets expressed in quantities of output is to introduce the probability of compounding errors merely for technical convenience.

A significant feature evolves from combining a short-run, micro-economic approach to planning with the necessity of including non-material components in an adequate index of development. If income distribution, full employment, and other similar goals are regarded as very important, it may be desirable to create "artificial" demands and supplies for certain products as a means to these ends. Over a long period of time such "artificial" demands may be replaced by "real" demands connected with induced changes in production functions and in the supply of complementary resources. Nevertheless, for purposes of short-run planning such "artificial" demands may easily be the most efficient means of fulfilling the desired short-run goals.

We thus bring the discussion full circle by returning to the relationship between decision-making prices and market prices. Both concepts originated within a theory of laissez-faire competitive prices. But the key assumption

necessary to efficient decision making in a competitive system is that the individual decision-making unit faces highly elastic supply and demand curves in all markets. This requires that there be ready substitutes available, a condition approximated either by having a large number of buyers and sellers or by allowing a very long time for adjustments to take place. Realistically, the competitive model now seems tied to either a long-run or a world-wide point of view.

In contrast, market price analysis in practice tends to focus on the short run. Thus it is extremely conscious of the income and revenue effects of price changes. These effects, in turn, are non-negligible because of bottlenecks and indivisibilities in short-run production and distribution functions. These market imperfections also determine the limitations and the power behind market price policy. Where effective market price policy is possible, policy norms must come from some non-market criteria. The search for such criteria is part of the search for decision-making prices.

As a result of this contrast between the two price concepts, the time dimension in price theory can no longer be avoided. How long can a society wait for the desired competitive market adjustments to take place? How long will it be before undesired competitive forces arise in the market to eliminate the effectiveness of a given policy?

This time aspect of the proper role of prices, this conflict of function, becomes especially critical in the search for rapid economic development. Above all others the development planner wants to achieve some concept of long-run economic efficiency as soon as possible. In many cases the political powers to whom he is responsible are anxious to have most of the future benefits re-discounted in some fashion so they are available <u>now</u> (or at least before the next election).

As a result, it follows that economic and political decisions become inseparable. The specification of a quantity target for a final good is a political decision. So is the specification of its price vis-a-vis other final goods. The concept of an intermediate good becomes a residual, asserting the absence of a political decision to give it value independent of its usefulness as a means to other ends. The market price of a factor has an impact both on the income of the factor owner and on the efficiency with which the factor is utilized. It is a political decision which holds one impact to be more important than the other and balances these against other price and output targets.

Recognizing the nature of these conflicts does not automatically resolve them. As previously noted, perhaps the best that can be hoped for is a dynamic tension in which the various opposing forces are each recognized to play a legitimate role. In this way each may be evaluated and a conscious choice made by a political balancing of the alternatives.

Thus the initial search for an objective approach to price policy somewhat independent of political decisions ends not in a mere failure to find such a combination but in an assertion that such a combination does not exist. Because of interdependence, even prices on intermediate goods become sensitive to political decisions. We are not happy with such a result, but recognizing it is preferable to denying that these political choices are necessary or to pretending that the difficulties can be completely resolved as soon as perfect knowledge about the economy has been obtained.

The choice of where to be arbitrary is after all the political prerogative of the policymakers - not of the planning technician. These choices should be accepted by the planners as given and the analysis and plan built around them.

Frequently, of course, this means the plan is neither as precise nor as neat as a professional economist might desire. But assumptions of *ceteris paribus* are not completely harmless. Sometimes the *ceteris* amounts to the *status quo ante* which is being attacked from all sides. Treatment of such unrealistic assumptions as inviolable restraints on policy should either be condemned as a violation of professional ethics or accepted as evidence of technical incompetence.