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Government decision-making requires the allocation of scarce resources among alternative uses. Economic theory usually simplifies the problem by assuming that some "objective function" is known, and then working out conditions of efficient allocation.

In government, especially at higher levels, the decision making process must be designed both to determine the objective function and to achieve an efficient allocation, and the two processes are highly interdependent. Government programs are given operational meaning in the process of choosing among alternative courses of action, leading in the same general direction.

At the highest level, the president makes proposals to withdraw resources from private use, and allocate them among various private uses in ways that will advance the general welfare. In view of the overall scarcity of resources, he must consider the competing claims of various public activities with each other, and the competing claims of the public and the private sectors. In an authoritarian society, notions concerning the relative merits of various activities may stem from the Olympian mind of a dictator or a planning board. In a democratic society, the president is helped or hindered by the advocacy of competing claims through elections, through other direct forms of political pressure, through expressions of public or private opinion, and in a host of other ways. Action is not taken in response to some

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clear blueprint of the general welfare; rather, concept of general welfare becomes articulated in the process of decision making.

The president is concerned broadly with defense, internal law and order, welfare and development. National goals in each of these broad areas are also general conceptions, which must also be articulated before an overall program for the government can be formulated. To illustrate the entire problem, and to avoid some of the complications arising from allocation between the public and the private sectors, I shall consider, in a very rudimentary way, the allocation of a given budget for defense.

I deliberately choose as my example the high level problem of optimizing the entire defense program, rather than a lower level one of optimizing, say, a particular weapon system. High level and lower level problems raise the same issues; and the difficulties to be surmounted are more vividly revealed when the former are used for illustration.

Defense is not, and never can be, measurable in the cardinal sense. It includes elements such as deterring attack, capability to win if deterrence fails, limiting damage to populations, and so forth. It cannot be reduced to units where each unit represents the same "amount" of defense. However, defense may be measurable in the ordinal sense. For coherent decision making, it seems necessary to speak of more or less defense, to say whether situation A represents more or less defense than B, and so forth. If a consistent ordering of a number of situations can be achieved, a numerical index of defense can, in principle, be constructed. But an increase in the index simply means that there is more defense. It does not say how much more. Such an index should obviously indicate our capability to deal with a (changing) external situation. To simplify the discussion, I assume that the outside world remains unchanged, except insofar as it is affected by our own actions.

Since experiments with enemies are not feasible, defense situations must be compared by intellectual processes, which include theorizing, empirical analysis, introspection, war gaming, appraisals of the enemy, and so forth. To perform these operations defense must

be broken down into meaningful components.

Suppose strategic theory concludes that the meaningful components for the present and the foreseeable future are strategic capability and limited war capability. Defense (D) depends in ways to be discovered on strategic capability (S) and limited war capability (L).

Assume for the moment that S and L can be measured in cardinal terms. The budget can be allocated so as to "maximize" defense if the minimum costs of varying amounts of S and L can be ascertained, and if their relative military effectiveness can be ascertained. Assume the cost side of the problem can be solved. This involves no insuperable problems if S and L are measurable quantities.

The question of effectiveness can be approached by examining substitutions between S and L that will yield equivalent defense situations. Political experts, strategists, and analysts attempt to determine trade-offs between S and L, taking into account reactions of potential enemies. An increase in S means less risk of general war. A reduction of L means greater risk of limited war. If these risks can be weighed against each other in the minds of the decision-makers, an indifference curve (or a segment of a curve) relating S and L can be found, based on some initial point of S and L.

If a different starting point is taken, a new curve can be formed, and so on. If none of the curves intersect -- and it would be unreasonable to suppose that they do -- all the curves must have the same functional shape, say $D = f(S, L)$. D then can be used as an index of defense; an increase in D means an increase in defense, but nothing more than that. The study of position of indifference does in short permit us to say whether given changes in L and S jointly increase or decrease defense.

A sharp distinction, however, may have to be drawn between small and large changes. Analysis of the existing defense structure may reliably indicate the consequences of small changes of S and L, but extrapolation of these results may be invalid. (In mathematical terms, integrability conditions may not be satisfied.) To take a concrete example: a country may be following a policy of massive retaliation. An analysis may reveal that a small increase in S at

the expense of L will strengthen its position. However, what the situation may really call for is a revision of strategy, involving a large decrease in S and a large increase in L. In such a situation an index cannot be constructed. Small and large changes have to be considered separately. But in either case decisions have to be made, whether changes, large or small, will improve or worsen "defense." For the moment, I shall assume either that an index can be constructed, or that we are concerned only with small changes in S and L.

If the prices p and g of S and L are known, the allocation of a given budget that will maximize D can be found. The necessary condition is the familiar one that the marginal rates of substitution between S and L should be proportionate to their prices.

With the prices of S and L given, an alternative index, that will order defense situations in the same way, can be constructed in terms of expenditures on S and L rather than their quantities. Thus $D' = \emptyset(pS, gL)$. Optimizing with this index yields the same allocation as before, with the condition that the marginal rate of substitution between x dollars spent on S and x dollars spent on L should be unity.

We must now return to the assumption that D can be considered in terms of factors that can be measured in quantitative terms. Efforts have been made to think of strategic deterrence in cardinal terms, such as numbers of enemy targets destroyed. While such measurement may be useful at "lower levels," it does not give an adequate picture of strategic forces. It takes no account, for instance, of the protection of the country if deterrence fails. No one has even attempted a cardinal measurement of L. In fact, it is very clear that S and L themselves can only be measured, if at all, ordinally; and the most we can hope for is to construct indexes of them, as with D itself. This difficulty is inherent in the situation.

The factors S and L should be selected with a dual purpose in mind. In the first place they must provide an adequate basis for strategic analysis. They must illuminate the objective of defense itself; and must therefore be categories whose defense significance can be appreciated. Secondly, however, they must be concrete enough

to be analyzed in terms of their cost. The question "can we achieve the present level of deterrence at lower cost" is relevant and significant.

Strictly, measurement of quantities and prices is only possible for uniform commodities, sold in a competitive market economy. The closer one gets to the market the more measurement is possible as an approximation, but the further one gets away from categories that are strategically relevant. A compromise must be made; and it can be taken for granted that the first breakdown of a major objective must be into factors that can only be measured in ordinal terms. Thus not only D, but S and L as well, are, at best, indexes.

If S and L can be resolved into primary factors whose quantities are measurable, indexes of them can be constructed in the manner described above. The index of defense would then depend on those indexes. To construct indifference curves relating them, analysts would have to make qualitative appraisals of the effects of given changes in the indexes on strategic and limited war capabilities respectively.

To allocate the defense budget it is also necessary to attach prices to given changes in the indexes. This is generally impossible because a given change in the index can be achieved through a great many different combinations of changes in the factors that compose it. If for $S = \theta(P, M)$ the cost of a change in S will depend on the combination of P and M used to accomplish the change and on their prices.

This difficulty can be overcome if S and L are always optimized, in terms of their factors and their prices. If a series of given budgets spent, say, on S are allocated between P and M so as to maximize S, we can obtain an optimized index of S in terms of the budget for S.

Fig. 1

Figure 1 shows indifference lines between P and M, and relative price lines corresponding to budget levels B_1 , B_2 , and B_3 . The length of the line OS joining tangency points, or some increasing function of it, can be used as an optimized index of S, which, with given prices of P and M, is a function of B_S , the budget for S. Similarly L is a function of B_L . Let $\bar{S} = \Psi_S(B_S)$, and $\bar{L} = \Psi_L(B_L)$. Ψ_S and Ψ_L are then the marginal costs of $\bar{S}$ and $\bar{L}$ to the government, and a transformation curve relating $\bar{S}$ to $\bar{L}$ can thus be drawn.

The defense budget as a whole can now be optimized either in terms of $\bar{L}$ and $\bar{S}$ or in terms of B_S and B_L in the manner described above, and illustrated by Figs. 2a and 2b.

Fig. 2a

Fig. 2b

The notion of discovering indifference relations between ordinal indexes is sufficiently unusual to call for further comment. $\bar{S}$ can be thought of as an ordering of defense situations $s_1, s_2, s_3 \dots$, with each numerical value of $\bar{S}$ indicating a particular situation. Similarly $\bar{L}$ represents an ordering, $k_1, k_2, k_3 \dots$. Suppose the initial position is k_n, s_n . Then if a change to s_{n+k} is contemplated, military analysts can consider the compensating change in $\bar{L}$ to, say, k_{n-j} that will leave the defense "posture" unchanged. Alternatively one can think of a given measure in the budget for S, and the compensating decrease in the budget for L.

As a practical matter, however, there is a distinction to be drawn. The concept of ordinal indexes and comparisons between them is a highly abstract one for practical decision-makers. On the other hand, comparison of the relative merits of spending given amounts of money in different ways is one that every administrator is familiar with. The ordinal indexes are implicit in the comparison, but it is probably better that they remain implicit. Attempts to use them explicitly can easily lead to their interpretation as cardinal indexes, which may be positively misleading.

Use of budgets, of course, does not mean that defense planning becomes a matter of finance. Each level of the budget represents a concrete defense situation. Analysis should be directed towards determining whether the same budget can be used to achieve a preferred level of S or L (that is, whether the costs of S or L can be reduced), as well as whether there should be substitutions between S and L.

The foregoing discussion has been based on highly restrictive assumptions. It has assumed that the "factors of production" of S and L and the techniques of using them are fixed and discoverable, and that the contributions of S and L to D are similarly fixed and discoverable. It has assumed, moreover, that one can proceed by way of sub-optimization of S and L to optimization of D. In short, the index of D is of the form

$$D = f [S (x_1, x_2), L (y_1, y_2)],$$

where the primary factors x_1 and x_2 are known and relate exclusively to S, and y_1 and y_2 relate exclusively to L. Decisions must still be made, even if these neat simplifying assumptions are not fulfilled. Let us consider a number of possibilities.

(1) One or more of the variables may influence not merely S or L, but they may influence both S and L or may influence D independently of S and L. The index function may then be of the form

$$D = f_1 [x, S(x_1, x_2), L(y_1, y_2)]$$

or

$$D = f_2 [S(x_1, x_2), L(y_1, y_2, x_1)].$$

To give concrete examples: In the first case Polaris missiles may be not merely a factor influencing S, but they may influence D as a whole, through their effect on relations with allies. In that event, sub-optimization of S will not be the way to optimize D. However, L in this case can be sub-optimized. As an example of the second case, the Polaris may be primarily a factor affecting S, but it may also have an L capability. In that event, neither S nor L should be sub-optimized.

In such cases the logical answer is not to sub-optimize at all, but merely to optimize in terms of x_1, x_2, y_1, y_2 . But the problem is far too complicated for that. It would be absurd to think of trying to discover rates of substitution among a host of primary factors. If our strategic doctrine is correct, the distinction between S and L is important, even though they cannot be separated into watertight compartments. The only answer I can give to the dilemma is organizational. S and L should not be organized or separate empires, and their optimizations in their own domains should not become established doctrine. Deliberations in each area should be continually influenced by officials whose function is to be aware of the complicated inter-relationships involved.

(2) Even though sub-optimization is considered possible, new

factors may affect the composition of S or L. The use of air transport instead of overseas bases for L purposes is a possible example. Even if this substitution only affects L, it will produce a new index of L. Consequently not only is a new sub-optimization required, but a new optimization as well. The indifference curve relating S and L will not be the same as before. Once the new system is installed, modifications can be thought of at the sub-optimization level. But at the time of its installation, all its defense implications must be considered.

If the new system can be introduced, in relatively small increments, one can think of the problem of introducing it in terms of substitutions between the new system and existing systems for both S and L taken together. Again, the most convenient, and probably the only feasible, way to do this is in terms of budgets. Starting from the existing situation, one considers whether the defense situation will be improved by spending, say, \$1 billion on the new system and contracting old systems (in an "optimum" way) by the same amount. The process is carried on for successive increments, until the benefits of the last increment are balanced by the disadvantages of the last contraction. (The procedure involves constructing segments of an indifference map between the new system and existing systems and finding a point of tangency with the budget line.)

(3) The changes involved may be large ones, dictated, for instance, by abrupt changes in the external situation; new technologies, such as the advent of nuclear weapons; and consequent changes in strategic doctrine. Here attempts to use incremental methods, and even to apply quantitative notions to comparisons of defense situations are almost meaningless. It makes little sense to say we have more or less defense today than we had in 1950 or 1938. If there is an option between making a large change and avoiding it, a complete program should be prepared, incorporating the change, and it should be compared in its entirety with the existing program. It may not even be feasible to work within the framework of a given budget. Only when a choice has been made can the principles of rational conduct begin to reassert themselves in making minor adjustments.

This discussion has been concerned with allocating a given defense budget. It does not determine the appropriate size of the budget. There may be threshold considerations that dictate that a defense budget below a certain minimum level is worthless. Beyond that, the level of the defense budget is determined in competition with the claims of other government programs and with those of the taxpayer.

The claims of various programs can be asserted and assessed if a number of optimized budgets for each of them is prepared and the consequences of shifting resources from program to program are explored. Allocation among major government programs is similar to allocation of the defense budget between S and L, and allocation between the total public sector and the private sector is achieved according to the same principles.

The central purpose of this paper has been to demonstrate the fundamental role of choices among alternative courses of action in government decision-making. The process of choice not only points to the most efficient way to attain given objectives, but is basic to the determination of the objectives themselves. Decision-making thus involves not merely determining how given objectives can be attained at minimum costs, but also exploration of the variety of ways in which resources can be effectively employed. Recognition of the latter aspect of decision-making has evoked a new set of concepts such as program budgeting, cost effectiveness, and systems analysis. In this paper I have attempted to examine the nature of decision-making in terms of standard economic theory, and, hopefully, to throw further light on the implications of the new vocabulary.

Recognition of the role of choice among alternatives should have an important bearing on government organization and procedures. I conceive of effective government decision-making as consisting of adversary processes, analogous to processes in the legal field. The proponents of alternative courses of action should state their claims, marshal their evidence, produce expert testimony, and perhaps cross-examine the other side. Someone in authority then has to make a choice. As in a legal case, the correctness of the decisions can

rarely be judged by any objective standards. Their validity depends on the methods by which they are reached.