WELFARE ECONOMICS AND GOVERNMENTAL PROGRAMS

WITH AN APPLICATION TO HIGHWAY FINANCE

DISSERTATION

Presented in Partial Fulfillment of the Requirements
for the Degree Doctor of Philosophy in the
Graduate School of The Ohio State
University

By

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The Ohio State University
1958

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PART ONE

WELFARE ECONOMICS AND GOVERNMENTAL PROGRAMS
CHAPTER I
INTRODUCTION

This study attempts to establish and to apply a body of economic criteria for the financing of those governmental programs to which the term "subsidy" is often applied. For lack of a generally accepted term, such programs are described in this study as those which lie in an "in-between" area. The chief characteristic of in-between programs is that they are operated with revenue derived from both prices (direct sales to consumers) and taxes (compulsory payments levied through collective action). Basically, such programs are aimed at the simultaneous satisfaction of both private and collective demands. Examples may be found in the transportation and public utility industries, the postal service, school programs, health and social insurance programs, programs for the protection and development of infant industries and many others. In these areas, the subsidy and its corollary, the tax,

1 A number of terms appear in this introductory statement which require definition. However, the terminology is developed at length in the text, and it is not convenient or necessary to attempt elaborate refinements at this point. One of the aims of this study is to establish more meaningful uses of the terms, "tax," "subsidy," "market," "collective," and "social." For the moment, it is suggested that the reader overlook what may appear to be an indiscriminate use of these terms.
represent values which the market either overlooks or deliberately rejects. Subsidies and taxes represent the difference between market and social value. But such payments cannot be evaluated until the unexpressed social magnitudes are at least defined and, if possible, measured. Almost anything can be justified in the name of an undefined and unmeasured social or public benefit.

In dealing with many governmental programs, economic analysis is confronted with the dilemma of working within both private and public sectors at the same time. Although the general abstract rule for an economic optimum - marginal social cost equal marginal social benefit - embraces both sectors, it appears to have had almost no direct impact on the financing of governmental programs. The rule has not been given enough content for concrete application. Government administrators and many students

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2This rule is associated especially with the work of Pigou, infra, p. 19, and Lerner, infra, p. 23. A similar but considerably more comprehensive formulation is characteristic of the work of the modern social welfare school represented by Bergson, infra, p. 16. Obviously, the significance of the rule depends upon the meaning attributed to the term social.

The term marginal may also be interpreted in a variety of ways. To the mathematician, it implies an infinitesimal change. To the applied economist, it may represent any size of change that is appropriately considered an addition. In the latter sense, the marginal amount may be quite large and may include all changes other than those associated with new investments and new products. And, of course, even these changes become marginal from the vantage point of the macro-economist. The point of view adopted in this study is that of the applied economist. It is maintained at a later point that most "lumpy" changes can be brought into a relation with marginal analysis. For an excellent discussion of various interpretations of the margin see A. P. Lerner, The Economics of Control (New York: The Macmillan Co., 1944), pp. 212-227.
have rejected the rule, marginal social cost equal marginal social benefit, on the ground that it is a useless abstraction. Some progress in the direction of more satisfying evaluations of governmental programs will have been made if the term social as it is used in applied economic analysis can be given a more specific meaning.

Notwithstanding the fact that all in-between programs are concerned with the identification and measurement of social value, a casual examination of economic literature reveals that the analysis of such programs is scattered over a variety of applied fields. As a general rule, these analyses have little relation to one another or to a unified framework of analytical principles and welfare standards. More often than not, notions about the market, social welfare, benefit or value, equity and administration are treated simultaneously and without distinction in the consideration of governmental programs. The result is a considerable amount of conflict and misdirected effort. The nature of the dilemma is illustrated by the well-known conflict between regulatory and promotional policies in the transportation and public utility

3 Neither this rule nor the term social benefit is mentioned in one of the most popular textbook treatments of government finance, Harold M. Groves, Financing Government (4th ed.; New York: Henry Holt & Co., 1954).

A sympathetic treatment of the rule is found in John Due, Government Finance (Homewood, Illinois: Richard D. Irwin, Inc., 1955), pp. 27-45. Due accepts the formal validity of the rule, but is sceptical about the possibility of application.
industries. In the main, regulatory policy is concerned with the determination and evaluation of prices in accordance with market standards, while promotional policy is concerned with a broader conception of social welfare requiring the determination and evaluation of taxes and subsidies. This dichotomy or duality of standards is characteristic of most in-between programs including the highway financial programs to be examined in the latter part of this study. A conceptual reconciliation of these two standards or, perhaps, their replacement by a single standard might help to eliminate some of the conflict that plagues public policy. Many will also agree that the economist's peace of mind requires the elimination from economic analysis of as many schizophrenic elements as possible.

The conflict of standards characteristic of in-between programs has its parallel in the frequently vague and distant relationship of orthodox economic theory to applied economics. The supreme role of rational, individual economic choice in orthodox economic theory appears to be at odds with the highly institu-

4 This conflict is considered at length in Charles L. Dearing and Wilfred Owen, National Transportation Policy (Washington: The Brookings Institution, 1949).

5 Although Arrow has shown that a completely consistent social welfare function cannot be developed within the stringent limitations imposed by modern welfare economics, it does not follow that progress cannot be made on a more modest scale. Arrow himself points to some of these possibilities in his discussion of "single-peaked" preferences, and partial unanimity. Infra, pp. 18, 56.
tionalized interrelationships with which applications must deal. An aggravated conflict appears when the term social welfare is given an organismic interpretation involving (in its most extreme form) a personification of The Ship of State, The Nation or Society. On this view, social welfare is somehow different or greater than individual welfare. Such a conception of social welfare is implicit in the prevalent view that taxes are a "burden" which the individual must "bear" for the "good" of society. Although some students are willing to accept this conception of social welfare along with its ethical implications relative to the significance of the individual, those who cling to a more individualistic ethic are confronted with the problem of reconciling individual and social welfare. The lack of consistent terminology and analytical tools for relating individual and social magnitudes serves to aggravate the dilemma. Although a complete reconciliation may not be possible, some progress will have been made if a more meaningful terminology can be developed. The distinc-

6 It should be noted that there are various shades of the "organismic" view ranging from the extreme mysticism of the German Romanticists represented by Adam Muller to the almost orthodox conceptions of collective action held by John R. Commons. Veblen, Ayres, Smuts and other "institutionalists" or "holists" occupy a position somewhere within this range. This "classification," of course, is a vast oversimplification of the strands of thought represented by these writers.

tions between "individual," "social," "market," and "public," "private" and "collective," along with many others are not always clear and often have an emotive force that obscures communication. Consideration of the problems posed by in-between programs should cast some additional light on these distinctions because such programs cannot be evaluated from a vantage point which does not consider both aspects of the problem.

An abstract framework of analytical tools and standards for even a limited approach to the problems described above clearly is desirable. However, abstraction must withstand the challenges of the real world. It is in this respect that the abstract rule, marginal social cost equal marginal social benefit, appears to have failed. Whether or not he wants, or even ought, to accept the challenge, the fact is that the burden of proof has somehow been placed on the theorist who constructs the abstraction. Establishment of the analytical framework represents only a portion of the task before us. It is necessary to test the abstractions by bringing them into relation with the specific problems of the real world.

Accordingly, a large part of this study is concerned with an application of economic welfare standards to an important in-between area -- highway finance. A review of the methods devised for financing roads and streets bears out the contention that general economists and transportation economists "have tended somewhat to drift apart in recent decades, with each group going its
own way indifferent to the work of the other." This tendency to "drift apart" is another aspect of the general problem previously described. It becomes manifest in the field of highway finance where both the transportation economist and the tax economist appear to have a different approach to the problem. Upon examination, the source of this difficulty appears to lie in the preoccupation of one group with "market" standards and rate-making and the predilection of the other with "social" standards and tax equity. Resolution of this conflict may be possible if some light can be cast upon the more general problem described earlier.

In addition to providing a test for an abstract framework of general principles, consideration of the problems confronting highway finance should lead to some conclusions relative to current highway financial policy. Since highway services involve the use of public facilities, highway financial policy gives rise to sharp and varied controversies. These controversies, in one form or another, center around the influence of highway financial policy on the allocation of traffic and resources. Highway user taxes act as prices for the use of highways, thus influencing the allocation of traffic (and resources) among the various transportation agencies. Assuming that optimal use of the transportation system is one of the aims of public policy, it is important that highway

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user tax rates be constructed so as to foster attainment of this goal. However, this does not imply that highway finance should reflect only market values. It is equally important to segregate, identify, and allow for those values which may not be reflected through the economic choices of individuals. Highway finance must consider both private and collective demands.

The inauguration of a vastly expanded federal highway program adds urgency to the need for an economic system of highway finance. An expanded highway program will provide additional capacity for commercial motor transportation. This may serve to strengthen the domestic transportation system. On the other hand, the program raises the possibility that the domestic transportation rate structure, already marred by the historical existence of excess capacity (which may be either desirable or inevitable), may undergo further deterioration. Although highway user charges pro-

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vide by far the largest portion of revenue devoted to roads and streets, the railroad industry continues to maintain that commercial motor vehicle transportation is being subsidized with public funds. Nor are the commercial trucking interests to be denied. They do not hesitate to point to social benefit and to the public interest when the question of cost allocations is raised and stoutly maintain that they "pay their way." Although these questions are not likely to be answered to the satisfaction of all the groups concerned, their solution requires the definition, segregation and, if possible, the measurement of both private and social magnitudes.

It is hoped that the abstract framework with which this study begins may contribute something toward the solution of this pressing public policy problem. It is appropriate now to set forth the method and outline of the study and to state more explicitly the major hypothesis to be investigated.

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10 It is interesting to note the consistency with which spokesmen for the commercial trucking industry refer to the Interstate Highway System as the "National Defense Highway System" while spokesmen for the railroad industry describe the same Interstate Highway System as "The Commercial Highway System." For many evidences of this controversy between "private" and "social" or "public" magnitude see U.S., Congress, House, National Highway Program, Hearings before the Subcommittee on Roads of the Committee on Public Works, 84th Cong., 1st Sess., 1956 on H.R. 8836 (Washington: Government Printing Office, 1956).
Method and Outline of the Study

The Analytical Framework

The analytical framework which is developed in this study attempts a transition from individual welfare to social welfare without at the same time bringing about an unconscious shift in value premises. If it becomes necessary to shift premises in bridging the gap between individual and social value, it is felt that the shift should be recognized explicitly. In order to accomplish this transition, the assumptions, procedures, and standards of modern welfare economics are adopted. There are three important elements in this approach: (1) the individualistic ethic, (2) the removal (but not necessarily the rejection) of interpersonal comparisons of utility, (3) the evaluation of public policy in terms of a Compensation Principle. These limitations mean that a distinction is maintained between economic efficiency and distributional considerations. Obviously, a conception of social welfare which eschews the distribution of income is far too narrow for general policy prescriptions. Nevertheless, it is possible to develop, within the limitations imposed, a concept of social welfare that appears to be useful for the analysis and evaluation of those governmental programs which are not based explicitly on distributional considerations. In effect, this portion of the study represents a step toward partial specification of the Bergson So-
cial Welfare Function. It also casts some light on Arrow's conclusions relative to the possibilities of specifying a social welfare function.

To provide a basic point of departure, the study begins with a description and uncritical review of the optimum allocation of resources posited by modern welfare economists (Chapter II). This review reveals the need for substantial modification if welfare principles are to be applied to programs which may be aimed in part at the satisfaction of a collective demand. An analytical means for making these modifications is found in the Marshall-Pigou conception of external economies and in the relaxation of the initial assumption that individual welfare is a function only of the goods and services held by the individual (Chapter III).

Extension of the external economies logic provides the basis for an analysis of collective demand in terms of individual demand functions (Chapter IV). This analysis leads in turn to an interpretation of government activity which rejects the usual implication that taxation is a "burden" to the taxpayer. At this point it becomes possible to reintroduce some old but still vigorous ideas concerning the welfare basis of taxation. These ideas appear to have been advocated initially by Wicksell, Pareto and de Viti de Marco. Consideration of these early contributions es-

\[11\text{Infra, p. 16.}\]
\[12\text{Infra, p. 18.}\]
establishes a theory of taxes and subsidies conforming to modern welfare criteria and leads to a partial reconciliation of price theory, tax theory and modern welfare economics (Chapter V).

The Application

The remainder of the study represents an attempt to employ the framework in the resolution of current issues confronting highway financial analysis. Currently, there are two competing approaches for the solution of highway financial problems -- the "benefits-received" method and the "pricing" method. Each approach is evaluated in the light of general economic theory and the criteria postulated by the analytical framework (Chapters VI and VII). These evaluations bring the current issues to the fore and provide the basis for the contention that both approaches to highway financial policy require modification. The issues are resolved and the outline of a revised theory of highway finance is set forth (Chapter VIII). The application to highway finance concludes with the establishment of working relationships for the implementation of a revised theory (Chapter IX).

Major Limitations of the Study

The chief limitations imposed by the decision to adopt the standards and procedures of modern welfare economics have already been noted. However, there are additional limitations of a theoretical and practical nature which ought to be noted.
Basically, the study relies on the welfare standards appropriate to static equilibrium conditions. Although the application considers adjustments to changes in demand and gives limited attention to the question of time lags in the adjustment of supply, it is not concerned with standards for highway development and investment except as these are implied by the system of highway finance. Similarly, the decision to limit the study to the problems raised by prices and taxes restricts attention to allocative decisions susceptible to marginal analysis. These are significant limitations because they subordinate the problems of development, growth and investment to those of rate-making. A complete picture might reverse these positions. These limitations are imposed by the desire to restrict the scope of the study as well as by the current status of economic theory. In order to maintain perspective, frequent reference is made to these limitations and, from time to time, the discussion digresses in order to suggest the means for taking them into account.

A further limitation on the application to highways is imposed by the decision to direct attention to the identification, segregation and classification of the economic factors impinging on governmental programs. This requires that the system of highway finance be evaluated in terms of economic welfare standards unalloyed by administrative and political considerations.

Jurisdictional, administrative and other problems associated with the institutional setting receive attention only to the
extent that they contribute to an understanding of the basic economic issues involved. Although this limitation makes the discussion less specific, it does not make it less realistic. In order to provide working rules for the administrator, a chapter is devoted to the establishment of a new set of operating principles for highway finance.

Although the technical problems associated with the allocation of highway costs receive limited attention, a revised basis for the incremental allocation of highway costs is set forth in the final chapter. It is anticipated that current efforts by the United States Bureau of Public Roads will eliminate many of the difficulties in the way of a more satisfying allocation of highway costs.\footnote{Summary}

This study is directed primarily at the analytical and conceptual problems which confront economic analysis when both private and public sectors must be considered at the same time. It attempts to bring together into a systematic framework several strands of economic analysis -- price theory, tax theory and welfare economics.

\footnote{\textit{Section 210 of The Federal-Aid Highway Act of 1956}, op. cit., requires the Secretary of Commerce to inaugurate a comprehensive highway cost allocation study and to report to Congress not later than March 1, 1959.}
The major hypothesis is that it is possible in the abstract and in applied situations to bridge at least a part of the gap between individual and social welfare without abandoning the individualistic ethic. This hypothesis is tested abstractly through the development of a framework of analytical tools and principles which conform to the individualistic ethic; it is tested in the context of the real world through an application to highway financial analysis. A corollary to the major hypothesis is that it is possible for governmental programs which lie in the in-between area to be financed through a combination of prices and taxes without creating a conflict between individual and social values.

The methods of analysis employed throughout the study are deductive. Development of the framework is largely abstract, whereas the application takes into account the facts, but not the figures, of the real world. In short, the methodology adopted requires the application of abstractions in a highly factual context.
CHAPTER II

THE ECONOMIC OPTIMUM AND SOCIAL VALUE

The solution to the economic problems confronting governmental programs is but a part of a larger solution whose aim is to "economize" resources in general. To provide the basis for economizing the way must be cleared first by a description of an optimum or "welfare" maximizing resource allocation and then by the selection of general principles whose application will aid in the attainment of the optimum.

Traditionally, economic analysis has been concerned with a maximization problem. That configuration of resources which maximizes represents the "ideal" or optimum output. Once the thing which is to be maximized is set forth clearly, the attainment of the optimum is a matter of technique or administration. Therefore, we begin by considering those things which are to be maximized.

Bergson offers a point of departure by postulating a Social Welfare Function. An allocation of resources which renders this function a maximum is ideal. Much controversy centers around the shape and content of the welfare function. Bergson

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appears to consider it a function of individual welfare which depends in turn on the goods and services held or consumed by the individual as well as on the goods and services held or consumed by other individuals.\(^2\) Bergson's conception includes the distribution of income as well as external economies and diseconomies. However, in its most general form the Social Welfare Function may include anything that is relevant to welfare and even leaves the definition of welfare an open question awaiting a value or perhaps a "social" judgment. Bergson's function thus presupposes some sort of social preference scale which in a democratic society presumably would be derived from individual preference scales.

Most orthodox economists probably are willing to accept the judgment that individual preferences should count. But what weights are to be attached to the individual preference scales? Individual preferences might carry "equal" weights or they might be weighted by the distribution of purchasing power, political power or bargaining power, to mention but a few of the possibilities. Obviously, the "importance" of one individual as compared to another involves questions which go far beyond the confines of economic analysis. The situation would not be so difficult if answers to these questions could be borrowed from the philosophers

or moralists. Here too, however, these questions are unresolved. One writer facetiously suggests that we resolve the problem by asking "Superman."³

Another obstacle, pointed out by Arrow, relates to the difficulty of constructing, even on an abstract level, a social preference scale which is consistent with the individual preferences from which it is derived. Arrow concludes that no social welfare function can be derived which meets certain "reasonable conditions" and which is also transitive.⁴ Although Arrow's logic appears to preclude the possibility of a generalized social welfare function, it is felt that the conditions postulated by Arrow impose more conflict than actually exists. One of Arrow's conditions requires that the social ordering cannot be imposed by social code or custom. At a later point it is held that this condition precludes certain forms of "persuasion" and collective action that may be perfectly compatible with the individualistic ethic on which Arrow's analysis appears to be based.

Nevertheless, an all-embracing concept of social welfare appears to be out of the question, at least as far as current economic analysis is concerned. Since we cannot wait for "Superman" or for the methodology of the social sciences to advance to a


point that allows objective evaluation of the judgments required by such an all-embracing concept of social welfare, there is no alternative than to begin on a more modest scale. The approach taken in this chapter is to begin with a narrow conception of economic welfare and to attempt, through a step by step relaxation of the initial assumptions, to specify a broader welfare function that may have some relevance to public policy. Basically, this is the caeteris paribus approach of the Neoclassical School and represents a sharp contrast to the Bergson approach which attempts to solve the whole problem with one magnificent maneuver. If we cannot have the whole, there is no choice but to settle for less.

An Initial Economic Optimum

As a consequence of the difficulties cited above, formulations of the optimum usually are based on a rather narrow and simplified concept of economic welfare. Economic welfare is considered to be a function of individual welfares. The individual utilities or welfares depend in turn on the quantities of goods and services received by individuals. Income, purchasing power, or goods and services received represent the weights to be assigned to individual preference scales. Moreover, individual welfares usually are assumed to be independent of one another. Once welfare is defined in such terms, the conditions specifying the optimum can be deduced through the application of widely accepted theoretic procedures.
Earlier work on the subject conceived welfare as the sum of the individual utilities. This view involves implicitly a quantification of utility along with the assumption of the validity of interpersonal comparison of utility.\(^5\) Recent work has sought to define welfare without making these assumptions.\(^6\) The chief requirement is that individuals can select from (or rank in order of preference) alternative combinations of goods and services; utilities are assumed to be ordinal and non-addable. The


choices and selections of individuals provide the scales of value needed to evaluate alternative resource allocations.\(^7\)

With these basic premises, most modern welfare economists go on to describe an economic welfare optimum as "a situation in which nobody can move to a position which he prefers without moving somebody else to a position which is less preferred."\(^8\) It is possible to derive a series of marginal conditions which must be satisfied if this optimal situation is to be achieved. The derivation of these conditions involves a considerable amount of technical, but generally accepted, analysis.\(^9\)

Melvin Reder provides a lucid and complete graphical treatment in which he sets forth seven marginal conditions of

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\(^7\)If the concept of consumer sovereignty is rejected, individual scales of value might be replaced by the scales of a dictator or Central Planning Board. Many, including this writer, would argue that any scheme which abandons the individual hardly can be described as "economic." For a discussion of the individualistic character of economic choice see: H. S. Ellis, "The Economic Way of Thinking," *American Economic Review*, XL (March, 1950), 1-12.

It does not follow from this view that market choice alone should rule. The extent to which markets are allowed to rule will depend on the accuracy with which they reflect individual costs and utilities and on the relative importance placed on non-economic ends.


maximum welfare. The first marginal condition specified by Reder determines an optimum of exchange. The second, third and fourth conditions relate to technical productive efficiency while the fifth specifies the relationship between production and the scale of consumer preferences (the optimal direction of production). Optimal relationships between leisure and product are posited by the sixth condition and the seventh denotes optimal time relationships (lending and borrowing).10

10 Melvin A. Reder, Studies in the Theory of Welfare Economics (New York: Columbia University Press, 1947). In technical terminology, the seven marginal conditions are summarized by Reder (p. 35) as follows:

1. The marginal rate of substitution between any two products must be the same for every individual who consumes both.
2. The marginal rate of transformation between any two products must be the same for any two firms that produce both.
3. The marginal rate of transformation between any factor and any product must be the same for any pair of firms using the factor and producing the product.
4. The marginal technical rate of substitution between any pair of factors must be the same for any two firms using both to produce the same product.
5. The marginal rate of substitution between any pair of products for any person consuming both must be the same as the marginal rate of transformation (for the community) between them.
6. The marginal rate of substitution between the amount of (product) X received for aiding in the production (by a given firm) and the time spent in rendering this aid must be the same for each factor unit owner as the marginal rate of transformation between the time of his factor unit spent in aiding production (in this way) and (the product) X.
7. The marginal rate of substitution between resource control at any pair of moments (t_i and t_j) must be the same for every pair of individuals or firms (including pairs, one member of which is a firm and the other an individual).
It should be noted that each of the conditions represents an equation of marginal rates. Theoretically, such an equation cannot be achieved unless all the functions are continuous over the relevant range and subject to some sort of "generalized principle of diminishing returns." 11

When stated in terms of cost and price, the optimum requires the satisfaction of two conditions: (1) price must equal marginal cost, (2) total cost of the optimum output must be at a minimum. 12 These two conditions resemble an early formulation of Lerner's Rules 1 and 2. 13 The first ensures an optimal division of resources among different goods (answering the question: How much of each good to produce?), while the second ensures the optimum combination of factors in each productive unit (answering the question: How to produce the optimal output?). The second condition is satisfied when production is adjusted so that the marginal product of each factor is equal to the price of the factor. This is no different from saying that production should be so adjusted that the price of the product is equal to the marginal cost of the factor. Thus, a single pricing principle, price equal mar-

11 "The generalized principle of diminishing returns may be stated thus: the movement of the system towards an optimum in the direction indicated by a divergence in marginal rates ... must lessen the divergence." Boulding, op. cit., p. 23.


ginal cost, emerges from the marginal conditions of maximum wel-
fare. This principle is perfectly general and embraces the cost-
price relationships of both product outputs and factor inputs.
Whereas the marginal conditions of maximum welfare merely describe
the optimal situation, marginal cost pricing provides, in theory
at least, a normative standard as well as a prescription. It
should be noted that marginal cost pricing is valid provided it is
universal.

Under conditions of perfect competition, infinite divisibil-
ity, and no external economies, all of the marginal conditions
are satisfied so that the universal equality of marginal cost and
price is achieved. This is the characteristic of perfect competi-
tion that makes it so attractive as a standard of economic effi-
ciency.

To this point we have defined a static economic optimum
along with a pricing principle for the attainment of the optimum.
But it is incorrect to infer from this discussion that the utili-
ization of resources should be guided wholly by this set of prin-
ciples. In addition to the very significant practical difficul-
ties that would have to be surmounted before marginal cost pricing
could become a reality, there are other qualifications of a more
fundamental nature. These qualifications fall into two main clas-
ses, equity and social value. Consideration of either equity or
social value usually leads to some form of government activity.
Equity involves judgments about the correctness of a particular
distribution of income. Social value will be defined in a subsequent section. The following sections examine the implications of these factors to the welfare optimum as it has been defined to this point.

**Equity**

The discussion relating to economic efficiency necessarily assumed the existence of some process for the measurement and aggregation of individual costs and utilities. Values derived from this process are the terms on which alternatives are available and provide the basis for economic choice. If we insist, as we do, that social welfare is a function of individual welfare, the decision-making process cannot be authoritarian but must reflect the voluntary choices of individuals. These choices can be expressed either through the market or through the polls. One gives weight to purchasing power; the other to political power. In order to make any statements relative to the desirability of a particular situation, it would be necessary to evaluate both the distribution of income and the distribution of political power. Except as noted below, the course adopted in this study is to make no judgments relating to these matters.

The decision to accept (either with or without reservation) the present political processes does not require much elaboration. Consideration of the equity of political processes would overwhelm the confines of this study as well as the aptitudes of
the writer. This matter is left to the political scientist.

Therefore, we can proceed to consider the optimum in the light of the distribution of income.

The optimum that has been set forth specifies an allocation of resources that maximizes the satisfaction of a given set of consumer preferences. This set of preferences depends on the tastes of individuals and on the ability of individuals to make their tastes known; it reflects the distribution of income. A different distribution of income would lead to a different, perhaps a more satisfactory, configuration of resources. There are as many optimum (efficient) resource allocations as there are distributions of income. Logically, the problem of defining an ideal distribution of income comes prior to that of defining an efficient allocation of resources. But there is no agreement concerning the welfare standards for judging the distribution of income. When, if ever, the Bergson Social Welfare Function is completely specified, this difficulty will be removed.

The optimum that has been defined adopts a given, presumably the present, distribution of income. This will suit only those who are willing to accept the proposition that the distribution of income is either correct or inevitable. Many, probably most, have doubts about the validity of this proposition, but differ with regard to what economic analysis should do about it. Some, like Robbins, argue that it is a question of ends involving
ethical judgments that the economist cannot make. On this view, economic analysis is concerned only with economic efficiency in a narrow sense and has nothing to say about the equity of a particular situation. It accepts uncritically as data whatever scales of value the market, custom, or some authority hands down. Most orthodox economists go further and adopt the ethical judgment that the freely expressed choices of individuals should guide the allocation of resources. If this judgment is followed by another which accepts interpersonal comparison of utility, it is possible to evaluate the distribution of income and to appraise the equity of a particular situation. Although appraisals based on the latter comparison may appeal to our sense of fairness, this is a subjective feeling and cannot be proven.

Nevertheless, economic policy must be evaluated in terms of both economic efficiency and equity. Although the economist is not an expert on matters of equity, the price of economic efficiency is often a loss in equity. In such situations the economist must aid in the weighing of alternatives. Nor is it enough for the economist passively to interpret the consensus on matters relating to equity. He may not be able to go against public

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opinion; but he must lead rather than interpret it." The distinc-
tion between equity and efficiency is most fruitful if it is
conceived as a methodological device for the isolation and analy-
sis of different things.

The course adopted in this study is to treat separately
those matters which can be handled objectively (economic efficien-
cy) and those which require subjective valuations (equity). This
distinction is especially useful for the evaluation of specific
governmental programs. Frequently, governmental programs repre-
sent a response to economic efficiency, but in one way or another
soon become involved in questions relating to equity. When this
occurs, there is a danger that the basic aims of the program will
become obscured and that the final result will serve to promote
the special interests of particular groups to the detriment of
both economic efficiency and distributional justice. Moreover,
the distribution of income represents a general question which
cannot be approached from the limited point of view of those gov-
ernmental programs which are not explicitly aimed at distribu-
tional considerations. An attempt to scatter responsibility for
equity among a host of governmental programs, administered by au-
thorities having a wide assortment of opinions, and implemented
by separate laws each of which is subject to a different inter-
pretation, is more likely to result in confusion and contradic-
tion than in distributional justice.

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16 Ibid., p. 315.
The fact that modern welfare economics does not make interpersonal comparisons does not imply that equity is overlooked. It appears to this writer that equity is more likely to be attained by an explicit recognition of the fact that questions of this sort involve important judgments and opinions which should not be confused with the more pedestrian standards of efficiency. The idea that competition is "good" and monopoly is "bad" represents an unfortunate application of the technical standards of efficiency to the ethical problem of justice. Indeed, it can be argued that modern welfare economics elevates equity to a position higher than it has held in the past by placing it on a raised pedestal in the clear view of scholars, legislators and the lay public. Let us turn now to the second qualification to the welfare optimum that has been selected, social value.

**Divergences between Private and Social Value**

Production and output are ideal when a given supply of factors is distributed in a manner such that no person can be made better off without making someone else worse off. Ideal output in this sense is achieved when production and exchange are adjusted so that marginal cost is equal to price. In a market economy, the reason most often given for a divergence between marginal cost and price is the existence of monopolistic elements arising either because markets are imperfect or because production is carried on
under conditions of decreasing cost. However, even thoroughgoing competition does not assure the attainment of economic efficiency.

Another important source of divergence is found in the failure of market price to comprehend all relevant costs and utilities. An interesting analysis of such situations is provided by Pigou who relates them to "imperfections in compensation arrangements." The result of the inadequacy is a divergence between private and social marginal cost and benefit. Since social cost and benefit are the relevant magnitudes, the rule, marginal cost equal price, can be translated into the rule, marginal social cost equal marginal social benefit. The latter rule assumes no imperfections in compensation arrangements. Doubts about the practical or institutional significance of the rule do not deprive it of formal validity. Moreover, the rule has relevance in that it directs attention to the nature and causes of divergences between social and private magnitudes.

Before examining these divergences, however, some meaning must be given to the terms social and private. The terms private value, cost or utility refer to the magnitudes that are transmitted through the market by rational and competitive individuals and firms seeking to maximize their own satisfaction or profit. The

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17 Pigou, op. cit., p. 159.
terms social value, cost or benefit comprehend all the magnitudes included in private value as well as those economic influences which are not or cannot be transmitted through the market. These are operational definitions and imply that divergences between social and private magnitudes are related to the imperfections in compensation arrangements described by Pigou whose views clearly imply a definition along these lines. It should be noted that the term social embraces only individual costs and utilities. It does not include that additional organism, the Ship of State, whose welfare is in some sense different or larger than that of the individuals who compose society.\textsuperscript{19}

The following discussion examines the hypothesis that the divergence between private and social value as well as collective demand can be explained by an extension of the external economies concept. It is maintained that external economies provide a conceptual basis for relating governmental activity to individual welfare. If such a reconciliation can be made, the way is cleared for a description of the welfare implications of governmental programs.

\textsuperscript{19} Whether or not the Ship of State is a valid abstraction is a philosophical question well beyond the confines of this analysis. This organismic view is associated with the Institutionalists and appears to clash with the individualistic premises adopted by orthodox economic theory. For views on both sides of this issue see: Talcott Parsons, \textit{The Structure of Social Action} (New York: McGraw-Hill Book Co., Inc., 1937), and H. S. Ellis, \textit{op. cit.}, pp. 1-12.
Throughout the discussion it is assumed that resources are fully employed and that the market is perfectly competitive. One further qualification is necessary. The discussion deals with magnitudes that are exceedingly difficult to measure. Although the operational significance of the analysis is viewed with some scepticism, this does not destroy its validity as a guide to policy or as a device for combatting fallacy and clarifying issues.

**External Economies and the Independence Assumption**

Economic analysis usually makes certain assumptions designed either to simplify the technical analysis or to limit the field of inquiry. Among these simplifications or delimitations is the exclusion of certain phenomena through the use of what we shall call "the independence assumption." The independence assumption is a methodological device. Generally, it is used to exclude from the analysis the indirect impact of the economic activity of one individual or firm on another individual or firm. In this way the analysis is limited to the consideration of direct costs and utilities, i.e., costs and utilities which are controlled by the individual through his power to exercise economic choice. Direct costs and utilities are the magnitudes the individual considers, or thinks he considers, when making an economic decision.

Interpreted rigidly, the independence assumption leads to the analysis of Robinson Crusoe's economic activities. Here there are no indirect costs and utilities. Crusoe is in complete control (of course, there is still risk and uncertainty), and his
every action produces an impact only on himself. Cultural or social forces have nothing to do with Crusoe's economic activity, and he satisfies wants that come from within the individual. The emphasis is on a biological or natural explanation of economic activity, and the analysis is cast in terms of "real" costs and utilities. Robinson Crusoe standing on an isolated island represents the most extreme application of the independence assumption. In order to relax the assumption, Friday is made to appear and a further relaxation is achieved by introducing markets and money.

A step by step relaxation of the independence assumption leads us along a continuum. "Cultural determinism" represents an opposite extreme where no independence assumption is made. Economic behavior is explained in terms of cultural, sociological or even mystical forces over which the individual has no control. On this view, the individual really has no power of choice and his economic decisions reflect indirect forces that come from without rather than from within the individual. Thus Veblen rejected the concept of individual economic choice and along with it any analysis based on the independence assumption.

At what point along this continuum economic analysis should draw the line remains an unresolved issue. Most orthodox economists are willing to go as far as the "measuring rod of money" will take them. However, one does not have to worship at the altar of cultural determinism to maintain that conspicuous consumption is an important fact which welfare economics might
properly take into account. On the other hand, no apology is needed for the refusal to admit obscure sociological phenomena into an analytical framework which seeks to be methodical and objective.

The foregoing comments are intended to show that the meaning and implications of the independence assumption are subject to a variety of interpretations. Specific meaning can be given to the independence assumption only in the light of what one believes can be admitted properly into the analysis. In order to add some content to the independence assumption, it is appropriate to examine briefly the role it occupies in orthodox economic analysis.

Adam Smith held that

every individual necessarily labours to render the annual revenue of the society as great as he can . . . and he is in this, as in many cases, led by an invisible hand to promote an end which was no part of his intention.\(^{20}\)

On this view, social welfare is served automatically through the deliberations of individuals in the market place; governmental activity is both superfluous and harmful. Implicit is the assumption that the consequences of any economic action whether they be beneficial or deleterious fall directly on its instigators through the action of the market mechanism. This was Smith's independence assumption. With the market as a nexus and competition as a check it was impossible for any individual to better himself at the ex-

pense of another. It follows that the maximization of private welfare leads to the maximization of social welfare or in Smith's words, "the public interest."

The theoretical validity of this conclusion was not seriously questioned by orthodox economic analysis until Marshall introduced the concept of external economies in his analysis of the welfare implications of increasing returns. In their Marshallian framework, external economies meant that the costs of production of the firm were dependent in part on the size of the industry. The independent decisions of other firms in a given industry might create economies for which no compensation is received or given. Thus social marginal cost might be below private marginal cost and private investment decisions would not recognize the full extent of the economies available. Private investment would fall short of the amount that is socially desirable unless a bounty were offered. It is not necessary to review the tax and subsidy scheme set forth by Marshall which was later elaborated by Pigou and cor-

rected by many others. Marshall's proposal recognized divergence between private and social value, defined a new frontier for government activity and, on an orthodox theoretical level, qualified the doctrine of the invisible hand through a partial relaxation of the independence assumption.

Because of the partial equilibrium nature of his analysis, Marshall confined external economies to an explanation of the supply curves of the firm and industry. Subsequently, the concept was expanded beyond the firm-industry relationship to include the external economies that arise because of inter-industry relationships. The implications of this extension to the theory of industrialization and especially to the role of government is apparent. However, external economies do not have to be confined to the supply side. The concept conceivably can include all those relationships and interdependencies that are not transmitted.

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22 Marshall's proposal led to considerable controversy and to the emergence of issues which are not yet clearly illuminated. A few of the analyses inspired by the proposal are listed below:


through the market mechanism. "External economies are the villain of the piece and the cause for conflict between private profit and social benefit." 

The technical analysis presented by most welfare economists excludes external economies through the use of an independence assumption. "Most formal models rule out such phenomena." It is common to assume that external economies either do not exist or have a zero algebraic value. Although the reader usually is made fully aware of the exclusion, its full implications are seldom drawn. Thus, Samuelson writes that

many of the conclusions of welfare economics will remain valid, but they will require certain modifications to allow for certain "external" consumption economies not dissimilar analytically to the external technological economies and diseconomies of the Marshall-Pigou type.

This is about all Samuelson has to say on the subject. Similarly, other economists mention external economies in footnotes or qualifying phrases. Reder goes further and devotes a section entitled "Further Obstacles" to the problem of external economies.

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25 Ibid., p. 144.
27 Bergson, "Socialist Economics, op. cit., p. 419.
28 Samuelson, op. cit., p. 224.
Although the subject is treated as a qualification or exception to the theoretical framework, Reder's discussion is much more complete than one usually finds in general treatments of welfare economics. Reder's discussion of external economies of production is Pigovian and requires no elaboration at this point. However, Reder goes on to consider the situation when "the utility function of one individual contains, as variables, the quantities of goods consumed by other persons." This case is described as "another type of external repercussion which is rarely, if ever, recognized in discussion of welfare economics." How does Reder handle this sort of external repercussion? Reder notes that the consumption activity of one individual may either increase or diminish the welfare of others. Welfare may be diminished if invidious expenditure occurs. Reder suggests that this situation be excluded from economic analysis. He recognizes that the use of the independence assumption insofar as external diseconomies of consumption are concerned "involves the complete obscuration of all problems of prestige, jealousy, etc. from the purview of our welfare criterion." But these problems are referred to the sociologist. If it is only a question of Veblen-like effects, Reder's prescrip-

29Reder, op. cit., p. 224.

30Ibid., p. 64.

31Ibid., p. 67.
tion is in a well-established orthodox tradition. Presently we shall maintain that more than sociological phenomena are excluded by the independence assumption.

Reder also recognizes those cases where the consumption activity of one person increases the welfare of another. Such cases are dismissed because they are "without great significance for economic policy."32

Thus unimpeded self-seeking will tend, in such cases, to maximize welfare, and thus the dependence of one individual's satisfaction on the consumption of another will not, ipso facto, make a policy of laissez faire incompatible with the tenets of welfare economics.33

Thus, external diseconomies of consumption are referred to the sociologist and external economies of consumption are found to have no policy significance. In one way or another, most welfare economists manage to give some consideration to external economies of production. Not so, with external economies of consumption. They are dismissed either as sociological phenomena or as having no policy significance. Bergson, of course, is an exception. In its most general form, the Bergson function contains all the variables that impinge on welfare. However, little progress has been made toward even a partial specification of the Bergson function.

In his polemical critique of welfare economics, Little perceives that something important (he never really tells us what)

32 Ibid., p. 30.
33 Ibid.
has been left out. The implications of the independence assumption are more clearly developed by Baumol in an imaginative analysis which begins about where Pigou left off. Baumol's contribution, however, anticipates the discussion. At this time it is necessary only to make the point that modern welfare economics proceeds on the basis of an independence assumption which has the effect of eliminating certain phenomena from the purview of economic theory. The implications of this methodological simplification are described and assessed in subsequent sections. In tracing out these implications, the discussion goes a small part of the way toward specifying the Bergson function since it brings an additional factor (external economies of consumption) within the framework of welfare economics. The analysis also leads to a theory of government consistent with the criteria of welfare economics and, to a very limited extent, sheds some light on the problems posed by Arrow's excellent analysis.

The Nature of External Economies

What is left out by the practice of analytically removing external economies? It is appropriate to begin by adopting a definition of external economies and then to investigate the nature of the divergence between private and social value which emerges from the definition. External economies are defined as

services and disservices rendered without compensation by one individual or firm to another individual or firm. This definition is broad and includes both the consumption and production side. Scitovsky lists four types of external economies. Since our concern involves an extension of one of these to an explanation of collective demand, the first three will be described briefly because they throw light on the types of activity government may undertake in the presence of external economies.

1. The first type of external economy is represented by the situation in which the output (production function) of an individual producer depends not only on his input of productive resources but also on the activities of other firms. This is the Marshallian concept of technological external economies. A thorough analysis of such situations has been set forth by Meade. Common examples on the diseconomies side are the cases of the fisherman or the oil producer whose independent actions deplete a common stock, thereby reducing the output or increasing the costs of others seeking to exploit the same stock. According

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35 The definition given above appears to have been implied by Pigou, op. cit., pp. 151-200, and is explicitly formulated by Scitovsky, "Two Types of External Economies," op. cit., p. 143.

to Meade, situations of this sort are rare and can be corrected by appropriate tax policy, say, through the imposition of severance taxes in the examples given.\cite{37}

On the economies side, the classic example is the development by a firm or an industry of a skilled labor force which becomes available to other firms and industries, thereby increasing their output or lowering their costs of production. Economies of this sort have been described further by Ellis and Fellner as reversible or irreversible depending on whether the removal of the initial source also results in the removal of the economy. Although a more careful analysis of this distinction would take us far afield, the implications to government are worth noting. The existence of irreversible external economies may justify temporary subsidy, while the existence of reversible external economies may justify permanent subsidy.\cite{38}

2. Another type of external economy (some would probably list it as a subclass of the first) relates to inventions, technique, and know-how which become available to particular firms without charge. In this case the private profitability of an invention may not be a good index of its general desirability. Patent protection tends to increase the private advantage and to lessen the divergence between private and social benefit. Such laws "inter-

\begin{footnotes}{37}{Ibid., p. 62.}\end{footnotes}

\begin{footnotes}{38}{Ellis and Fellner, op. cit., p. 67.}\end{footnotes}
nalize" the economy and transmit it through the market mechanism. However, since such laws also encourage monopoly, the remedy may be worse than the disease. A combination of patent protection and compulsory licensing at reasonable royalty provides a means by which the market can be adjusted for divergences between private and social magnitudes without, at the same time, encouraging monopoly. This type of external economy also justifies government sponsored research of the sort practiced by the U. S. Departments of Agriculture and Commerce.

3. Another well-known type of external influence is represented by a situation in which the satisfaction of individuals may depend on the activities of producers. The classic examples are water pollution and smoke. These deleterious effects can be reflected in market value by requiring the installation of protective devices or through the adoption of zoning and other restrictions.

These three instances of external economies and diseconomies have appeared in the literature continuously since the publication of Pigou's *Wealth and Welfare* in 1911. Another, and perhaps more important form which will be developed at greater length, relates to the interdependence of consumption activity.

39 Determination of an appropriate return or royalty to venture capital and to innovational activity opens the whole question of the origin, nature and function of profits and requires imputations that are exceedingly difficult to make.
A Neglected Case: External Economies of Consumption

In the process of consumption the consumer may do a service or disservice for which he neither receives nor gives compensation. Baumol maintains that external economies of consumption are not exceptional and, indeed, should be considered the rule. Aside from Veblen-effects, external economies of consumption offer a theoretical explanation of the resource-using activities of government.

It is obvious that certain goods and services, besides providing satisfaction to their consumers, also affect to a greater or lesser degree the welfare of other people. The person who installs slides and swings on his property for the recreation of his children not only increases the welfare of his own family but also that of neighboring families who now contend with fewer of those discomforts associated with bored and idle youngsters. If the preferences of neighbors and, indeed, those of the community as a whole were reflected, the value of the swings would be enhanced considerably. The difference in social and private value may justify some sort of governmental action, perhaps in the form of a bounty, to bring supply into a closer relation with the "collective" demand. An excise tax might be used in the opposite case where private valuations do not consider fully the social costs or disutilities imposed by private consumption. It should be noted

40 Baumol, op. cit., p. 166.
that this sort of discrepancy between social and private value would occur even if the distribution of income were ideal.

The advantages enjoyed by the neighbors and the community as a whole from the swings in the previous example may be thought of as indirect advantages. But these indirect advantages may be so great that each neighbor or individual in the community may be willing to contribute something (provided others do so) to increase the supply of swings; the result may be a recreation center provided by the government and financed through some form of taxation. If (and this is not very likely) the tax could be levied so that no one in the community felt worse off, government activity is justified on grounds of economic efficiency alone.

The traditional activities of government are such that it is exceedingly difficult to distinguish between "direct and indirect effects or between consumers and other people also affected." Such activities are of a community or social nature and the demand for them is often described as a collective demand. The maintenance of police protection and national defense is, perhaps, the most extreme example.

Moving from the case of the swings which justifies a subsidy to the case of national defense is simply a matter of the degree of divergence between social and private value. In the former, the external economies are a small proportion of the total;

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41 Scitovsky, Welfare and Competition, op. cit., p. 186.
in the latter they are a large proportion of the total. It is important to note that the external economies accrue to individuals. But since the market reflects only those values which affect individuals directly, decisions concerning the provision of such services must be made through government.

The scope of government activity changes from time to time depending on the adequacy of the market or the individual himself to take external effects into account. Military security and personal safety, for example, have not always been regarded as matters of public concern and collective action. Although the increasing interdependence in modern society has tended to justify an expanded role for government, the possibility of substituting market decisions for collective decisions after external economies disappear should always be considered. Thus, tariff protection, subsidies to infant industries and other forms of activity instituted originally in the collective interest should be reviewed continually to determine whether the initial economy is still external.

These considerations point to the "dynamics" (the term is used loosely) of external economies. External economies can be interpreted from the point of view of time where the advantages accrue to some individual or firm at a future date. The individual faces a considerable risk in providing an investment whose

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42 Ibid., p. 187.
fruits are expected to accrue in the distant future. In addition to the possibility that the investment itself may fail, the individual may be, for any number of reasons including death, in no position to reap the benefits. Nevertheless, someone does benefit at a future date. The risk imposed on the original investor is in excess of the risk faced by the community as a whole (the community being considered as including future generations). Since the benefits are in part external to the individual investor, there is a divergence of private and social value. In analyzing this problem, Baumol concludes that such investments may not be made by the private economy.\(^{43}\)

A related argument commonly used to justify government investment is that private capital cannot be marshaled in large enough quantities to provide the investment. Although it is felt that this argument misses the point, it is not in conflict with Baumol's conclusion since investment for the future usually does require large quantities of capital. Provision for the future, then, represents another form of external economy which must be served by collective procedures.

Baumol, Scitovsky and Hicks along with most socialist economists have warned that economic organization on an atomistic basis is not well enough coordinated to provide adequately for the

\(^{43}\)Baumol, op. cit., p. 92.
Moreover, where the activities of individuals are interrelated through time the economy may be incompletely informed.

Inasmuch as in an individualistic economy current and future activity is ultimately based on uncoordinated decisions, some of which are being made at every given moment and others of which are yet to be made, information about the prospective activity of others that is disseminated in any such economy is necessarily incomplete and obsolete.45

However, it should be emphasized that even government cannot have perfect knowledge. This kind of an argument for government interference has force only when individual actions involve significant effects on several individuals who do not have control through the market mechanism.

The conclusion that government activity ought to include provision for the future is adopted, but not without qualification. Implicit in all statements of this view is the assumption that it is economically efficient to provide for coming generations. That is, in the interest of economic efficiency, we must consider the preferences of individuals who are not yet born. This comes close to the going concern or mystical Ship of State


doctrine rejected in the first instance by the writers responsible for the arguments that have been outlined above.

These considerations point to the difficulty of maintaining the individualistic ethic when problems relating to the distant future enter the picture. It is common to assume that provision for the future requires dynamic analysis. Whether or not this assumption is valid depends a good deal on the meaning given to the term dynamic. It appears to this writer that a more reasonable explanation is to be found in the criticisms of the Institutionalists. It is difficult to maintain the individualistic ethic in the light of the actions of individuals relative to the provision for their children, children's children, or even for posterity. To impute altruistic motives to the individual does not appear to be enough. It seems that the somewhat disturbing conception of the going concern provides a more satisfactory basis for the analysis of the distant future.

On the whole, human behavior in the Western World appears to be guided by an individualistic ethic. However, the ethical values of the "clan" or "tribe" are never completely submerged, and they become of paramount importance in consideration of the

46 Dynamic analysis has been defined in various ways including (1) the dating of every quantity, (2) the inclusion of expectations, (3) the study of time lags and paths of adjustment, (4) the study of secular growth and (5) evolution, cultural determinism and futurity. For an orthodox discussion see R. F. Harrod, Towards a Dynamic Economics (London: Macmillan & Co., Ltd., 1949), pp. 3-20. For a heterodox interpretation see Alan Gruchy, Modern Economic Thought (New York: Prentice-Hall, Inc., 1947), pp. 15-31.
distant future and at times of crisis. Notwithstanding the ap­parent relevance of the organismic interpretation in such situa­tions, it is still held that excessive preoccupation with organ­isms may involve the maximization not of individual welfare, or of any welfare for that matter, but of an illusion.

It will be interesting to investigate the possibilities of explaining group action in terms of the individualistic ethic. It is felt that much more is and can be done in the name of the indi­vidual without resorting to sophistry or rationalization than is commonly supposed. When the individualistic ethic no longer ap­pears to provide a reasonable description of the value system, it is best to make an explicit shift in our premises. On the other hand, economic analysis would be remiss if it were to undertake a premature shift in premises. The ethical system of the Western World may not require that the supremacy of the individual be maintained at all costs, but it does require that it be protected zealously from the onslaught of those who would submerge the indi­vidual in the interest of a vaguely defined social organism. Al­though orthodox economic analysis bears more than its share of burdens-of-proof, the burden of proof with regard to the individ­ualistic ethic lies on the shoulders of those who would attack it.

It would be much more satisfying to rest the case for gov­ernment on the static external economies described earlier. How­ever, the fact remains that governmental activity does and should cast an eye to the long run. Before proceeding to a more detailed
treatment of the implications of the external economies logic to governmental activity and finance, it may be helpful to bring together the threads of the preceding discussion and to draw some provisional conclusions.

**Summary**

Where the production and consumption of goods and services influence the welfare of an individual with no external repercussions on the welfare of other individuals, marginal private and social benefits are equal as well as marginal private and social costs. To the extent that this harmony exists, economic efficiency can be approximated by allowing the competitive market to allocate resources. In this case, the conclusions reached through the use of the independence assumption appear to be perfectly valid.

Relaxation of the independence assumption and the admission of external economies opens the door to a flood of additional considerations and to an explanation of divergences between private and social value. Where social and private valuations diverge because of external economies and diseconomies, they may be brought into closer relation through a judicious use of the taxes and bounties discussed by Pigou. The result is an "adjusted" market still relying on private choice. However, these choices now are made in the light of the additional costs and utilities which would not have been transmitted through the market. As the divergence (and hence the taxes and bounties) becomes greater, the
scope of private choice narrows and that of collective choice
broadens until the market is replaced wholly by government and the
goods or services are provided "free." Collective goods are the
most important species of that larger class which we have called
external economies. This conception parallels and in no way con-
flicts with the traditional view that collective goods yield indi-
visible social benefits which cannot be parcelled out for sale on
the market. However, the external economies interpretation im-
plies more; it emphasizes the place of collective demand in a gen-
eral framework of economic efficiency. It is important to remem-
ber that adjustments for external economies increase individual
welfare and, therefore, can be brought into a relation with a wel-
fare function based on the individualistic ethic. These adjust-
ments can be made to conform to the condition that economic effi-
-ciency is promoted if at least one person can be made better off
without making someone else worse off.

Government expenditure is frequently considered from the
point of view of an organismic theory of the State and is related
to economic efficiency and individual welfare in a loose and unde-
fined way. Although they cannot be measured easily, external
economies can indeed be related to individual welfare. Therefore,
it appears that relaxation of the independence assumption provides
an analytical means for approaching government. This possibility
is pursued in the following chapters.
CHAPTER III

EXTERNAL ECONOMIES, INDIVIDUAL WELFARE
AND COLLECTIVE AGREEMENTS

The first condition of modern welfare economics is that the consumer must be in an independently selected or "chosen" position.¹ Since it is commonly held that government involves some coercion, it follows that government activity clashes with the principle that the individual should be in a chosen position. This negative conclusion implies that government is a "necessary evil," at least from the point of view of the individual. As a consequence, government is treated as a separate category dealing with welfare which are in some sense social but not individual.

Generally, students of government state the rule, marginal social cost equal marginal social benefit, and with considerable justification quickly discard it as a working principle. For how can one measure the diffuse social benefits and costs of a particular government program? Even if some overall measurements of

¹The criterion of choice has been developed in relation to a behavior-line system by I. M. D. Little, A Critique of Welfare Economics (Oxford: The Clarendon Press, 1950), pp. 33-40. Although Little's analysis suggests very little that had not been suggested earlier by the usual indifference curve analysis, it is peculiarly appropriate for the study of governmental activity because of its emphasis on the behavior of individuals in a group context.
cost and benefit could be made, it is assumed that any attempt to relate these values to individual welfare is futile. But the individual is only partially abandoned. After all, he provides the resources that are utilized by government. Thus, a large part of government finance becomes a study of how to distribute equitably the "burden" of government. Accordingly, the student must either address himself to philosophical or legal concepts of equity or to the difficult and pressing problems of achieving administrative and technical efficiency in the day to day operations of government. Economic theory appears to have little relevance. It is felt that this difficulty stems in part from a negative or coercive interpretation of government. A more positive interpretation of the role of government is possible through an extension of the external economies argument.

Ample evidence of the burden approach can be found by examining the contents of any standard text on government finance. The lack of analytical attention to government expenditures is appalling. Harold M. Groves, Financing Government (4th ed.; New York: Henry Holt & Co., 1954), for example, devotes twenty of twenty-eight chapters to a discussion of taxes (eighteen of the twenty are discussions of specific taxes), six chapters to intergovernmental fiscal relations and fiscal policy, and only two descriptive chapters to governmental expenditures. These two chapters do little more than point a finger at rising government expenditures. The total impression gained from an examination of this and other texts is that the resources marshaled by government either vanish into thin air or are thrown into the sea. It is interesting that students of government finance are perhaps the most remiss in pointing out the significance of government activity to individual welfare.
A Positive Interpretation of Governmental Activity

It has been noted that the first condition of welfare economics is that "the consumer is free to choose between the various collections of goods within the limits set by his purchasing power." Accordingly, the only restriction on the attainment of an individually chosen position is the limitation of purchasing power. The independence assumption states that the economic activity of other individuals and firms does not aid or impede the attainment of a chosen position on the part of any one firm or individual. If this condition prevailed, the only justification for economic activity on the part of government would be to redistribute purchasing power in an equitable manner.

Upon relaxing the independence assumption, it is recognized that the extent to which anyone can attain his chosen position is determined in part by external economies and diseconomies. In some cases, others will make it easier for an individual to reach his preferred position (external economies); in other cases, they will frustrate his efforts (external diseconomies). If the individual could only restrict or coerce others, he could then go

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3 Little, op. cit., p. 38.
about attaining a preferred position. Indeed, he would accept willingly some restrictions on his own behavior if the others would only leave him alone. The stage is set for the creation of a coercive authority. But is such an authority really coercive?

It is clear that the individual would prefer restriction on the activity of all others and none on himself. However, this course is not available. To attain his chosen position, the individual voluntarily accepts a coercive authority. Conceivably, such an authority could have the consent of all individuals. There must be net gains to someone, otherwise the authority would never have been established. If the gains are distributed in such a manner as to make no one worse off (this must be possible if the gain is positive), it follows that unanimity in the public sector is an admissible possibility. If unanimity is admitted, a strong welfare judgment may be made without resort to interpersonal comparisons of individuals. It can even be argued that continued membership in a particular social group implies acceptance of the rules and policies established by that group. International shipping magnates whose ships fly the flags of one nation and are staffed by crews of another find that their individually chosen position can be attained best by rejecting a national coercive authority. Most individuals would not find it to their advantage to do so. Thus Baumol writes:

The mode of conduct which is most likely to promote the welfare of the individual when he is acting in concert with others may not be the course of action most
conducive to the welfare of that person when he is act-
ing individualistically ... An individual would be
foolish to contribute voluntarily to military prepara-
tion unless others also did so ... yet, while failure
to contribute may be rational from the point of view of
each member of the community acting individualistically
it may well be in the collective interest and in the
interest of each individual to employ coercion if nec-
 essary to exact such contributions from everyone.5

On a more down-to-earth level, one would certainly ques-
tion the proposition that a progressive income tax has unanimous
approval. Nor is it possible to maintain that such a tax makes no
one worse off. However, this does not invalidate a voluntary
theory of government. It simply emphasizes the fact that one of
the chief functions of governmental processes is to make decisions
concerning equity, a controversial matter which usually results in
someone's being worse off.

Few economists appear to have recognized the significance
of the Paretian (efficiency) optimum to collective action. Proper-
ly interpreted, the Paretian optimum leads to all those reor-
ganizations which can be achieved without conflict. Boulding de-
votes a paragraph and a footnote to this question. Since Bouli-
ding's brief comment is the only explicit statement of the dis-
tinctions pursued in this study, the entire passage is cited be-
low:

The real significance of the Paretian welfare eco-
nomics, then, is that it sets forth explicitly the dis-
tinction between those changes which can take place
through "trading"—i.e., through a mutual benefit of

5Baumol, op. cit., p. 15.
all parties—and those changes which involve "conflict," or the benefit of one party at the expense of another. In a civilization which is threatened with extinction because of the inability to solve the problem of conflict this distinction may be of considerable importance. Because conflict is costly, often very costly, and there is a reasonable presumption that it is almost certain to be more costly than trading, economists in general, and welfare economists in particular, have had a strong prejudice in favor of trading; and this is why the Paretian optimum is regarded as desirable. Considered merely as analysis, however, the contribution of the Paretian type construction is the distinction between trading and conflict, and not the judgment between them.6

In a footnote to this passage, Boulding reminds the reader that "I have introduced the terms 'trading' and 'conflict' into the discussion myself . . ."7

To this writer's knowledge no one has pursued Boulding's revealing distinction. This distinction implies that the Paretian optimum might be concerned with a good deal more than market decisions. Any reorganization has a welfare basis if it can be achieved without conflict. Collective decision-making processes have a place in Paretian welfare economics provided these processes are aimed at the attainment of unanimity. When Boulding's distinction is brought into relation with external economies and diseconomies, the Paretian optimum is extended to include governmental activity. External economies and diseconomies are services


and disservices which can be traded provided a means for trading is available. Collective or governmental action is one of the important means for striking bargains consistent with the rigorous limitations imposed by Paretian welfare economics. Development and elaboration of this conception represents one of the chief contributions of this study.

Economic efficiency reflects a position that can be achieved through trading or unanimous approval. Government may eschew interpersonal comparisons, including all matters of equity, and still have a raison d'être in trades concerning external economies. Thus, a portion of governmental activity can be abstracted and brought into the general body of economic theory. This quid pro quo or Rousseau-like theory of government is plausible and is essential if we are to arrive at anything more positive than a necessary burden or organismic view of government.

Arrow recognizes the possibility of unanimity in his discussion of "single-peaked preferences."

The assumption . . . of complete agreement among individuals on the ordering of social alternatives, may seem obviously contrary to fact. But, properly interpreted, it is at the basis of a great portion of political philosophy, namely, the idealist school. This view is expressed in the works of Rousseau, Kant, and T. H. Green, among many others.8

8Kenneth Arrow, Social Choice and Individual Value (New York: The Cowles Commission, 1951), pp. 81-2. According to Rousseau: "If the opposition of individual interests has rendered the establishment of societies necessary, it is the accord of these same interests which has rendered it possible." The Social Contract (rev. ed.; G. P. Putnam's Sons, 1906), p. 34.
The idealist political philosophers envision unanimity on moral as well as technical matters and their doctrines imply that a social preference function of the Bergson type can be constructed. Although this writer cannot assess this philosophical material as it relates to moral and ethical questions, it seems clear that unanimity is a valid assumption at least in matters of economic efficiency. This is as far as the present analysis seeks to go. Although no apology is needed for an idealistic approach, it should be recognized that the view adopted here is not slavishly idealistic because it does not include those moral and ethical questions which would be at the heart of any dissent to a voluntary theory of government.

It should be noted also that this interpretation of government makes possible the assimilation of only a portion of governmental activity into the general body of economic theory. Although we have taken a step in the direction of a more complete specification of Bergson's Social Welfare Function, we have made little progress toward the solution of a much larger problem, namely, equity or distributive justice. Arrow's analysis points up the difficulty of developing an all-embracing concept of so-

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9A geometrical development of this "efficiency" interpretation has been developed in H. D. Bowen, "The Interpretation of Voting in the Allocation of Resources," Quarterly Journal of Economics, LVIII (November, 1943), 27-43.

cial welfare which is consistent with individual preference functions. But Arrow's discussion refers to "social states" in which all economic variables including the distribution of income are specified. Although it may be impossible to define an optimal social state without making interpersonal comparisons of utility, it is possible to define a "collective state" in which individuals voluntarily take into account their impact on one another. The condition imposed by Arrow that social codes or customs should not determine individual choices excludes the means through which individuals "get along." It is customary to smile at certain occasions, and even though one does not feel like smiling, he still smiles. To claim that this "forced" smile places one on a lower level of "happiness" is to imply that an individual cannot voluntarily do those things needed to "get along in the world." It "pays" to force a smile now and then.

Collective or unanimous agreements may not lead to a social optimum in the Bergson sense, but they do lead to a higher position than would be attained by individuals who could not or would not recognize the possibility of unanimously approved collective action.

When approached from this point of view, it becomes apparent that coercion does not in all cases require movement away from a chosen position. Arrow does not distinguish between coercion to
which the individual is willing to submit provided others also do so and coercion which must be imposed by invoking the sovereignty of the state or of the group.

The concept of collective action developed here occupies a position in-between individual action and social action. Social action, collective action and individual action may be distinguished on the basis of the type of coercion employed. Collective action implies voluntary restraint; social action implies imposed restraint and individual action implies no restraint. The distinction between voluntary, imposed and no restraint like black, gray and white becomes blurred and is subject to various interpretations. Nevertheless, it makes possible some progress toward a partial specification of the Bergson Social Welfare Function.

Thus government is viewed as a positive instrument aimed at aiding individuals to attain a preferred position. With the establishment of government, individuals follow a different path, but it is a welfare maximizing path. Moreover, it is individual welfare that is being maximized. These ideas are not new; they are almost a common heritage of the Western World. The independence assumption amounts to the analytical removal of these ideas from the body of economic theory.

In maintaining that external economies should be considered within the general framework of economic analysis, we arrive at a position not far from that taken by Pigou who sought to bring into economics those external factors which can be "brought into
relation with a money measure."10 On the other hand, the concept of government that has been presented brings to mind the view held by John R. Commons that collective action involves the "control, liberation, and expansion of individual action."11 Throughout his work, Commons emphasized the volitional character of collective action and often spoke of the individual will in action. Commons went on to maintain that the institutions shaped by the will in action were the proper subject of economic inquiry, and this leads to the study of going concerns and social organisms. The more orthodox view adopted in this study differs in that it maintains that the individual is the proper subject of inquiry.12 It is not unreasonable to conclude that the difference is one of degree.

Pigou, for example, recognized external economies of consumption, but did not push economic investigation into sociological inquiries about the nature of jealousy, prestige and conspicuous con-


12E. R. A. Seligman has expressed a similar (but not identical) view: "... the social theory of fiscal science answers the much-mooted question as to what is the proper subject of fiscal science -- the state or the individual ... as we have explained it the state is nothing but the individuals who compose the state. The state is indeed not an organism and still less a superorganism." "The Social Theory of Fiscal Science," *Political Science Quarterly*, XLII (March, 1926), 382.
sumption. However, Commons' concept of collective action as the liberation and expansion of the human will can be integrated into the main body of economic theory.

**The Broader Implications of Unanimity and the External Economies Argument**

At the outset economic welfare was defined as a function of individual welfares which depended in turn on the goods and services held or received by individuals. Moreover, individual welfares were assumed to be independent of one another. By admitting external economies of consumption, individual welfare is made to depend on an additional set of considerations. The utility functions of individuals now contain, as variables, the consumption of other individuals, and the term economic welfare takes on a new and broader significance. Inclusion of the consumption of others in the welfare function of the individual also implies consideration of the impacts of the distribution of income on economic welfare. These impacts may be evaluated to the extent that the analysis does not make interpersonal comparisons of utility. Indeed, a very broad interpretation of the logic that has been employed suggests the possibility of considering the external impacts of consumption on the "happiness" of the community. Although subsequent analysis is based on a relatively narrow interpretation of external economies, the broader implications provide some inviting opportunities for further study. Let us begin, then, by considering some of the broader implications of the external
economies argument. This will serve to place subsequent analysis in perspective as well as to indicate possible areas for more careful study.

Welfare economics has policy significance to the extent that it can provide objective tests for economic reorganizations. Regardless of the content given to the terms welfare or happiness, the test for a reorganization remains the same: Economic welfare (or even happiness) is increased if it is possible to make at least one person better off (or happier) without making someone else worse off (or unhappier). Although the test for a reorganization does not depend on a definition of welfare or happiness, economists appear to believe that the test can have no significance to policy unless the quantity or quality to be maximized can be placed on some sort of an index, say, an indifference map, which depends on definable and objective quantities or qualities. The index must have enough content to allow for ordinal comparisons. The case of unanimous agreement (no conflict) is an exception. Any reorganization, economic or otherwise, involving either measurable phenomena or immeasurable phenomena, maximizes if it has unanimous approval. Unanimous approval does away with the need for ordinal measurements as well as with the problem of the weights in dollars or votes assigned to various individuals. It makes no difference if one person has ten votes while another only has one. If there is unanimous agreement, no one can be made worse off and no further justification is needed for a reorganiza-
tion. This may seem so perfectly obvious that it may be objected that all such situations have been discovered and have been exploited fully. This writer doubts that such situations have been exploited fully, but even if they have, the concept of unanimity represents a useful addition to the economist's box of tools because it permits policy recommendations without any value judgments whatsoever. The only value judgment is that everyone must agree, and this hardly classifies as a value judgment unless a premium is somehow placed on disagreement.

Modern welfare economics also requires unanimous agreement since it deals only with those reorganizations which make no one worse off. However, in this case specific content is given to the term worse off. As Little points out, it is possible for a reorganization to make a person "worse off" but "happier." If individuals can agree unanimously, we do not care whether anyone is made worse off in the usual economic sense.

Individuals who are brought together may agree unanimously to stop making one another unhappy, say, through conspicuous consumption. Spontaneous agreements of this sort are not unknown. Mens' social fraternities on college campuses often agree unanimously to do away with corsages, "favors" or "name bands" at certain social functions. Similar agreements relative to Christmas, birthday or wedding gifts undoubtedly are commonplace. Provided they have unanimous approval, such agreements increase economic welfare. Unanimous agreements to smile and say "good morn-
ing" increase happiness. To be effective as well as maximizing, the agreement must also include the means of enforcement. At an earlier point it was held that the use of force in such situations does not involve compulsion that is inconsistent with the central tenets of modern welfare economics.

Collective agreements all involve the principle of the *quid pro quo*. One person agrees to act or refrain from acting provided others also agree to do so. Incidentally, we have come around once again to John R. Commons and his principles of "forebearance" and "working rules." The relationship of Commons' interpretation of collective action to modern welfare economics has been overlooked completely and provides an interesting subject for the student of economic thought.

Some may wish to go even further and insist that unanimous agreement concerning the decision-making process implies unanimous approval of all decisions. Thus, the voting requirement for a re-organization of the decision-making process, say, a constitutional amendment, may require larger majorities than the majorities to make routine decisions. Veto powers, minority rights and checks and balances may all be interpreted as attempts to approach the objective standard of unanimity. Of course, these aspects of the analysis of external economies are of concern to political scientists and philosophers. However, no harm is done by a reminder that the criteria of modern welfare economics are applied in other
disciplines and are not so sterile or lacking in policy significance as some critics would have us believe.

The relationship between unanimous agreements and the Compensation Principle is also worth noting. Any reorganization in accordance with the Compensation Principle has unanimous approval. However, the Compensation Principle requires measurement because unanimous approval is "bought" by bribing those who stand to lose. As it is usually interpreted, the Compensation Principle requires a transfer of some of the gains achieved by the reorganization to the losers so as to leave them at least as well off as they were before the reorganization. Since individual welfares are usually assumed to be independent of one another, the bribe cannot come in the form of an external economy. It must come in the form of a direct transfer of goods and services to the losers. However, unanimity is possible through transfers which come in some form other than goods or services. A slum clearance and public housing program financed by the rich might have unanimous approval among both rich and poor. If unanimous approval is forthcoming, the Compensation Principle does not have to be applied. The losers in this case are not losers at all. Compensation is received in the form of an external economy. Compensation may come in the form of an increase in goods and services or of an increase in happiness. Property values may increase, business may improve, and various other advantages measurable in money terms may accrue to those who pay for the project. All these gains come within the purview of
the Compensation Principle. They can all be set off against the payments made by various individuals for slum clearance. On the other hand, unanimous approval might be achieved even if there were no such gains because the continued existence of the slum may violate the moral or aesthetic sensibilities of those who agree to pay the bill. In such cases there is a voluntary redistribution of income from rich to poor. It may be objected that situations of this sort are not stable. According to Reder, unimpeded self-interest will lead to slum clearance. The rich will voluntarily agree to inaugurate the project and to pay the bill. Although this may be true, the point is that unimpeded self-interest in this, and in many other cases, cannot become effective except through collective action. Regardless of the form which external economies take, they usually call for some form of collective action. And such collective action maximizes the welfare or happiness of individuals.

These comments are enough to indicate the nature of the work that might be done within the limits of modern welfare economics. Welfare economists may be expected to give increasing attention to the development of welfare criteria for the evaluation of group decisions. One criterion that emerges from our discussion is that any redistribution of income which has unanimous approval increases welfare. This standard considers "do-gooding,"

\[^{13}\text{Supra, p. 39.}\]
aesthetic, and other "non-economic" motives which may or may not have significance to the economist. However, such motives often have an important impact on the allocation of resources, and it would appear that they should have a place in economic analysis. It may be assumed that such motives do not exist or, better, that any redistribution of income conforming to the criterion of unanimity already has been carried out. Although subsequent discussion proceeds on this assumption, there are two qualifications which might limit its validity.

In the first place, unanimous collective agreements require awareness of external economies as well as leadership and a forum for the expression of choices which cannot be expressed through the market. If awareness, leadership or a forum are lacking or inadequate, all possible collective agreements will not have been exploited. To say that this is the political scientist's problem confines economics to the market place. It appears to this writer that the economist ought to exert leadership and create awareness wherever external economies appear to be significant. Many policies which appear to be controversial may be resolved unanimously provided there is awareness and leadership. Indeed, collective agreements are the fare of applied economics. It would appear, for example, that welfare economics might be able to say more about collective bargaining through application of the criterion of unanimity.
In the second place, unanimity is itself an interesting subject for further study. Reorganizations taken one at a time may not have unanimous approval, but such approval may be attained if reorganizations are considered as a group or over a period of time. It appears to this writer that additional progress could be made by following through with the external economies logic combined with a principle of unanimity. Although this amounts to the partial "institutionalization" of economic theory, it may be possible to make judgments that are consistent with the rigorous criteria established by modern welfare economics.

Although there are many interesting and broad implications of the external economies argument, the present study is concerned with a relatively narrow application. The discussion to this point emphasizes the relationship between external economies, individual welfare and government activity. In fine, government represents a decision-making process which assists individuals to attain their own ends. If this is correct, government expenditures for collective goods can be related to individual welfare. It follows that a particular public expenditure or activity conceivably can result in every individual's being on a higher level of satisfaction. If the latter condition is satisfied, government expenditures can be justified on the basis of economic efficiency.

alone. The harmony implied here is no more naive than the doctrine of the "invisible hand." Whereas that doctrine fell a victim to external economies, the view held here falls a victim to equity (conflict). But this anticipates the discussion. Having suggested (but not yet established) an "efficiency" relationship between the individual and government, it is possible to proceed to the technical discussion of external economies of consumption.
CHAPTER IV

THE ANALYSIS OF COLLECTIVE DEMAND

Although external economies may be interpreted so broadly as to include all sorts of pleasures and satisfactions, the ensuing discussion is limited to those economies which give rise to collective action relative to the use of resources. Thus collective agreements to smile and say "good morning" may increase happiness but have no direct relevance to economic welfare. We are interested only in those external economies which impinge directly on a resource margin and which, therefore, warrant a reallocation of economic resources.

A further limitation is imposed by assuming that a person is worse off if he exchanges economic resources for something less than an equivalent return. This eliminates from our consideration the activity of the do-gooders described earlier who are willing to exchange goods, services or control of economic resources for aesthetic, moral or other satisfactions. It should be emphasized that this does not imply that do-gooding is without economic significance. It is assumed that the do-gooders individually or collectively have already done as much good as they are willing to do without some equivalent return in goods and services or control over resources. Both sides of the *quid pro quo* equa-
tion with which we shall deal is cast in terms of goods and services or economic resources. This distinction is somewhat vague and difficult to maintain. For example, a person who contributes to a Tuberculosis Fund may or may not anticipate a return in the form of an equivalent measurable in money terms. Part of his contribution is prompted by do-gooding motives, but another part can be thought of as an insurance premium for the health and safety of his family. That part which is an insurance premium comes within the purview of our analysis. Although there is a risk of beclouding this distinction, we should also note that the insurance premium portion of the contribution may or may not reflect external economies. The part of the individual's contribution which is an insurance premium helps to provide x-rays for members of his own family as well as for other persons. The payment for the x-rays of other persons (assuming no do-gooding motive) is the external economy with which we are concerned. In effect, part of the payment is a subsidy (not a gift but perhaps a bribe) to another individual in order to induce him to have an x-ray.

These limitations mean that the external economies relevant to our discussion are those which call forth an offer of subsidy to the consumer from the recipient of an external economy. The subsidy will not be offered unless it promises to bring about an increase in consumption, nor will it be accepted if the consumer does not wish to add to his consumption even at the lower price.
now available. Having limited the discussion to those external economies which call forth a subsidy, let us now turn to the development of some terminology.

The Terminology

Basically, external economies of consumption lead to joint or "collective satisfactions." The term "collective satisfaction" is used deliberately in order to avoid a complicated classification of external economies of consumption. Strictly speaking, it is possible to distinguish two classes of external economies of consumption which conform to the limitations established above. One class leads to "collective satisfaction," the other to "collective consumption." Although this distinction is not significant enough to be maintained, it helps to point up certain difficulties that ought to be cleared away.

External economies of consumption yield collective satisfaction if the recipient of the external economy can receive the economy only through the consumption of another. In this case, the consumption of one person is a necessary condition for the satisfaction of another. For example, a polio vaccination yields external economies, but the recipient of the external economy does not receive the vaccine. The consumption is separate, but the satisfaction is collective.

On the other hand, an external economy yields collective consumption when the recipient of the external economy could re-
ceive the advantages through purchases or consumption of his own. For example, in hiring a guard for his home, Jones indirectly provides for the safety of his neighbor, Smith. However, Jones's decision to hire a guard is not a necessary condition for Smith's safety because Smith could also hire a guard. This kind of external economy leads to collective consumption and separate satisfaction. A slight modification of the illustration leads to a different situation. Suppose Smith has an economic interest (say, in the form of a mortgage) in Jones's property. Now Smith receives both types of external economy: (1) indirect consumption because Jones's guard protects Smith's property and (2) indirect satisfaction because Jones has provided precautions that could not (by assumption) be provided by Smith without bribing or conferring with Jones. Now we have collective consumption and collective satisfaction, a conglomerate situation. Finally, in the absence of external economies of consumption we leave the collective element and return to the market place -- separate consumption and separate satisfaction -- where our distinction between consumption and satisfaction begins to lose whatever significance it might have.

To simplify the discussion these alternative possibilities are overlooked. Whether an external economy leads to collective consumption, to collective satisfaction or to some combination of the two appears to make no difference in the welfare implications of the problem. In both cases, the recipient of the external
economy may offer to subsidize the consumer. Moreover, the distinction creates semantic difficulties and leads us into vague classifications of the order and nature of satisfactions. For example, one might reasonably conclude that both individuals "consume" one polio vaccination if the vaccination gives protection to both. In order to avoid the semantic pitfalls inherent in such distinctions, the term collective satisfaction is used to describe all situations involving external economies of consumption.

Collective demand is the price-quantity relationship for goods and services which yield collective satisfactions. Throughout, it has been maintained that collective satisfaction is meaningful only if it is considered a function of individual satisfactions or utilities. It follows from this view that collective demand must be derived from individual demands. The possibility of arriving at such a collective demand curve is considered in subsequent sections.

The goods or services for which a collective demand exists may be available in either small or large units relative to individual demands. Thus, the collective demands for polio vaccine or annual chest x-rays are of the same nature and order as the collective demands for protection from mosquitoes or for effective sewage disposal. However, it is more convenient and economical to provide for malaria prevention and sewage disposal on a group basis and for the polio vaccine on an individual basis. The distinction between group and individual cuts across all consumption activity
and is not peculiar to collective consumption activity which arises only when there are external economies of consumption. But the distinction has a special significance to collective demand because it focuses attention on the form of collective action that is needed. In order to avoid misunderstanding and to set forth the basis of the subsequent analysis, it is necessary to elaborate the distinction between group and individual consumption.

Group consumption arises when it is impossible or uneconomic to satisfy individual demands one at a time. Theatre performances, lectures and athletic events are examples of the satisfaction of many individual demands at the same time with a single application of resources. In spite of the fact that all demands are satisfied at the same time with a single application of resources, the individual satisfactions are separate and distinct. Each individual at a theatre performance receives a satisfaction that neither depends upon nor influences the satisfaction of other spectators. Of course, this assumes that the behavior of the audience has a negligible impact on the enjoyment of the performance. In this illustration there are no significant external economies of consumption. There is group consumption and separate satisfaction. Swimming pools and amusement parks belong in the same category. The relative nature of the distinction between group consumption and individual consumption is apparent when we consider that theatre performances or athletic events may be
staged for the enjoyment of only one person. The distinction de­
pends upon the relationship between the size of unit required to
satisfy the demand and the size of the individual demand.

A battleship also satisfies many demands with a single ap­
plication of resources. The battleship, like the swimming pool,
is large relative to individual demands. But the satisfactions
are joint or collective rather than separate. In other words, one
demand cannot be satisfied to the exclusion of the other, nor can
the defense of one person be increased or diminished without hav­
ing a simultaneous impact on the defense of another. The battle­
ship involves significant external economies or collective satis­
faction while the swimming pool involves only separate satisfac­
tion. In both instances there is group consumption.

Collective satisfactions of the same nature as those cre­
ated by group consumption can also be created through consumption
of goods or services which are available in small units relative
to the demands of individuals. To illustrate, let us consider a
commodity or service that comes in units such that it can be pur­
chased and consumed separately, say, vaccinations against communi­
cable diseases. Vaccinations are divisible in almost every re­
spect. Indeed, the individual may have a choice of one, two or
three injections depending on the amount of protection he wishes
to purchase. However, the external economies associated with vac­
cinations may be so great as to warrant a subsidy from others. In
this instance collective satisfaction depends upon individual con­
sumption. Thus, there can be a collective demand for a commodity that comes in small enough units to be purchased and consumed individually. And in many instances the collective demand can be satisfied only through individual consumption.

It appears, then, that the size or divisibility of the good or service is not crucial to the analysis or definition of collective demand. However, the size of unit may determine the nature or form of collective action that must be taken. Where the commodity is available in small units, legislation without government resource-using activity may be enough. Where the product can be had only in large units relative to individual demands, the government must undertake resource-using activity.

The technical discussion which follows deals with three cases, all of which involve external economies of consumption and collective demand. In the first case, an abstract situation is deliberately established in order to show how collective demand is derived from individual demands acting through the market. The first case involves no coercion and the adjustment through the market is clearly welfare maximizing. To simplify the presentation of the first case, the distinction between group and individual consumption is overlooked.

The second and third cases deal with external economies involving collective agreements (contracts) which require enforcement or coercion. In the second case, the collective agreement refers to the individual or private consumption of those goods and
services which yield collective satisfactions, while the third case refers to group consumption which yields collective satisfactions. The former leads to the regulation of private consumption, while the latter leads to government resource-using activity.

Case 1: Abstract Market Adjustment

Let us begin with two individuals, A and B, who experience external economies of consumption when either purchases, consumes or utilizes a particular commodity or service. The individuals, for example, might be neighbors with an untended plot of land lying between their properties. In Figure 1, $D_a$ and $D_b$ represent the individual demands for beautification of the plot of land relating, say, the number of hours that grounds-keepers would be hired at a series of hourly wages. If the current wage for grounds-keepers is $P$, and the individuals do not take account of their interdependence, A will purchase $q$ man-hours of labor; B will purchase none. However, B experiences a windfall external economy depicted by the area $OqRS$ for which he would have been willing to pay an amount depicted by the area $OqRT$. The amount $q$.

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1 The geometry follows conventions described by Mrs. Joan Robinson, *Economics of Imperfect Competition* (London: Macmillan & Co., Ltd., 1933), chap. II.

The term "elasticity of demand" as used in this study does not imply measurement of elasticity. The precise definition of a function, $y = f(x)$, is $\frac{dy}{dx}$. Since $x$, $y$ and $\frac{dy}{dx}$ will, in general, all have different values at different points on the curve, elasticity may be and usually is different at different points on the curve. R. G. D. Allen, *Mathematical Analysis for Economists* (London: Macmillan & Co., Ltd., 1938), pp. 251-64.
does not represent a point of stable equilibrium because B will offer to subsidize A's purchase of an additional unit. The amount of the subsidy, U, will be greater than zero and less than T. (Technically, the initial subsidy offered by B will be an increment greater than zero.) With this offer, the price of an additional unit to A is P-U, and A will expand his purchases to q'. B will increase the subsidy offered so long as additional quantities are forthcoming at a subsidy per unit below his demand price for those quantities. Similarly, A will continue to purchase additional units until quantity Q is reached such that his demand price for Q plus B's subsidy (B's demand price for Q) becomes equal to P.\(^2\) The equilibrium occurs at point M where the respective contributions of A and B toward the purchase of Q are Pa and Pb \((P_a + P_b = P)\). The combined or collective demand of A and B \((D_c)\) is determined by a series of points like M and can be constructed by a vertical summation of the separate demands. This, of course, is in contrast to the usual horizontal summation when the individual demands are assumed to be independent.

An analogous situation arises in the case of joint products whose total costs are allocated on the basis of the demands for the separate products. Since the marginal cost for the separate products cannot be determined, there is a theoretical case for discriminatory pricing. In the case of joint products the

\(^2\)The same equilibrium is determined at the quantity which makes the sum of the marginal revenues equal to the price.
Figure 1. Market Adjustment for External Economies of Consumption
physical conditions of production are such that costs are not assignable. It is possible to argue that external economies of consumption are joint products on the consumption side.\(^3\)

In the illustration of the two neighbors with the untended plot of land, the total price paid for the service (hours of labor) is equal to marginal cost (assuming competition). Moreover, costs are clearly assignable to individual units of physical output. The justification for the different (discriminatory?) shares paid by A and B must be found in the physical conditions surrounding consumption rather than in the physical conditions of production. The satisfactions are joint or collective, and there appears to be no way of distributing the total except on the basis of "value-of-service."

Orthodox economic analysis always proceeds on the assumption that satisfactions are separate. Collective satisfaction leads to a special form of discrimination about which economic analysis has almost nothing to say. Indeed, a strong argument can

\(^3\)In this connection it is interesting to note that Lerner never mentions external economies of production or of consumption. Although Lerner's treatment of such situations is not clear, it appears that external economies of production are treated in a chapter entitled "Indivisibilities." Thus, for example, the smoke nuisance or the development of a skilled labor force associated with the growth of a particular firm are simply indivisibilities or by-products of the activity of the firm. Two products, one internal, the other external, emerge as a lump from a single production process. A. P. Lerner, The Economics of Control (New York: Macmillan Co., 1944), chap. 11.
be made that the different shares paid by A and B do not represent
different or discriminatory prices paid for the same service. Let
us examine this argument more carefully.

In Figure 1, the respective contributions of A and B to­
ward the purchase of amount Q at price P are shown by the rectan­
gles OQWP_\text{a} and OQVP_\text{b}. Let us suppose that B does not offer a sub­
sidy to A, but arrives at his own expenditure pattern after taking
into account the number of hours of labor hired by A.

If the commodity is divisible, the quantity purchased by A
is the amount OQWP_\text{a} divided by the price P. This quantity is de­
picted by N on Figure 2. The amount purchased by B, depicted by C
on Figure 2, can be determined in a similar manner. Separate de­
mands for A and B are determined by a series of points like N and C.
The horizontal sum of these demands is the market demand and
is the same curve arrived at through the vertical summation shown
in Figure 1. Thus, at price P, A purchases S units while P pur­
chases S' units (S + S' = Q). Each pays the same price for the
commodity, and, assuming competition, this price is equal to mar­
ginal cost. Now it appears that there is no discrimination in
spite of the fact that A and B contribute different amounts to the
maintenance of the plot of land. What appears at first glance to
be discrimination becomes marginal cost pricing once the demands
of the individuals are adjusted for external repercussions. In­
deed, discrimination in the usual sense can never occur unless the
demands are independent. Although we have shown that both indi­
Figure 2. Net (Derived) Demand Curves
ividuals may pay the same unit price for different amounts of the commodity and that discrimination in the usual sense may not occur, it must be remembered that the "net" demand curves reflect the adjustments of each individual to the "value-of-service" or demand of the other. Thus, value-of-service to one individual has an impact on the demand of the other. The individual may purchase at a price equal to marginal cost, but the amount of his purchases will depend partly on the value-of-service to the other individual. Another way of saying the same thing is that more than one demand curve is relevant to a single purchase. It appears that the situation described does not fall neatly into any established category of economic phenomena. Perhaps the prices paid by the individuals ought to be described as "non-discriminatory, value-of-service prices." At any rate, the solution on the basis of the "net" demand curves does not violate any of the conditions for a welfare optimum. The production side is completely unaffected and marginal rates of substitution on the consumption side are not distorted. Indeed, marginal rates of substitution are distorted when the "net" demand curves are not taken into consideration.

Returning to Figure 2, it should be noted that the new or net demand curves are to the left and more inelastic than the original independent demand curves (D_a and D_b in Figure 1). One of the net curves becomes negatively sloped indicating that continued increases in the purchases of one individual will bring about decreases in the purchase of the other in spite of a fall in
price. The analysis can be extended to include more than two individuals by vertically summing additional independent demand functions to the composite or collective demand $D_c$ in Figure 1. Consideration of the peculiar relationships which arise as a result of the interdependence of many demands would lead us far afield. Subsequently, it is held that government provides a mechanism for considering and resolving these interdependencies.

The derivation of the net demand curves is not entirely satisfactory because quantities were calculated by dividing the total share of each individual by the price. A more rigorous derivation is possible. Since this derivation is lengthy, it has been placed in a note to this chapter. Only a brief description of the reasoning is needed here. Returning to Figure 1, if the price is $P$, and $A$ purchases $q$ units, $B$ experiences a windfall measured by $OqRT$. Although this windfall is not in money form, it will bring about a rearrangement of $B$'s expenditure pattern. All of $B$'s demand functions change. One of these changing demand functions is the demand for grounds-keepers. Thus $A$'s purchases create income effects which will bring about a change in $B$'s demand. The extent of the change will depend on the income elasticity of $B$'s demand. Any action $B$ finally takes will create similar effects on $A$. By studying these changes it is possible to derive net demand curves identical to those derived by the short-cut method that has been utilized.
The discussion to this point indicates two methods for conceptualizing collective demand and the equilibrium adjustment which occurs in the presence of external economies of consumption. The first method involves a simple vertical summation of independent demands to arrive at the collective demand. The total price or cost of the quantity purchased collectively is allocated among individuals on the basis of value-of-service. It is assumed that all individuals consume the same amount, i.e., everyone consumes the total amount purchased by the group. The second method involves a horizontal summation of net demands to arrive at collective demand. Although the collective demand and the amounts paid by individuals determined in accordance with the second method are the same as those determined through the first method, the logic of the net demand analysis leads to cost-of-service or non-discriminatory pricing. In effect, value-of-service serves to allocate different amounts to each individual while the individual pays a cost-of-service price for the amounts so allocated.

Whether the satisfaction of collective demand requires value-of-service or cost-of-service pricing appears to depend on the possibility of determining the amounts consumed by individuals. If the commodity or service which satisfies a collective demand can be purchased and consumed by individuals, the solution conforms to cost-of-service principles. Where this is impossible, it is best described as value-of-service. The difference is a relative one depending on the extent to which different amounts
may be assigned or perhaps imputed to different individuals. It appears that when there is joint or collective satisfaction, value-of-service and cost-of-service become closely related—never the same, never completely different. However, an attempt to disentangle the one from the other is made in a subsequent section.

It should be noted that the analysis began with a situation in which the price was low enough for one of the individual demands to become effective. This was necessary so that other persons could respond to the external economies associated with the initial purchase with offers of subsidy for additional purchases or with purchases of their own. Thus, the process of adjustment occurred through the market. That is, if the net demands become the market demands, the external economies of consumption are "internalized" through the market mechanism. However, a market solution breaks down completely if the entire length of both demand curves lies below the price or cost of the commodity. For no initial purchase is made and no response is forthcoming. It remains, then, to consider the case where both independent demand curves lie below the price. Since the market cannot become operative in such situations, a coordinating agency must be established.

The need for a coordinating agency is apparent if the individual demand curves have the relationship with price shown in Figure 3. If the commodity provides external economies, the individual demands may be summed vertically to yield $D_o$, the total collective demand, and an effective demand for quantity $Q$. But
now some means has to be found to bring the individuals together so that a purchase can be made. If the individuals are neighbors, they may make suitable arrangements through discussion. But if many individuals are involved, the coordination can be accomplished by government or some other collective organization. In the deliberations of such bodies, the individual demands may be considered and taxes determined. Since the solution is different depending on the nature of the product, the analysis is divided into two parts, the first dealing with a commodity that can be purchased and consumed individually, the second with a commodity which requires group consumption. Although the important cases involve group consumption, it is convenient to begin with a commodity sufficiently divisible to be consumed individually.

Case 2: Individual Consumption of Goods Which Yield Collective Satisfactions

The situation depicted in Figure 3 is assumed to satisfy the following conditions: (a) the commodity can be purchased and consumed individually, (b) the independent demands of all individuals lie below the supply price and (c) the commodity yields external economies of consumption.

It is possible to imagine a few instances in which all three conditions might be satisfied. For example, an increase in both individual and social welfare might be associated with annual physical examinations aimed at preventing the spread of a contagious disease. Medical examinations in these circumstances clear-
Figure 3. Relationship of Individual, Collective and Market Demands
ly yield external economies. Let us suppose that the individual demands and the fees charged by physicians are such that individuals do not have a sufficient number of examinations. The situation may be aggravated by an inequitable distribution of income but could exist even if incomes were equal. A redistribution of income, therefore, may fail to achieve optimal results. Furthermore, a redistribution could not be justified without making those interpersonal comparisons which we have been so careful to avoid. What is the solution indicated by the analysis developed in this study? The relevant relationships are shown in Figure 3.

Whereas a horizontal summation of the independent demand curves of individuals X, Y and Z (D_m) yields no effective demand for examinations at the prevailing price, a horizontal summation (D_c) which is appropriate in the presence of external economies does yield a demand effective at the prevailing price. If individuals X, Y and Z are brought together the external economies will be recognized and an amount Q will be purchased. Thus X, who does not purchase enough examinations for himself, may be willing to offer something toward an examination for Y and Z, especially if Y and Z are known to come into close contact with X, his family, his associates, or even his customers. If the others follow a similar line of reasoning, the individual demand curves will move to the left and become more inelastic as shown in Figure 2. The demand curves maintain this position only as long as the individuals consider their interdependence. But now each individual
demand may rise above the price line at some positive quantity, and the individuals may agree to receive and personally pay for a certain number of medical examinations.

Although some means must be found to enforce the agreement, one could hardly say that compulsion is involved in this situation. Nor does the fact that, after reaching the agreement, an individual may go to considerable trouble to avoid honoring it contradict the view that the solution results in an increase in welfare without making anyone worse off. Though there are not many realistic examples of instances in which agreements of this sort are made, a few cases which come close may be cited. Laws requiring compulsory annual inspection and adjustment of automobile brakes are not novel. Individuals might be required to pay for such inspections at a private garage, and the law might be enforced through a system of windshield stickers. It is possible that such laws may be passed unanimously without any of those moral or ethical judgments which usually bring about disagreement. Health certificates signed by a family physician are sometimes a requisite for school enrollment as well as for the purchase of a marriage license. All such laws are a response to a collective demand (vertical summation of individual demands) and involve a reallocation of resources without taxation and without government resource-using activity.

It is also interesting to note that if the price of medical examinations were much lower, the independent market demand
would result in more physical examinations than the collective demand \( (D_m) \). In other words, unless external economies are considered, it is possible to have more than the optimum number of examinations. How often does an individual ruefully admit, "If I had known you were going to do it, I would not have gone to so much trouble to do it myself"?

The conclusion of this part of the analysis is that a collective demand can be satisfied without abandoning marginal cost pricing if the commodity or service can be consumed individually. It may often be more convenient for a government agency to provide the service, but this requires no change in pricing principles. Fees paid to government for services that individuals are "compelled" to purchase can be based on sound pricing principles. A cost-of-service application of the benefit theory of taxation is the relevant rule for economic efficiency whenever a collective demand calls for a divisible service.

Case 3: Group Consumption of Goods Which Yield Collective Satisfactions

Collective demand usually leads to the provision of services which are not conveniently divisible. Battleships and fire engines, for example, come in large units relative to individual demands. Figure 4 shows the independent demand curves of individuals A and B and a discontinuous supply curve, \( S \), representing a commodity or service that cannot be had in smaller quantities than \( Q_1 \). The situation is much the same as those that have already
Figure 4. Group Consumption, Collective Satisfaction
been considered; there is no effective market demand, but the indi-
viduals acting in concert have a collective demand, $D_c$. An
amount $Q$ is purchased, $A$ pays $P_a$ and $B$ pays $P_b$. Now, however, indi-
viduals cannot purchase the commodity since it is not divisible. Nor is there any way of knowing the amount that each person con-
sumes.

The fact that the individuals contribute different shares toward the purchase of the commodity may reflect either different amounts at the same unit price to each individual (net demand) or a fixed amount at different prices to each individual (independent demand). If different quantities can be imputed to the individ-
uals, the payments may be described as reflecting the cost-of-
service. But if different prices are charged for the same quantity of service, the payments are described best as reflecting the value-of-service. In either case the payment is the same. Al-
though different amounts may be imputed to individuals, the fact remains that an increment of public service cannot be assigned to individuals. It is probably best to think of this allocation of shares as a value-of-service allocation involving the same prin-
ciples that would prevail in the competitive production and sale of joint products. The term cost-of-service is retained for those situations in which increments can be assigned to individuals.
Implications of the Technical Analysis

There are two implications of the analysis of collective demand that ought to be noted: (1) It has relevance to the evaluation of those programs which have been described as lying in an in-between area and (2) It provides a welfare basis for taxation without abandoning the individualistic ethic or the rigorous analytical limitations imposed by modern welfare economics. Let us briefly consider each of these implications.

The analysis is relevant to in-between areas because it provides a conceptual basis for combining private and collective elements. Where external economies or indirect benefits are a small proportion of the total (direct plus indirect), a subsidy to the consumer (or producer) is in order. The size of the subsidy will depend on the relationship between market and collective demands. Where all the advantages are indirect, there will be an effective collective demand but no market demand and government resource-using activity or coercive (in the volitional sense described earlier) taxation may be required. Analytically, it is possible to determine a market demand through horizontal additions of individual demand functions and a collective demand through vertical additions. If, at a given price, the market demand is equal to the collective demand, no governmental action is required. On the other hand, if the collective demand exceeds the market demand the use of additional resources in that area of consumption (or production) must be encouraged through the use of
subsidies or through direct government participation in the use of resources. Tax levies would be determined in accordance with the principles that have been described. In this general manner, it is possible to determine the proportions in which prices and taxes are combined and the relative significance of the social or collective elements involved in any governmental program. At least this much can be accomplished through the employment of modern welfare economics in the analysis of questions involving both private and collective magnitudes. Although the possibility of rigorous application of these ideas is too much to hope for, an attempt to apply this general procedure to highways is demonstrated in Chapter VIII.

The second implication of the analysis relates to the "burden" approach to taxation. A tax system which translates into effect the voluntary choices of individuals imposes no more a "burden" than the price one pays for anything. A positive view of taxation was expressed by Swedish and Italian economists at the turn of the century. Unfortunately, these writers do not appear to have had a serious impact on English and American thought which continues to emphasize the "load" or "burden" of taxation. A much more positive view of taxation attended the Keynesian Revolution which resulted in a new set of tax principles. But these principles offer no guidance once resources are fully employed and usually involve judgments which modern welfare economists attempt to avoid.
These and other implications of the technical analysis are discussed in the following chapter which attempts to establish the welfare basis for governmental programs. The final result is the emergence of an analytical framework for application to in-between programs and a reconciliation of price theory and tax theory under the aegis of modern welfare economics.
A NOTE TO CHAPTER IV

Net Demand Curves

The behavior of individuals in the presence of external economies has been depicted graphically with the aid of traditional demand curves. It was shown that once individuals recognize the interdependence of their consumption activities, their demand functions change. In the case of external economies of consumption, the change generally leads to a more inelastic demand curve which lies to the left of the original demand curve. Although the net demand curves are not of crucial importance to the main body of the discussion in the text, they represent a refinement that is worth some additional attention. It will be recalled that the net demand curves were derived through arithmetical division. The derivations in the text would be described best as "estimates" rather than logical derivations. Indifference technique provides tools for a more satisfactory derivation of the net demand curves. Since the text describes the general approach and the assumptions, we shall proceed directly to the geometry.  

In order to demonstrate the geometry that will be used, let us begin with a traditional demand curve for an individual

Thus, D in Figure 5 is the demand of individual A for a commodity or service, X. If A's income or purchasing power, I, is increased to I', his demand curve will shift to the right and take a position depicted by D'. If the price, P, is held constant, the amounts Q and Q' will represent the amount of X that would be purchased at the respective incomes I and I'.

The relationship can be transferred to an indifference map which measures quantities of commodity X along the horizontal axis and income, money, or general purchasing power along the vertical axis (Figure 6). With the price fixed at P, a series of parallel budget lines can be drawn each of which defines alternative allocations of a particular income. The lines LL and LL' are the relevant budget lines for the respective incomes I and I'. The amounts Q and Q' (Figure 5) which represent the amounts purchased at each of the two levels of income can now be transferred to the horizontal axis of Figure 6. This determines the expenditure pattern of individual A at two levels of income. The points E and E' are positions of equilibrium. Since E and E' lie on the highest level of satisfaction attainable within the limits of a given income, these points will be on indifference curves (CC and CC') which are tangent to lines LL and LL' at E and E'. Points of tangency between budget lines and indifference curves define A's income-consumption curve, IC. (It is important to note that we have maintained a relationship between the demand curves of Figure 5 and
Figure 5. Individual Demand at Two Levels of Income

Figure 6. Derivation of Income-Consumption Curve
the construction in Figure 6.) If a similar construction is envisioned for individual B, the technique can be applied to the analysis of external economies.

The application to external economies of consumption is demonstrated in Figures 7 and 8. Let I be the income of A (Figure 7), and let i be the income of B (Figure 8). The price of commodity X is fixed. It is convenient to utilize a separate diagram for each individual. Upper case lettering refers to A's diagram; lower case refers to B's. Each of the individuals also has an income-consumption curve, IC and ic, and a budget line, LL and ll, both of which are derived by the method already described. Every point on an income-consumption curve represents a point of tangency between an indifference curve and a budget line. In order to simplify the diagrams only one indifference curve is shown. Although the indifference curves are not shown, reference to any point on an income-consumption curve refers to an indifference curve which is tangent to a budget line at that point.

Before external economies are considered, the respective equilibrium positions of A and B occur at points E₀ and e₀ which will lie on the highest indifference curve (not shown) that each can attain within the limits of his purchasing power (I and i). The respective quantities purchased by A and B are Q and q. The equilibrium becomes unstable when we add the condition that each individual derives satisfaction from the consumption or purchases of the other. The recognition of external economies of consump-
Figure 7. Equilibrium Adjustment of Individual A

Figure 8. Equilibrium Adjustment of Individual B
tion means that each individual now experiences satisfactions from a larger quantity of commodity X than he has purchased. This will decrease the individual's marginal rate of substitution for commodity X. The result is disequilibrium. Let us examine the process of adjustment to the new equilibrium (referred to hereafter as the net or final equilibrium).

Suppose that individual A derives satisfaction from B's consumption. That is, the total amount of the commodity or service enjoyed by A is not Q but Q + q (or Q + some proportion of q). Point S on A's indifference map represents the situation in which A now finds himself - he enjoys more of commodity X (Q + q) and the same amount of all other commodities or income (Z). Although individual A is now on a higher indifference curve which goes through point S, he is not on the highest indifference curve attainable. What is the nature of his adjustment?

The income represented by point S is depicted by a budget line KK, drawn through S and parallel to A's original budget line (LL). The distance, d, on the vertical axis measures the amount of the windfall that A associates with B's purchase of q units. If KK were in fact his budget line, i.e., if I' were his income, A would allocate his expenditures in the manner depicted by R which

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5 The notation in parenthesis refers to the possibility that the commodity may not yield external economies to A until after B has purchased a certain amount, or that A experiences satisfaction only from some proportion of B's purchases. In this event, A will experience satisfaction from all of the units he has purchased plus that proportion of B's purchases which do yield external economies. This qualification has no effect on the analysis.
is a point of tangency between KK and an indifference curve, CC. Point R calls for $Q_1$ of commodity $X$ and $Z_1$ of other commodities. Since B has provided $q$, A rearranges his expenditure pattern and purchases an amount $Q_2$ ($Q_1 - q$) of commodity $X$ which is less than the initial equilibrium amount $Q$. By diminishing his purchases to $Q_2$, individual A brings his marginal rate of substitution for commodity $X$ back into an appropriate relation with the market price. The result is a release of part of A's income (measured by $d_1$ on the vertical axis) for the purchase of other commodities. Individual A is at an equilibrium when his money income is allocated in the manner indicated by point T ($Q_2$ of $X$ and $Z_1$ of all other commodities). A's level of satisfaction is shown by point R on curve CC. The difference between points R and T is $q$, the amount of $X$ purchased by B.

Let us turn now to B whose original equilibrium is depicted by $e_0$. Upon recognizing that A is providing $Q_2$, B experiences the same sort of increase in real income and redefines his maximizing position at point r which calls for $q_1$ of the commodity. Since A is providing $Q_2$, B purchases $q_2$ ($q_1 - Q_2$) which is less than $q$, the initial equilibrium amount. B's new allocation of money income is shown by point t, and his level of satisfaction is shown by point r on indifference curve cc. The difference between points r and t is $Q_2$, the amount of $X$ purchased by A.

B's adjustment brings about a decrease in the total amount of $X$ and, therefore, an increase in A's marginal rate of substitu-
tion for X. Point $S_1$ on A's diagram represents the new situation to which A must now adjust. $KK_1$ is the income appropriate to $S_1$, and $R_1$ is the point of tangency between $KK_1$ and an indifference curve. Accordingly, individual A adjusts to the amounts indicated by $R_1$ and arrives at the allocation of income shown by $U$. His level of satisfaction is the indifference curve that goes through $R_1$. Next B adjusts and so on. This is enough to describe the process. Now, what is the nature of the equilibrium?

Throughout the process of adjustment each individual moves along an income-consumption curve (IC) as the other individual increases or decreases his purchases of the commodity. The impact on the individual's expenditure pattern is indicated by movement along his budget line (LL). Beginning at points $T$ and $t$ (the respective expenditure patterns of A and B at the end of the first adjustment), A increases his purchases and B decreases his purchases. Thus, A's marginal rate of substitution for commodity X begins to decrease while B's rate begins to increase. The two marginal rates of substitution become equal at some point on the budget line short of $E_o$ (for A) and $e_o$ (for B). When this occurs, a final or net equilibrium has been attained. In the net equilibrium each allocates his income as indicated by $E_f$ (or $e_f$) and each is on an indifference curve which goes through $R_f$ (or $r_f$). The amount of X purchased by A and B is $q_f$ and $q_f$, respectively. The
total amount of X purchased is the amount that would have been purchased on the basis of a **vertical** summation of the independent demand curves. (See Chapter IV.)

Up to this point, the money incomes (budget lines) of A and B have been fixed. If money income is varied, other equilibrium points like F can be determined. Thus, G represents the net equilibrium point if A's income were greater than I, and H would be the net equilibrium point if A's income were less than I.

Points like H, F and G define a net income-consumption curve for individual A (NIC in Figure 9) which takes into consideration the external economies of consumption associated with B's consumption activity. Every point on the net income-consumption curve is a point of tangency between a budget line and an indifference curve. But now the indifference curves have changed — they, too, are net of external economies. The original (independent) and net income-consumption curves are compared in Figure 9. (Although they are not shown, there are two sets of indifference curves in the field of the diagram, one for each income-consumption curve.) The net income-consumption curves are to the left and more inelastic.

It is possible to derive the net demand curves from the information in Figure 9 by allowing the price of X to vary (i.e., by changing the slope of the budget line, but holding the left end of the line at the same point (I) on the vertical axis). The points of tangency between budget lines and indifference curves
Figure 9. Independent and Net Income-Consumption Curves

Figure 10. Independent and Net Demand Curves
found on the net income-consumption curve determine the quantities that would be purchased at a series of prices. The results are summarized in Figure 10. The net demand curves for A and B \((DN_a\) and \(DN_b\)) are to the left and more inelastic than the independent demand curves, \(D_a\) and \(D_b\). The geometric presentation validates the conclusions reached in the text.

Although economic theory deals with cross-elasticities of this sort, the interdependency of demand functions provides a relatively unexplored area for further investigation. It cannot be substantiated by much more than intuition, but it is the writer's opinion that this type of analysis can cast additional light on the theory of rate discrimination in situations involving direct interdependency of demands. More important, perhaps, is the "institutionalization" of the traditional demand curve which is always drawn on the assumption that satisfactions or utilities are independent. In group or social situations the individual's demand changes. The foregoing analysis provides a geometric means for bringing some of these changes into the general framework of economic theory. Conspicuous consumption as well as many other social phenomena can be analyzed through the use of the geometry that has been established.
CHAPTER V

WELFARE STANDARDS FOR GOVERNMENTAL PROGRAMS

This chapter reintroduces the so-called Pure or Voluntary Exchange Theory of government finance and attempts to draw together the threads of earlier discussions into a unified set of standards and procedures for the analysis of governmental programs. Although those elements peculiar to in-between programs receive primary emphasis, the rationale of this chapter has applicability to governmental activity in general.

The conceptions in this chapter are well-known to theorists but appear to have been rejected or overlooked by practitioners. Many historical contributions as well as a considerable amount of contemporary theory are taken for granted. The contribution of this chapter lies in the arrangement of theoretical ideas into a framework for applications. The gap between modern welfare economics and applied economics necessarily is wide. This chapter does not purport to close that gap, but it is felt that it represents a step in that direction.

The discussion in Chapters III and IV emphasizes the volitional character of governmental measures aimed at the promotion of economic efficiency and the compulsive character of governmental measures aimed at the attainment of equity. The juxtaposition
of compulsion and equity may seem paradoxical. However, this is an artificial juxtaposition imposed by a "neutral" interpretation of the individualistic ethic or by the removal of interpersonal comparisons of utility. When standards for making such comparisons are adopted, the attainment of justice or equity may appear to be as obviously advantageous and non-coercive to the individual as the attainment of economic efficiency. Although "neutral" solutions may magnify greatly the importance of single individuals or minority groups, they represent the logical starting point for the analysis of problems arising in a society which values the individualistic ethic. Since neutrality is to be the starting point, it is appropriate to begin this chapter with a review of the Voluntary Exchange Theory advocated by Wicksell in Sweden and de Viti de Marco in Italy.

The Voluntary Exchange Theory

An early statement of a voluntary theory of government finance was presented by Antonio de Viti de Marco in 1898. Imbedded in de Marco's reasoning is the view that public economy is the result of voluntary action on the part of individuals seeking to maximize their own welfare. He described taxes as payments for "season tickets" entitling the individual to the unlimited and free use of services and privileges provided by the state. De Marco

insisted that individuals consumed different amounts of public service and brilliantly defended the hypothesis that the amounts of public service consumed are proportional to income. This contention along with a "diffusion" theory of tax incidence provided the basis for de Marco's recommendation for proportional taxation.

It is unfortunate that de Marco implied that this was a "just" theory of taxation. Clearly, de Marco did not intend to redistribute income, and one writer has described his work as "rationalizations of de Viti's conservative tastes," which are "more old-fashioned than liberal." This description of de Marco's tastes might also apply to that branch of modern welfare economics which adheres to a Paretian or trading concept of the optimum.

Wicksell also espoused a voluntary theory of taxation. However, Wicksell combined it with that "social conscience" so obviously missing in the work of Pareto and de Marco. Wicksell's views were refined and elaborated by his student, Lindahl. Although translations of the relevant works have not been made, the main ideas of these writers can be found in various articles and

\[\text{References:}\]


2. Supra, p. 19.
reviews. In addition, Wicksell's translated Lectures contain some scattered references to taxation and to the theory of government.

Lindahl presented the view that the amounts of public expenditures and tax payments are the result of an equilibrium adjustment. According to Lindahl, the demand of one individual for a collective good represents a supply or offer schedule to other individuals. That is, A's offer to contribute a particular amount or percentage of the total cost of a collective good is a supply curve to B; similarly, B's offer is a supply schedule to A.

The solution conceived by Lindahl, is summarized in Figure 11. Amounts of a collective good are measured along the horizontal axis, and the percentage of the total cost offered by individ-

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4 The Voluntary Exchange Theory appears to have been first stated in 1896 by Wicksell in Finanztheorie Untersuchungen (Jena: Gustav Fischer, 1896).

Analytical development of Wicksell's formulation is associated with Erik Lindahl, Die Gerechtigkeit in der Besteuerung (Lund Universitets-Bokhandlen, 1919) and "Einige Strittige Fragen der Steuertheorie" in Wirtschaftstheorie der Gegenwart (Wein, 1928).


5 Figure 11 is adapted from Musgrave, op. cit., p. 216. Musgrave cites Lindahl's Gerechtigkeit, p. 89.
Figure 11. Lindahl's Solution

A's Per Cent of Total Cost

B's Per Cent of Total Cost

Amount of Public Service
ual A is measured along the vertical axis. The curve aa represents A's demand for public goods at various prices or percentage contributions. As the amount of service increases, the percentage of the total that A is willing to pay decreases. A similar curve bb may be drawn for individual B, rotated 180° in a counterclockwise direction, and superimposed on A's chart. Agreement is reached at a quantity Q with individual A contributing sixty per cent of the total cost; individual B contributes forty per cent of the total cost. Lindahl extended the analysis by considering a large number of demands simultaneously. All of the individuals concerned must be present or represented for a simultaneous attainment of equilibrium.

It is apparent that the two individual demands in Lindahl's diagram may be summed vertically to yield the same equilibrium. The solutions to Figures 1 to 4, presented earlier in connection with the analysis of external economies, were demonstrated through a vertical summation of the individual demands. Geometrically, the same results could have been obtained in Figures 1 to 4 by rotating and superimposing one of the demand curves so as to arrive at the equilibrium depicted by Lindahl. However, vertical summation represents a more general case since it may be applied to both divisible and indivisible commodities and provides a conceptual basis for combining taxes and prices. It was shown earlier

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6 Supra, pp. 82-98.
that collective demand may be satisfied by legislation requiring individuals to make a private purchase in the market place. Lindahl's solution can apply only to goods or services that are provided on a group basis and which cannot be sold to individuals. The refinement implied by the analysis in Chapter IV emphasizes that consumption of any kind is of collective concern if it involves significant external economies or diseconomies, and that collective goods are only one means of satisfying collective demand.

The Voluntary Exchange Theory, qualified by the discussion in Chapter IV, provides the main outlines of an economically efficient, or neutral system of taxation. The entire discussion adds up to a benefit theory of taxation which may be applied on either a cost-of-service or value-of-service basis. Although these two applications of the benefit theory are recognized by students, they are usually placed in a context which emphasizes tax equity rather than economic efficiency.7 The possible objection to the benefit theory on grounds of equity is clear. Although de Marco appears to have been satisfied about the equity of such a scheme, Lindahl and Wicksell were not satisfied. Consideration of modifications in the interest of equity are deferred, however, until some other objections to the Voluntary Exchange Theory have been cleared away.

Objections and Limitations

The Problem of Measurement

Most critiques of the benefit theory emphasize the difficulty of measuring costs or estimating benefits. However, this is a technical difficulty. It prevents easy application but does not destroy the theory. Buchanan defends this position as follows:

If benefits from public services accrue to individuals as a group (and this is impossible to deny), it follows that specific benefits are received by particular individuals, regardless of the technical difficulty of dividing the benefit among them. The rejection of the benefit theory of taxation should not rest upon the individual isolation of specific benefits but upon the unacceptability of the ethical ideal of the individual quid pro quo.9

There is another and even more telling argument in defense of the view taken in this study. If measurements of benefit are not made or at least implied, the revenue-expenditure system cannot be evaluated in terms either of economic efficiency or of equity. If quid pro quo calculations are rejected, there can be no principle of tax equity. No matter what ethical principle is selected — ability-to-pay or benefit — benefits must be measured or hypothesized if only to determine whether or not the system adheres to the ethical principle. A complete framework must relate

8"Any attempt to translate the cost-of-service theory into specific terms reduces it to nonsense." Ibid., p. 250.

9Buchanan, op. cit., p. 500.
the allocation of taxes with the distribution of benefits. If this alternative cannot be accepted, we must abandon the individual completely and adopt the organismic view.

Buchanan suggests that application of the benefit theory must involve empirical research relating tax incidence to the distribution of net benefits. If research does not yield conclusive answers, it may lead to a reasonable benefit hypothesis. A reasonable hypothesis as to the distribution of benefits is certainly better than none.

De Marco and others have argued effectively that public expenditures should be considered before reaching any conclusions with regard to the incidence of taxation. Professor Edwin Cannan, writing in 1899, reached a similar conclusion:

I have no doubt that it is desirable to eschew the use of the term "incidence" of taxation. It unduly restrains inquiries into the justice and expediency of taxes, since it is always held that the "real incidence" of a tax is upon the persons who ultimately pay. . . . It is, therefore, far better to consider the effects of taxation. By using this more general term, we should find it easier to avoid the usual mistake of supposing that taxes are subject to an economics of their own, instead of having effects just like any other expense.

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The analysis required for a completely satisfactory evaluation of the revenue-expenditure process is as impractical as any general equilibrium analysis. However, the traditional analysis of shifting and incidence represents a first step toward the determination of total and net tax effects. Such analysis along with an estimation of the benefits resulting from expenditures provides a means for pinpointing the gainers and losers so that a reasonable policy evaluation can be made.

This is a large order and calls for empirical investigation of a sort that is pursued frequently by individuals and organizations which seek to evaluate particular government programs. Although a complete or general evaluation is the ultimate goal, considerable progress can be made by partial and admittedly incomplete studies of particular government programs. If these studies recognize a coherent, albeit abstract, set of general principles, a forward step will have been taken in the direction of a general evaluation.

The Problem of Compulsion

Another objection to the Voluntary Exchange Theory is the unrealistic nature of the assumption of unanimous agreement (trading equilibrium). Musgrave maintains that government activity in-

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volves compulsion and rejects the entire theory because

The contention that fiscal policy is determined as a direct resultant of the mutual agreements of a multitude of contributors, acceptable to each and all of them . . . constitutes an unacceptable simplification.\textsuperscript{13}

An answer to this objection has already been given in an earlier chapter which set forth an interpretation of government based on an extension of the external economies analysis.\textsuperscript{14} Although the assumption of unanimity is a simplification, it is not an unacceptable simplification. In the presence of external economies "voluntary compulsion" is a requisite for the maximization of individual welfare.

From another point of view, the Voluntary Exchange Theory can be interpreted as the Compensation Principle when compensation is actually paid. A government revenue and expenditure program represents an economic reorganization. Such reorganizations are deemed desirable if the gainers can compensate the losers and still leave a surplus. The question put to the individual is:

"How much are you willing to pay (or must you be paid) in order to bring about this reorganization?" Thus, the Compensation Principle sets up an exchange relationship between gainers and losers;

\textsuperscript{13}Musgrave, \textit{op. cit.}, p. 220.

\textsuperscript{14}Wicksell and Lindahl also developed a principle of voluntary and unanimous acceptance of tax measures. Unfortunately, there are no translations of the relevant works. Some material, but not enough for an adequate description of their views on this subject, is presented in C. G. Uhr, \textit{op. cit.}, pp. 834-37.
the compensation payment represents the terms on which the reorganization is carried out. In the case of a public revenue-expenditure program, the gainers and losers are usually the same persons. Individuals gain from government expenditures and lose when they pay taxes.

If the Compensation Principle has any validity at all, it must lead to the Voluntary Exchange Theory. All this, of course, begs the question. What is needed is a defense of the Compensation Principle. But there is very little this writer can add to the literature of this subject. Nevertheless, it is worth emphasizing that the Voluntary Exchange Theory involves no greater strain on the imagination than some widely accepted assumptions of economic theory.

The Voluntary Exchange Theory seems unrealistic because government decisions involve much more than economic efficiency. Conflict and compulsion inevitably are involved when ethical judgments, which must be made, are in fact made. Musgrave's criticism of Lindahl's conclusions points up the poverty of economic analysis when it is shorn of interpersonal comparisons of utility. The same general criticism applies to modern welfare economics.

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16 Benham, op. cit., p. 436.
Equity

No tax policy can be evaluated on the basis of economic efficiency alone. Indeed, it appears that notions about tax equity are of much greater significance. Obviously, the Voluntary Exchange Theory can be applied directly only in a society which has an ideal distribution of income. Only a fantastic interpretation of the theory could justify most of the welfare programs and transfer payments that are deemed desirable in a society with significant income inequalities. To the extent that the theory is applicable, however, it bridges a gap between general economic theory and public finance. The chief advantage of the benefit theory or Voluntary Exchange Theory is not as a prescription but as a basis for distinguishing between equity and efficiency. It makes explicit the nature of the judgments that are made. In the final analysis, refinements of this sort appear to be the chief contribution of most of the recent work in welfare economics.

Wicksell and Lindahl appear to have held an efficiency view of the Voluntary Exchange Theory. Lindahl, for example, implicitly drew a distinction between equity and efficiency when he defined a dual role for government. According to Lindahl, the first responsibility of government is to attain a just distribution of income through whatever means are at its disposal. Having achieved this end, government activity should be ordered so that the distribution of income would be left unchanged. Thus, there are two tax distributions - a "social" distribution and a "neu-
The benefit theory, of course, applies to the neutral distribution. De Marco, looking at society through Pareto's eyes, recognized only the neutral half of the problem.

According to Wicksell, a "fiscal residuum" appears when benefits are not commensurate to taxes. When the individual receives benefits greater than the taxes he pays, he enjoys a positive fiscal residuum. If taxes exceed benefits the residuum is negative. The Voluntary Exchange Theory leads to a zero fiscal residuum and a neutral tax system. This provides a method of differentiation superior to the usual distinction between progressive, proportional and regressive taxation. For example, a progressive tax system can be defined as one in which the low income groups enjoy a positive fiscal residuum while the high income groups have a negative residuum. If interpersonal comparisons are admitted, it is possible to compare the positive and negative balances and to achieve the maximization of a "social" residuum.

The Relationship of Governmental Programs to Market Allocations

The preceding discussion emphasizes the most extreme form of external economy, collective demand. It is not difficult to

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17 These views also appear in Wicksell's Lectures, I, op. cit., pp. 142-45, and in his Finanztheoretische cited by Uhr, op. cit., pp. 835-36.

18 Buchanan, op. cit., p. 502.
apply the discussion to the in-between areas. External economies of consumption have been described at length in earlier sections. Their existence requires a system of taxes and subsidies designed to reflect magnitudes overlooked or rejected by the market mechanism. Similar conclusions apply in the presence of external economies of production. Since almost all economic activity results in some external repercussions, the external economies logic, if pushed far, provides an argument for abandonment of the market as an allocative mechanism. The market, in fact, is abandoned when external economies take the extreme form of collective demand. It is appropriate now to place the market and government in perspective by considering instances in which external economies appear in a less extreme form. Such situations have been described by Pigou and Baumol.

**Limited External Economies of Production and Consumption**

Baumol recognized the implications of external economies to a market economy. In the presence of external economies of production, output in particular industries is either smaller or larger than the optimum. This deviation from the optimum may create some paradoxical situations. If, for example, production involves significant external diseconomies, the restricted monopoly output may be nearer the optimum than competitive output. On the other hand, competitive output may be too small when it yields im-
important external economies. These considerations lead Baumol to assess the alternatives to a market system. He concludes that

the general problem seems to be amenable to amelioration by a system of bounties and taxes so long as we have a fairly good idea of its direction and magnitude . . . . Since the precise preference patterns of consumers are by no means easy to determine, it is not generally easy to recognize a deviation from ideal output, let alone to calculate its direction and magnitude. Thus, decisions by a central planning group or any other body acting as allocator of resources in place of the market mechanism may not be much more successful than the market in eliminating deviations from ideal output. ¹⁹

The system of taxes and bounties envisaged by Baumol presumably would apply to obvious instances of misallocation. In most cases, according to Baumol, the economies or diseconomies will cancel out, i.e., apply with equal force to all industries, and no serious misallocation will occur. With the exception of such generalizations, Baumol offers little help regarding the methods that might be used for determining the size and magnitude of external economies. Again, it is empirical investigations that will tell us where, when and how long government measures are required.

The effectiveness of taxes and bounties in eliminating deviations from the optimum will depend on the elasticity of demand and supply. The output of a product whose demand or supply is highly inelastic will not be affected much by reasonable taxes and

bounties. Thus, consumption of alcoholic beverages may involve significant external diseconomies, many of which can be measured, but the taxes required to bring about a decrease in consumption may have to be so high as to make administration of the tax difficult. In spite of the fact that taxes and bounties may have little effect on the output of a particular commodity, such taxes are still justified because they place costs on those who impose them.

Although resources may not be driven toward or away from the product in question, the taxes and bounties would still have income effects which would bring about a reallocation of resources. However, income effects are more diffuse and difficult to evaluate than substitution effects, and taxes and bounties justified on this basis may not be worth the trouble.

Thus, external economies imply two sorts of government action relative to taxes and subsidies. The first is the satisfaction of collective demand which usually requires resource-using activities on the part of government. The second requires a Pigovian system of taxes and bounties aimed at bringing market

20 The same difficulty appears when marginal cost pricing is considered. One of the reasons for pricing at marginal cost is to ensure a more efficient utilization of a fixed plant. But if the demand has little elasticity, the output of the plant will be about the same regardless of the pricing scheme. It has been noted that measurements of demand elasticity are not implied in this study, supra, p. 82. The terms "elastic" or "inelastic" are employed only in situations where relationships but not measurements are crucial. The terms "more" or "less" are used to describe changes in the elasticity of demand.
values into a closer relation with social values. The difference between these two forms of governmental activity is simply a matter of the relative magnitude of external economies.

To avoid misunderstanding, it may be helpful to describe the relation between Pigovian taxes and bounties and the compensation payments envisaged by modern welfare economists. The connection between the Compensation Principle and the Voluntary Exchange Theory was described in an earlier section. Compensation payments are usually discussed in a framework based on the independence assumption. Such payments are necessary because welfare analysis does not presume to make interpersonal comparisons of utility. A given welfare reorganization involves two steps, one in the interest of efficiency, the other in the interest of equity.

The usual example is the case of monopoly operating with prices in excess of marginal cost and with restricted output. Reorganization to a marginal cost basis involves losses, and therefore, compensation to the monopolist. Reorganization increases welfare because the monopolist would have his profits anyway and the community is better off by the amount of expanded output. This much can be said without making interpersonal comparisons. If the monopolist is not compensated or is only partially compensated, the judgment is of a different order. It is a judgment about distributive justice and does require interpersonal comparison.
The values used in calculating the compensation to the monopolist have nothing to do with the external economies discussed in this study. Furthermore, it is held by modern welfare economists that the taxes that must be levied in order to make compensation should not disturb the margin. Strictly speaking, only poll taxes and rents satisfy this criterion. The view that taxes should be non-marginal implies that individual decisions correctly reflect all costs and utilities and that there are no external economies or diseconomies. This follows from the adoption of the independence assumption. A Pigovian system of taxes and bounties deliberately impinges the margin. It may be helpful to think of these taxes and bounties as "costs" and "prices." With this terminology change, the apparent inconsistency with modern welfare economics disappears. 21

To avoid confusion and in the interest of completeness, it is appropriate to describe two additional factors which may require governmental financial activity — decreasing costs and production at the least-cost point.

21 Upon closer examination, it appears that many modern welfare economists do not consider taxes at all. The usual function of taxes is either to redistribute welfare or to provide resources for some government agency. Lump sum or poll taxes could hardly redistribute income without becoming income taxes, and the independence assumption eliminates collective demand from consideration. Thus, modern welfare economics as it is usually interpreted does not yield enough, even on an abstract level, for an economic analysis of accepted governmental functions. Consideration of external economies eliminates some of the difficulty without conflicting with the basic premises of modern welfare theory. When standards of equity are developed, the framework may be completed.
Decreasing Costs

The prescription for economic efficiency in the absence of external economies is private marginal cost equal price. From the point of view of economic theory, this prescription does not require governmental activity in constant and increasing cost situations. However, marginal cost pricing in decreasing cost situations results in losses. Since the market operates on the basis of a criterion of profitability, continued optimal production in decreasing cost industries requires either government operation at a loss or subsidized private operations. In both cases, a source of revenue must be found to cover the losses.

The question of losses due to marginal cost pricing has been discussed by many writers. It is not necessary in this study to review or to evaluate the various proposals that have been suggested. It appears that the best solution to the problem consistent with private ownership and operation is the two-part

tariff. Under this proposal the consumer pays a marginal cost price at the time of purchase. In addition, lump sum installation or service charges are employed in order to cover the losses due to marginal cost pricing. The lump sum charge is non-marginal and, therefore, does not impede the expansion of consumption and production to the point at which marginal cost is equal to price. With the exception of the two-part tariff or some variation of multi-part pricing, marginal cost pricing requires taxation and subsidy.

Hotelling suggested that rents, windfalls and other surpluses be used for this purpose. However, this solution may not conform to the criterion that no one can be made worse off because it redistributes income from those who accumulate rents and surpluses to the gainers from marginal cost pricing. Hotelling's argument that the distribution of benefits would be roughly in proportion to the distribution of taxes does not appear to have convinced the more rigorous minded welfare economists. In order


24 Hotelling, op. cit., p. 257. Hotelling also noted that "the considerations applicable to taxation are very nearly identical with those involved in proper rate-making." Ibid., p. 242.

25 Hotelling's view on the question of rents and windfalls has been criticized by Coase, op. cit., pp. 177-79.
to conform to welfare criteria, the loss must be covered through taxes paid by the consumers of the service and "no one should pay more than his consumers' surplus." 26

These questions have a very close relationship to the external economies logic that has been employed in this study. External economies are surpluses due to the activity of others (or government). "Free" police protection is conceptually no different than marginal cost pricing at a zero price. The Voluntary Exchange Theory describes the procedures appropriate to the financing of the "overheads" associated with "free" or collective goods and services. The same general procedures may be used to cover the losses due to marginal cost pricing.

If there are no external economies, there is still a welfare basis for taxation in order to cover the losses due to marginal cost pricing. Although general income taxes and the Hotel-ling solution are excluded because of distributional considerations, it may be possible to employ some form of the benefit theory of taxation. Indeed, the lump sum taxes frequently suggested for decreasing cost situations are determined by measurements of consumers surplus which is a reflection of benefits received.

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Following de Marco, we could conceive certain tax payments as "season" tickets or even lifetime payments for membership in a society which relies on marginal-cost pricing. The equivalent conception when operations are private is the installation or initial service charge. Payment for the "season" ticket must be made by the person consuming or using the good or service which is priced in accordance with the marginal cost principle. Suppose, for example, that there are no external economies, but that there are decreasing costs in the provision of, say, postal or highway services. The public authority will sustain losses in conforming to the marginal cost standard. In this case it would be appropriate to utilize postal licenses, vehicle registration taxes, lump sum payments for postal service at the time a residence is constructed, or lump sum payments for highway services at the time an initial driver's license is issued. These payments may be made on an annual basis provided they do not interfere with the use of postal or highway facilities. Such payments may be viewed as fixed charges for the "privilege" of using facilities having marginal costs below average costs.

A driver's license represents a "right" or privilege which did not exist previously. Under certain conditions, the sale of such privileges is consistent with the criteria of modern welfare economics. In order to forestall objections, it ought to be noted that this discussion does not provide a welfare basis for those principles of tax equity sometimes described as the "privilege
doctrine" or the "state-partnership" doctrine.\(^{27}\) The privilege
document of tax equity implies that all rights and privileges are
salable commodities whether or not economic resources are used in
the provision of those privileges. The state-partnership or "si­
lient" partner doctrine holds that the state is a cooperating agent
or organism which must receive its fair share of economic booty.
These and many other possibilities present themselves once the
door is opened to allow the taxation of privileges, rights and
benefits.

The taxation of privileges conforms to welfare standards
only when the payment is a necessary condition for enjoyment of
the privilege. Economic welfare criteria would be violated if
taxation were based on previously existing privileges or on privi­
leges which could be had without further use of resources. To em­
ploy an Austrian phraseology: Intramarginal privileges are not a
fit subject for taxation according to modern welfare economics.
For example, assume that highways or postal facilities never de­
preciated. Marginal costs would be zero and the investment would
never have to be replaced. A return to capital is not necessary
because the investments are, by definition, "sunk." If there are
no bondholders or private owners of the postal and highway facili­

\(^{27}\) For a brief but excellent description and criticism of these
doctrines see Schultz and Harris, \textit{op. cit.}, pp. 250-58. See also:
de Marco, \textit{op. cit.}, pp. 1-39, and Paul Studenski, "Toward a Theory
of Business Taxation," \textit{Journal of Political Economy}, XLVIII,
(October, 1940), 630-32.
ties the service should remain "free." Neither a price based on marginal cost for the direct use of these facilities nor a tax for the unlimited privilege of using them (to cover sunk costs) can be justified on welfare principles. If there are bondholders, it would be wise to buy them off once and for all. A capital levy is not appropriate for such purposes because such action may involve making the bondholders worse off. Compensation for bondholders, however, may be derived from a tax on the privilege of using postal and highway facilities.

Thus, taxation of privileges is restricted to those necessary payments needed to bring about an economic reorganization conforming to the rule that no one should be made worse off. On our assumptions, the privilege of deriving an income is not a taxable commodity. Privilege, license and other lump sum taxes might be used to cover losses of governmental undertakings of a distinctly commercial nature, while the benefit theory would be used when there is a collective demand. In governmental undertakings characterized by both decreasing costs and external economies, two forms of subsidy may be necessary. The first is a subsidy designed to cover losses due to marginal cost pricing based on the privilege of unlimited use of the facility at marginal cost prices. A second payment may be needed in order to reflect external economies. The tax on the privilege of using a service priced at marginal cost is paid by the consumer or direct beneficiary, while the tax for external economies is paid by the indirect bene-
ficiary. In both situations the payment should not exceed either (a) the consumer's surplus or (b) the amount needed to call forth the additional resources. The latter limitation means that surpluses, rents and windfalls of one sort or another will remain in the hands of all the marginal beneficiaries.

Further consideration of these questions would either carry us well beyond the confines of this study or to a repetition of the technical discussion in Chapter IV. It is not held that these distinctions can be maintained in the context of the real world. However, it is felt that they do provide a limited basis for the segregation and analysis of separate phenomena. This is one of the chief aims of welfare economics. Nor is it held that the abstract analysis is complete. The relationships between price theory (markets), tax theory (government) and welfare economics (standards) provide a continuing challenge to the theorist as well as to the practitioner.

Additional Considerations on the Role of Government

For various technical reasons government may undertake to supply goods and services in response to private demands with only the slightest consideration of external economies or decreasing costs. The demand or consumption side may be perfectly compatible with market choice, but government may enjoy advantages of a sort that make it the least-cost producer. Technical efficiency dictates that government engage in the provision of such goods and
services. Toll roads, waterworks, and transit systems are a few of the examples that might be given. In many such cases government price and output policies can be determined on an "as if competitive" (marginal cost equal price) basis.

Notwithstanding the examples given, pure forms of commercial activity of this sort are almost non-existent in the United States because of a disposition to favor private enterprise. The presumption as to technical efficiency usually tips the scales in favor of private industry. Nevertheless, it would appear that government should undertake those operations in which it is a least-cost producer.

A further justification for government activity in the absence of external economies arises when the technical conditions of supply are incompatible with a workable market situation. Such situations usually are handled through anti-trust action or public regulation. However, regulation usually is concerned with a good deal more than economic efficiency and often leads to government operation on grounds of equity.

As a rule, government operation is a last resort arising because of the force of the administrative problems connected with regulation or because the industry cannot survive under the regulation that is imposed. The industry may be expected to offer service at less than remunerative rates on the ground that "everyone should be able to afford water and electricity." Such demands may eventually lead to government operation. This solution is not
prompted by technical efficiency, or by economic efficiency, but rather by a faulty distribution of income. In continuing to operate the industry at a "loss" government is, in effect, redistributing welfare.

Finally, we return to external economies as a justification for government operation. Suppose we revise the judgment, "everyone should be able to afford water" to "I want everyone to use water because it helps to prevent disease and I do not want to get sick." The revised statement involves external economies since it implies an increase in individual welfare associated with the consumption of others. It does not necessarily indicate a redistribution of income. A contribution might be exacted in order to "subsidize" some water users "at the expense of" others without making anyone worst off. Situations of this sort were analyzed in the general discussion of collective demand.

The question of subsidy raises an incidental and interesting problem which illuminates the nature of the judgments implicit in the distinction between equity and economic efficiency. Let us suppose that some water users are subsidized. Now, it is possible that the person who thinks "everyone should be able to afford water" is as willing to pay the subsidy as the person who does not "want to get sick." If this is true, the distinction between equity and economic efficiency is meaningless. It cannot be denied that an individual's "happiness" can be increased even if it means a decrease in his welfare (as this term has been defined). Never-
theless, it has been maintained that there is a meaningful difference in the satisfaction of a person who gives a gift without expecting anything in return and in the satisfaction of the person who gives the gift in anticipation of something in return. The former involves ethics which economic analysis can "lay aside for the moment," while the latter fits into the general framework of economic efficiency.

These considerations point to the boundaries and limitations of economic analysis. Economics cannot push the study of satisfactions or welfare so far as to become enmeshed in moral and spiritual satisfactions. The economist deals with those wants which can be objectively satisfied through the efficient use of resources. The discomforts associated with a congested highway are relevant to economics only in so far as they can be removed by a more efficient use of resources - the building of a wider highway. Although the best (and worst) things in life are free, economic welfare considers those things that can be had only at a cost.

The Welfare Basis of Public Policy

It is appropriate now to draw together the conceptions, standards and procedures implied by this study. The purpose of this section is to provide a basis for the identification, description, measurement and evaluation of the economic factors which lead to governmental activity.
It is possible to identify three types of resource allocation each of which maximizes a particular quantity (or quality), and each of which requires a particular kind of analysis and public policy. The major classification in an analytical framework might include the following alternative resource allocations:

1. Market allocations
2. Collective allocations
3. Social allocations

The order in which these alternatives are listed reflects the breadth or comprehensiveness of the welfare functions that are maximized. Analytically, the descending order of the list reflects a gradual relaxation of the independence assumption. Nomenclature and definitions appropriate to each allocation will be set forth in the course of the discussion. At this point it should be noted that the social allocation refers to that allocation which would maximize the Bergson Social Welfare Function described earlier. Although social welfare in the Bergson sense may never be specified completely, it represents an abstract goal and, therefore, provides a conceptual standard of comparison. The term social welfare as used in this discussion refers to Bergson's abstraction. The order in which the three allocations are listed implies an ordering for analytical purposes but not for policy purposes. Ideally, public policy would consider only attainment of the social

28 Supra, p. 18.
allocation, while market and collective allocations would become means to that end, not ends in themselves. It should also be noted that market and collective allocations are neutral with regard to the distribution of income. They lead to economic efficiency but not necessarily to equity. With these preliminary comments, let us turn to a description of the concepts, standards and procedures appropriate to each allocation.

Market Allocations

Market allocations are the result of individual economic action and reflect direct costs and direct utilities (the independence assumption). Market allocation maximizes social welfare on the assumptions that (a) the distribution of income is just and (b) the economic activity of each individual has no indirect (or non-market) impact on the positions independently selected by other individuals. If these assumptions are valid, government economic activity is restricted to the following:

1. The maintenance of a workable market system including regulatory activities.
2. The production and sale of goods and services in which government has special technical and administrative advantages.
3. The pricing of goods and services on a marginal cost basis in decreasing cost situations.

The relevant rule in all such cases is private marginal cost equal price. Adoption of this rule will lead to losses and the need for
subsidy in decreasing cost situations. Revenue for such subsidies would be derived through lump sum charges or taxes. Appropriate sources of revenue for this purpose are taxes levied on the basis of a restricted privilege theory of taxation, service and installation charges and fees, and other lump sum charges consistent with criteria that have been described in considerable detail. On our present assumptions, decreasing costs are the only element which provides a welfare argument for taxation. Smith's well-known "exceptions" — defense, justice and public works — appear to have no place in the economics of the market place. 29

Although the market allocation requires very little in the way of taxation, it is obvious that government regulation of the market or government production and sale of goods and services might call for a considerable amount of activity ranging from mild intervention to socialism.

Collective Allocations

Collective allocations are the result of voluntary individual action which takes into account the impact of individual action on the positions selected independently by other individuals. It maximizes social welfare on the assumptions that (a) the

29 Adam Smith, The Wealth of Nations (1776) (Cannan Edition, New York: Random House, 1937), pp. 653-767. Smith describes such expenditures as the "duty of the sovereign." Smith appears to have been the father of the combination of the individualistic ethic and the organismic view. On the whole, students of public finance have displayed their reverence for Smith by adding almost nothing in the way of refinements to Smith's Book V.
distribution of income is just and (b) all significant external economies can be taken into account.

Collective allocations are attained through agreements conforming to the criterion of unanimity or the Compensation Principle. Since it emphasizes the means by which agreements can be reached without making someone "worse off," the criterion of unanimity is an application of the Compensation Principle. Collective allocations require the voluntary acceptance of coercion as well as the means of enforcement, but do not involve coercion on the part of the "sovereign" or the "will" of the majority.

Taxes and subsidies are required in the attainment of a collective allocation. Since such payments are a necessary condition for bringing about the contemplated allocation, they are best described as price-taxes and price-subsidies. The terms tax and subsidy may be reserved for those payments which redistribute income. Taxes which redistribute income involve compulsion per se, while price-taxes involve coercion in the sense described earlier; both may require identical means of enforcement. Another way of saying the same thing is that taxes are imposed and price-taxes are accepted, but both must be enforced.

Theoretically, taxes are non-marginal and price-taxes are marginal. The latter distinction is difficult to maintain because of the tendency to levy taxes on assets or property, rather than on individuals, goods and services. The result may be that taxes and price-taxes are capitalized. A capitalized tax is in many
respects a "good" tax because its removal would result in windfalls and inadvertently to a redistribution of income. Capitalized "errors" in taxation are fully discounted and cannot be corrected without redistributing income or making elaborate compensation payments.

Price-taxes and price-subsidies may be determined through the use of the Voluntary Exchange Theory or the Compensation Principle. Basically, the Voluntary Exchange Theory is the Compensation Principle applied to public finance. A crude interpretation of the Voluntary Exchange Theory leads to the benefit theory of taxation. A more refined interpretation requires that the redistributive element be removed by maintaining a distinction between those benefits which are "cost-determined" and those which are rents and quasi-rents. Rents and quasi-rents may be reserved for the purpose of attaining an equitable distribution of income, while cost-determined surpluses may be used for the attainment of economic efficiency. In practical situations this distinction may prove difficult to maintain.

In some instances the collective allocation may be achieved through agreements which do not require the use of price-taxes and price-subsidies. Unanimous agreements to forbid or to require certain forms of activity are not inconceivable and are welfare maximizing. Although such agreements may involve many non-economic elements, they are relevant to economic analysis if they alter the configuration of resources.
The chief difficulty in the way of collective allocations arises with regard to the recognition and measurement of external economies. Conformance to the welfare criteria that have been adopted requires that the indirect benefits of a particular policy be identified, measured and related to specific individuals. Notwithstanding the difficulties involved, empirical investigation leading to "cost-benefit" ratios and "benefits-received" are made frequently. One of the technical tasks of the economist is to bring such investigations into relationship with a framework of economic efficiency. Economic efficiency pays everyone in spite of the fact that this is not always obvious. The reduction of tariffs provides an excellent example of the need to educate and persuade the individual.

It may seem somewhat idealistic to suggest that individual horizons will ever be broad enough to accept voluntarily certain restraints as the rational path to maximum individual welfare and to freedom. If economic policy is to involve something more positive than "control" and if the individualistic ethic is to be maintained, the economic system should respond to the needs of rational and responsible individuals. The means for attainment of these goals are many and varied. Economists will find some prescriptions in the "volitional" economics of John R. Commons — working rules, forebearance and many others.
Social Allocations

By assumption, the social allocation maximizes social welfare. Although social welfare remains an abstraction or an ideal, its implication to modern economic analysis relates to the distribution of income. Social allocations require the employment of all the means at the disposal of government to bring about a just distribution of income. There are two obvious means for bringing about this redistribution: (a) direct transfers and (b) indirect transfers. Direct transfers require compulsory taxes and the granting of subsidies without resource-using activity. Indirect transfers involve the use of resources for the creation of direct and indirect benefits without equivalent compensation in the form of price-taxes.

Direct transfers cannot be made to conform to the criterion that no one should be made worse off. Indirect transfers can be made to conform to this criterion because the benefits associated with a particular resource-using policy may exceed the costs. If the surplus is positive, there is some room for redistribution without making anyone worse off. Thus, rents and quasi-rents associated with a particular resource-using policy may be used for redistributive purposes without violating any of the conditions of welfare. Rents and quasi-rents not associated with a particular policy cannot be taxed without violating the criterion that no one can be made worse off, but can be taxed without violating the marginal conditions of welfare. As a practical matter, it would be
almost impossible to tax rents and quasi-rents without violating marginal conditions. There are two reasons for this. In the first place, rents and quasi-rents are often capitalized, sometimes well in advance, on the basis of expectations. In the second place, a tax must have a measure; the measurement itself is likely to involve a marginal magnitude.

It appears, then, that the use of the tax system for redistributive purposes is very limited unless restricted welfare criteria are abandoned. In any strong attempt to bring about a just distribution of income interpersonal comparisons will have to be made. On the other hand, welfare economics is not so sterile relative to taxation as has been supposed. The Voluntary Exchange Theory provides a basis for taxation that has been overlooked entirely. So long as resources are not thrown into the sea, there is a welfare basis for taxation. On the whole, modern welfare economists like many students of government finance appear to have overlooked the significance of traditional governmental expenditures to individual welfare. Collective allocations are an addition to the general framework of modern welfare economics. Their recognition represents a small step in the direction of a more complete specification of the Social Welfare Function and the ultimate attainment of social allocations.
Emergence of an Analytical Framework

The preceding review points to a large number of symmetrical, three-fold classifications. These classifications provide a basis for the identification, description, measurement and evaluation of the various elements involved in governmental programs. There is a temptation to place these classifications in tabular form, but this would imply a degree of rigor and refinement that does not exist. However, some of the possible relationships may be visualized by considering the following list of symmetrical or coordinate elements:

1. Resource Allocations
   - a. market
   - b. collective
   - c. social

2. Quantity Measured
   - a. market value
   - b. external economies
   - c. equity

3. Type of Activity
   - a. individual
   - b. collective
   - c. social

4. Degree of Restraint
   - a. no restraint
   - b. voluntary restraint
   - c. imposed restraint

5. Payments
   - a. price
   - b. price-tax
   - c. tax

6. Subsidy
   - a. marginal cost subsidy
   - b. price-subsidy
   - c. subsidy

7. Tax Theory
   - a. privilege
   - b. benefit
   - c. ability to pay

8. Income Distribution
   - a. neutral
   - b. neutral
   - c. just

Much of the symmetry implied by the above list is artificial because the distinctions are all relative. Nevertheless, the possibilities for a more consistent terminology and nomenclature, and for orderly analysis are obvious. Such classifications also
provide a basis for interdisciplinary cooperation. Some of the classifications involve considerations appropriate to the disciplines of philosophy, political science and psychology. The establishment of inter-disciplinary counterparts may improve communication and eventually further the attainment of salient solutions to public policy problems. Such interdisciplinary integration does not imply holism, cultural determinism, or any of the mystical doctrines that have been taken to task in this study. Even the most mechanistic minded would agree that abandonment of the "economic man" does not imply abandonment of the individualistic ethic.

Insofar as economic analysis is concerned the analytical framework requires the (1) identification, (2) description, (3) measurement and (4) evaluation of (a) market value, (b) external economies and (c) equity.

Markets will devote a given amount of resources to a particular area of production. The adequacy of the market allocation will depend on the breadth of the individual point-of-view because the market mechanism is a technical device for the expression of whatever choices the individual selects to make. Evaluation of the biological, psychological and philosophical content of these choices involves questions of great significance to economic analysis but does not appear to be a necessary part of an operational analysis.
External economies may be defined operationally as those magnitudes not reflected in the market. For purposes of economic analysis, it is necessary to place limitations on what is and what is not an external economy. It has been suggested that external economies be limited to magnitudes the consideration of which would lead to a significant reallocation of resources conforming either to the Compensation Principle or the criterion of unanimity. These restrictions place external economies within the relatively narrow framework of economic efficiency. As procedures for more adequate measurements and evaluations become available, it may become possible to add new dimensions to this conception. Thus, the limits to operational economic analysis are set largely by the technical facts of the real world.

Consideration of external economies may lead to an adjustment of the market allocation through some form of governmental program. Such programs will involve price-taxes and price-subsidies and, perhaps, a public resource-using program. Finally, the entire structure must be reviewed in the interests of equity. This general approach has the advantage of bringing into focus the various judgments and measurements that must be made as well as the alternatives that are available.

Many governmental programs have been developed in response to both private and collective demands. The analytical dilemmas that arise because of this dual function cannot be resolved so long as economic analysis does not explain collective demand in
terms of individual welfare. Confusion as to both the aims and means of many governmental programs is obvious from a casual examination of the content and implementation of enabling legislation. Notions about the market, external economies and equity are treated simultaneously and without distinction. Although this may be the way of the political world, it is not the way of economic analysis which seeks to be both systematic and objective.

The method of analysis suggested is especially applicable to public programs for highways, schools, public power, compulsory health, medical and retirement insurance, postal service, research, public utilities and many others which lie in an in-between area. These are functions to which the term subsidy is often applied. It is important to know whether a subsidy is required in order to allocate resources efficiently or in order to redistribute income. Regardless of the justification for subsidy, neither efficiency nor equity can be promoted without first making the distinction.

The entire approach involves measurements that are exceedingly difficult to make. Its application to national security, police protection, and other programs of a purely collective nature would require extremely shaky hypotheses as to the distribution of costs and benefits. Where measurements are extremely dubious, more force can be given to notions about the distribution of income. If one of the aims of taxation is to redistribute income, it is clear that taxation for national defense represents a better vehicle for redistribution than taxation for public highways.
Summary

The entire discussion in this study has been based on a step by step relaxation of the independence assumption. Beginning with Marshall's technological external economies, the discussion has moved from the production side to an explanation of collective demand and to a positive explanation of the role of government.

The result of considering interdependencies that are not reflected in the market amounts to the "institutionalization" of economic theory. Logically, this could lead to the study of the entire range of human relationships and could carry us far beyond the most reasonable boundaries of economic analysis. The independence assumption may be compared to a faucet which may be turned on and off depending on the amount of external influence that reasonably may be admitted. External economies can be viewed as the link between economics and other disciplines. The holists opened the tap so wide as to engulf the individual, while modern welfare economics shuts it so tight as to prevent the analysis of perfectly legitimate economic relationships.

At no point has the discussion lost sight of the hypothesis that social welfare is an increasing function of individual welfare or of the widely accepted criterion that welfare is increased if at least one individual can be made better off without making someone else worse off. Interpersonal comparisons of utility have not been made and the distinction between equity and efficiency has been preserved (perhaps unfortunately). Although this
distinction may involve some strain on the senses of practical men, it is felt that it has enough meaning to warrant bringing a part of government finance into the general structure of economic theory.

It is felt that the conceptual framework that has been presented represents some progress toward a more satisfying analysis of government. Governmental programs are usually evaluated without much reliance on the principles provided by economic theory. To many, including this writer, this is not a happy state of affairs. The concepts, some of which are abstract, that have been set forth may be rejected by some as having little practical significance. Others may find intellectual satisfaction from such reconciliations and even this is worth something.

In a sense, the remainder of this study seeks to establish the practical validity of the ideas pursued to this point through an application of the framework that has been suggested to the current conflict in highway finance. Although the current conflict in highway finance will be discussed in detail, basically it involves the question of subsidy to motor vehicle users. The relation of the analytical framework to this problem is obvious. The application to highways will provide a test of the framework that has been suggested and will serve to illustrate what can and what cannot be done within the confines of modern welfare economics.
PART II

THE APPLICATION TO HIGHWAY FINANCE

Highway problems cut across the boundaries of many disciplines and specialties, and their solution must measure up to a variety of standards. Students of taxation emphasize the "governmental function" aspect and dwell on those problems of tax equity and administration that must be solved if any governmental function is to be carried out successfully. On the other hand, students of transportation view highways from the vantage point of the transportation function and emphasize inter-agency competition and price theory.\(^1\) One group appears to view with relative apathy the impact of highways on the development of an efficient domestic transportation system while the other appears to advocate a kind of toll financing so rigorous as to destroy the common law concept of the "free" public highway.

\(^1\)Although the "price-like" nature of highway user taxation is recognized by all students, there is not general agreement on the objectives of such taxes. Such taxes are viewed by some as "just" payments for a governmental service while others insist that they are primarily "allocators." One group emphasizes tax equity and the principle of governmental budgetary comprehensiveness while the other emphasizes resource and traffic allocation. An able discussion of these issues has been presented by Richard M. Zettel, "Objectives and Concepts of Highway User Taxation," \textit{Highway-User Taxation}, Highway Research Board Bulletin 92 (Washington: National Academy of Sciences, National Research Council, 1955), pp. 1-14.
Within the past four or five years long-standing differences have become sharper, and it now appears that the principles of highway finance soon will undergo substantial change. Since changes and modifications are being proposed with increasing frequency, it is hardly appropriate to speak of a "current" theory of highway finance. Indeed, it is possible to distinguish two current schools of thought. The first and most widely accepted of these schools emphasizes a "benefits-received" or unrestricted external economies approach to highway finance. To a greater or lesser degree all current applications rely on some variation of the benefits-received approach. A second approach to highway finance is espoused by writers who emphasize the use of "cost-price" or market analysis to highway financial problems. Advocates of the cost-price approach have restricted their attention to specific problems, i.e., traffic congestion and the financing of primary traffic routes. As a result, their prescriptions are usually treated as modifications to the benefits-received approach which, though shaken, still provides the basis for modern highway financial analysis.

2These differences are described in detail in the following chapters.

3The incremental-cost principle for allocating highway costs is accepted by both schools and is not an important issue. The practical difference in the two approaches relates to the extent that "indirect benefits" should be considered in the establishment of a highway financial policy.
In terms of the framework that has been suggested, the issues surrounding this conflict resolve themselves into the following question: Is highway financial policy a response to market values, external economies, tax equity or, after all is said and done, do the crucial decisions turn on administrative considerations?  

In addition to these issues surrounding the aims and purposes of highway financial policy, there are many unresolved methodological problems. Efforts to solve highway problems by methods that could be called scientific or even consistent have been largely futile. "The most convincing efforts seem to have been those which rely on judgment and on the compromise of legitimate differences of opinion." Notable examples of this down-to-earth

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4 The situation today is not much clearer than it was in 1951 when a committee of the National Tax Association said: "Wide areas of disagreement exist, especially with regard to the problem of allocating the costs of publicly provided transportation facilities to the public generally and among the various user groups... federal studies failed to narrow the range of controversy... a new approach is necessary..." National Tax Association, "Final Report of the Committee on Taxation of Transportation," Proceedings, 1951 (Washington, 1952), p. 374.

approach are found in the work of Nelson, Ross, Simpson and others who have prepared studies in response to the needs of state legislatures. 6

Practical solutions have much to commend them, especially when prepared under the pressure of legislative bodies and in the face of the opposition of special-interest groups. 7 But such solutions inevitably involve decisions and compromises which may be attacked as arbitrary. On the other hand, a theoretical solution makes assumptions at the outset and results follow rigorously. Finally, compromises are made by those responsible for policy. The analysis itself remains intact; its premises remain unobscured. It is felt that much of the current controversy in highway finance is related to the failure to follow through with a given set of premises.

Whether one starts with equity, efficiency, or administration, it is clear that compromises must be made. However, it does not follow that the compromises need to be made at the outset. Another aim of this discussion is to examine the hypothesis that

6Highway financial analyses on a state level are too numerous to list. These studies are discussed in an appendix which is concerned with techniques and applications.

7"If it [the solution] is to do more than collect dust on library shelves it must be 'tailor-made' to the circumstances." Harmer E. Davis, Preliminary Appraisal of State Highway Finance Studies, A Report to the Research Subcommittee of the Western Interstate Subcommittee of the Committee on Highway Policy (Berkeley, California: University of California, The Institute of Transportation and Traffic Engineering, 1953), p. 10. (Mimeographed.)
compromises have been made at the wrong time with the result that they have been elevated to the status of "principles." These principles, it appears, have become an implicit part of the analytical framework and have tended to obscure valid issues.

To summarize, this part of the study is an evaluation of the principles currently employed in dealing with highway financial problems in terms of the analytical framework suggested in Part One. It seeks to identify and sort out the judgments and measurements that are made and to place them in a framework amenable to the standards of modern economic theory and still acceptable to the "man in the field." The practical result of the discussion is to cast doubt on the theoretical validity of the traditional "user-nonuser" allocation of costs.

A separate chapter is devoted to each of the competing approaches to highway finance. Since the benefits-received (unrestricted external economies) approach appears to be the ruling body of thought in highway finance, the discussion begins with a description and evaluation of this approach to highway finance. Extensions, modifications and exceptions which emphasize a pricing or market approach are discussed in the subsequent chapter. Finally, the specific issues are brought to the fore, a resolution is attempted, and the outline of a revised theory of highway finance is set forth. The theoretical framework suggested in the earlier chapters of this study is employed throughout. Applications and techniques are described in Chapter IX.
CHAPTER VI

THE BENEFITS-RECEIVED APPROACH (UNRESTRICTED EXTERNAL ECONOMIES)

Historically, the highway plant has been viewed as a capital facility provided by the government in the discharge of its ordinary duties relating to the "general welfare."\(^1\) Therefore, the problem of financing highways was left primarily to students of taxation who treated the highway function as a part of the broad classification, general government. This general service concept of highway finance began to disappear shortly after the appearance of the motor vehicle and the ensuing demand for an extensive system of smooth, paved roads connecting all communities.\(^2\)


\(^{2}\) The so-called commercial concept associated with toll road development early in the Nineteenth Century never applied to local roads and began to disappear shortly after the Civil War. Dearing, op. cit., pp. 36-43.
A method was found for charging the motor vehicle operator a road "toll" - gasoline taxes and license fees were inaugurated. Later, commercial vehicles in competition with other forms of transportation and seeking a portion of the nation's resources appeared on the highways. These developments gave impetus to the view that those who demand and use the highways should pay for them. A system of user charges offered a rare opportunity for the solution of highway problems. Such charges could be justified on grounds of both economic efficiency and equity. Moreover, they presented relatively few administrative problems. The chief problem was one of determining the amounts that should be collected from various users. In addressing this problem writers have developed what

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3 The gasoline tax was considered as a possible source of federal revenue as early as 1914. However, the first gasoline tax was inaugurated by Oregon in 1919. By 1932 all the states as well as the Federal Government had enacted gasoline tax legislation. The story of the gasoline tax is told by Finla G. Crawford, Motor Fuel Taxation in the United States (Syracuse, New York: By the author, 1939).

License fees were inaugurated by New York in 1901. Although they did not meet with the enthusiastic public approval that attended the gasoline tax, such taxes have become an integral part of all state tax systems. For a discussion of the early growth of such taxes see James W. Martin, The Motor Vehicle Registration License, Bulletin of the National Tax Association, XII (1927), 193-208.

4 One of the first statements of the possibilities of user charges is found in J. M. Clark, Economics of Overhead Cost (6th imp.; Chicago: University of Chicago Press, 1923), pp. 298-305.
might be termed a theory of highway finance. The first comprehensive statement of the current theory of highway finance was set forth in 1940 by the Federal Coordinator of Transportation.5

The Federal Coordinator's Report

The development of principles of highway finance was an incidental part of the Coordinator's study, the chief aim of which was "to determine the extent to which public aid has been and is given to the various modes of transportation and is a factor in their competition with each other."6 Since the report sought to determine the extent to which various groups had "paid their way," specific private beneficiaries of publicly provided facilities were related to specific tax payments. This brings to light two


The Office of the Coordinator of Transportation was created by the Emergency Railroad Transportation Act of 1933. The Coordinator was given very broad powers of investigation and soon became embroiled in the subsidy issue which had reached large proportions as a result of a shrinking transportation market and increased competition in the transportation system. Volume IV, which relates to highway transportation, is usually associated with the name of Charles S. Morgan. All references are to Volume IV, hereinafter cited as The Coordinator's Report.

Later, the Coordinator's findings were reviewed in another comprehensive study: Board of Investigation and Research, Public Aids to Domestic Transportation, 79th Cong., 1st Sess., 1944, House Doc. 159. This 1944 study is associated with Burton Behling. Although the two reports differed in a great many ways, they were both concerned with the same general problem and approached it in a similar manner.

6The Coordinator's Report, p. 3.
characteristics of the Coordinator's report which have been overlooked by those who accepted the report as a basis for a theory of highway finance.

In the first place, the Coordinator's cost allocations were aimed at answering an historical question, namely, the extent to which various groups had "paid their way" during the period 1921-1937. Although an answer to this question might indicate the need for making corrections in the distribution of financial responsibility for publicly provided facilities, it does not provide general principles of highway finance. The principles governing the allocation of historical costs do not necessarily apply to the allocation of current or future costs. The current problem is always one of how to allocate and pay for resources over which some authority has control.

A second characteristic of the report is that it sought to pinpoint private individuals and groups who had received public aids. This meant that various groups had to be identified and related to both the facility which they used and the payments

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7 At least one writer has taken exception to the use of The Coordinator's Report as a prototype for highway financial analyses. "The objective of federal studies was to determine public aids . . . and to test the neutrality of the tax structure as it affected different transportation media. But the state highway finance studies look forward to the financing of a future program." Harmer E. Davis, Preliminary Appraisal of State Highway Finance Studies, A Report to the Research Subcommittee of the Western Interstate Subcommittee of the Committee on Highway Policy (Berkeley, California: University of California, The Institute of Transportation and Traffic Engineering, 1953), p. 4. (Mimeographed.)
which they made. Thus, for example, a distinction was made between a school bus and a commercial bus. Such a distinction is necessary if the aim is to determine the amount of subsidy to private groups in competition with other private groups. But the distinction is not based on the nature of highway costs and results, as we shall see, in an arbitrary assignment of highway costs. Public use of the highways entails costs no different than those imposed by private use. These limitations appear to have been recognized by the Coordinator who stated that

these costs do not necessarily determine the taxing program to be followed. Considerations may enter into the framing of such a program which have no bearing on the finding with respect to public aids.  

In short, the chief aim of the Coordinator was to gather facts and to place these facts in a relationship that would cast some light on a specific problem. The report contains no economic analysis in the orthodox sense, and its conclusions make no reference to "principles" or to highway economics. In spite of the Coordinator's explicit warnings to the contrary, the report appears to have become the cornerstone of a general theory of highway finance. It is appropriate, then, to examine briefly the approach utilized by the Federal Coordinator. The method of attack was outlined by the Coordinator as follows:

Determination of whether motor-vehicle users, or any classes of users, have enjoyed or enjoy what may be termed public aid or subsidy requires, first,

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8The Coordinator's Report, p. 45.
ascertainment of the costs represented by highways and streets; second, an allocation of these costs between motor-vehicle users and other beneficiaries of the improvements; and third, a comparison of costs allocated to users with the payments they have made. Some users require different facilities from those which will suffice for others; these differential costs, together with a proportionate share of the base cost, must be assigned to such users and comparisons made with the payments they make. 9

This statement is a fair description of the approach employed in the numerous analyses of highway financial problems within the past fifteen or twenty years.

The weakest and perhaps the most widely accepted link in the Coordinator's study relates to the initial definition of highway beneficiaries. In approaching this problem, the report begins with a warning that highway benefits under the heading of "recreation, reduction of distribution costs, etc.," should not be considered in the allocation of highway costs as if these benefits were separate and apart from motor vehicle use . . . . To evaluate benefits of this kind separately and, as if there were something distinctive about them is, for the most part, inappropriate. 10

However, within one page of this declaration the report states that "the benefits which transportation uses of highways and

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9 Ibid., p. 2.
10 Ibid., p. 16.
streets confer on property" should be considered in the allocation of costs. Then, the report goes on to make more exceptions:

The use of streets and highways by motorized fire and police departments, by public ambulances and by other motor vehicles used in carrying on the general functions of Government is also to be distinguished from their use by the motoring public or by commercial operators. The transportation of children to and from school, the rural delivery and the use of roads for military purposes further illustrates uses which are not the direct responsibility of motor vehicle users as such . . .

In the provision of all roads and streets there are, therefore, costs which are not attributable to the motor vehicle user as such but which are chargeable against the tax-supported general functions of Government or against benefitted property. (underlining supplied)

The distinction between a user as such and a user not as such may be important in the fixing of financial responsibility, but the distinction has nothing whatsoever to do with highway costs or with their economic allocation. Distinctions also were made between land use or "access" roads and general-purpose or "through" roads. Through roads became the motorists' responsibility and were to be financed through user charges; access roads became the property owners' responsibility to be financed through taxes on property. The share or responsibility of "tax-supported general functions of Government" was also determined.  

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11 Ibid.

12 Ibid.

13 The techniques employed in arriving at the assignment of cost responsibility are described in an Appendix.
Enough has been said to make the point that the definition of beneficiaries confuses the problem of cost allocation with the problem of who "ought" to pay and with the methods and techniques used in collecting highway revenue. This framework may have been appropriate for an analysis of the subsidy issue. Although even this is doubtful. Unfortunately, the Coordinator's approach appears to have had a tremendous influence on the development of a theory of highway finance. In terms of the economic theory of cost, the Coordinator's benefits-received approach implies a jointness of cost which in fact does not exist. Moreover, indirect or nonuser benefits were listed but not defined. The relevance of the more rigorous conception of external economies to this problem is obvious. The implications of the analysis of external economies pursued in Part One to the problem of indirect benefits shall be discussed in detail at a later point.

The Current Framework of Solution

After publication of The Coordinator's Report, the current theory of highway finance began to take shape. A comprehensive and convincing statement of the theory was set forth by Charles L. Dearing. Dearing appears to have been successful in popularizing the benefits-received approach among students of highway finance. Although the subsidy issue was incidental to the main part of his analysis, Dearing's reasoning closely paralleled that of the Coordinator. Dearing appears to have held a "multi-purpose" view of
the highway plant. This, of course, is consistent with the joint cost implication of the procedures employed by the Coordinator. According to Dearing:

The modern road plant is a multi-purpose facility, producing services that are distributed unevenly throughout society. All classes of roads serve in one degree or another to give access to land and dwellings; to facilitate the movement of goods and people primarily associated with community life; to supply avenues of optimum inter-community mobility; and, finally, to expedite the administration of essential functions of government. Thus, it follows that individuals and groups of society benefit in widely varying degrees from the values produced by the several parts of the road plant.14

From this statement, Dearing somehow concludes that those who benefit from the use of highways should be assigned a share of highway cost. This is the great non sequitur in the current approach to highway finance. The notion that those who benefit should also pay is an appealing standard of equity. However, economic policy also must be judged in terms of efficiency. As we shall see at a later point, the benefits-received standard is not consistent with standards of economic efficiency, and any gains that might follow from the use of some preconceived notion of equity may be more than offset by a misallocation of resources.

According to the benefits-received approach, the role of the motorist is continually changing. For when he leaves his residence, he drives on a residential street, built not for motorists as such, but for a restricted group of property owners. Soon,

14 Dearing, op. cit., p. 207.
however, he is driving on a heavily traveled thoroughfare serving all traffic, including trucks, buses, and passenger vehicles. This road is built for motorists as such. It has a general purpose, or what is termed a through function, as opposed to the restricted function of the residential street or country lane, which has an access function.\textsuperscript{15}

On the basis of these differing functions assigned to the highway plant, writers have segregated three major groups enjoying the road plant, each in varying degrees and in different forms. As if by coincidence, each group of beneficiaries can contribute road funds according to a different principle of taxation. Motorists, property owners, and general taxpayers, the major groups, can contribute respectively according to "cost," "benefit," and "ability to pay" principles of taxation.\textsuperscript{16}

The motorist who competes with other transportation agencies will pay the full cost of that portion of the highway system which can be imputed to motorists as such. In the same way, the

\textsuperscript{15}The "access" element does not include special access costs, e.g., provision for driveways, entrances, exits, etc.

\textsuperscript{16}This classification follows Herbert D. Simpson, \textit{Highway Finance}, A Study Prepared for the Ohio Program Commission (Columbus, Ohio, 1951), p. 78. Simpson reserved the term benefit for value-of-service situations, and the term cost for cost-of-service situations.

Although some writers place highway finance under the single category, "benefit theory of taxation," it is not clear whether they refer to highway user taxes or to highway finance in general. See, for example: Harold M. Groves, \textit{Financing Government} (New York: Henry Holt & Co., 1954), pp. 265-66.
cost of an access facility is to be paid by the property owner whose property value is enhanced by the improvement — he pays a special assessment. The portion of the cost of the road plant which provides a general service is to be defrayed by the general fund contribution of taxpayers which usually bears some relationship to ability to pay. Thus, each of the functions of the highway plant falls into a slot already provided by the institutional tax structure. There is no alarm over the fact that an initial allocation of costs in this manner is actually based on an arbitrary definition of highway beneficiaries. A through highway, for example, may be assigned entirely to motorists. Who is to say that this road provides no general service or access?

The various highway functions delineated by the multi-purpose view fit into still another area. As we are dealing with various groups, each enjoying the highway plant in varying degrees and forms, so also are we dealing with various types of roads, each suited for a particular function and administered by a different level of government. Those roads which provide a through function are represented by state administered rural routes and their urban extensions. The roads administered by township governments or local road districts serve to provide access, and those roads which provide general or "neighborhood" service are administered by county government. Furthermore, each level of government has a source of revenue consistent with the function of the highways under its jurisdiction.
Thus, the nature and function of the highway plant "fits" the tax system as well as the jurisdictional system. With this "model," the solution to the problem of allocating highway costs becomes a matter of technique. Most solutions to the problem have depended on attempts to allocate highway costs on the basis of access or through components or some variation more or less consistent with the theory presented above. 

The implication of the multi-purpose interpretation is an initial allocation of highway costs between motorists, property owners and general taxpayers. In practice, the three-fold allocation became a two-fold allocation between users and nonusers. The local governments were to be responsible for collection of the nonuser share relying on whatever distributive criteria seemed appropriate, while the state governments became responsible for the user share relying on highway user taxes. To complete the solution, the user share of the total cost had to be allocated among various classes of vehicles so that user tax rate differentials could be determined. The validity of the whole procedure rests on the validity of the initial allocation between users and nonusers. This is a crucial step since it fixes the level of cost to be assigned in the form of fees and taxes to the operators of motor vehicles. The allocation among user classes may be consistent internally but the absolute amounts assigned may be in error. Since

17See the Appendix for a discussion of applications and techniques.
the adequacy of the whole process depends on the initial allocation, the review of this chapter is limited to this area. The allocation among user classes is discussed in Chapter IX.

Evaluation of the Framework

An evaluation of this structure in terms of economic efficiency has never been made. Indeed, such an evaluation could be unfair because the system was never set forth as an economically efficient method of dealing with highway problems. The delineation of highway functions and beneficiaries is made in the light of the institutional setting in which the highway function is carried on. Thus, Dearing described the multi-purpose view as reflecting the "economic and political" character of the highway function.18

Furthermore, the current approach never claimed to make possible more than reasonable or equitable allocations of cost. It is significant that most studies of highway problems bear the term "equitable" in their title. Indeed, the term is used to include almost every conceivable situation. There is no pretense at segregating the premises on which the system is based.

18 Dearing, op. cit., p. 207. Another writer states that the allocation of costs between users and nonusers is established by "a governing process." "These can be called the political proportions." C. Emery Troxel, Economics of Transport (New York: Rinehart & Co., Inc., 1955), p. 255. As we shall see, others are not so explicit in defining the "proportions" of the problem.
All things considered, the current approach may lead to an acceptable overall highway financial structure. Nevertheless, there are long standing controversies which have not been resolved because of preconceptions which appear to have been imposed by administrative considerations or by implicit notions about equity. Many of these differences can be resolved if the problem of cost allocation is separated from that of administration and equity. First, let us examine more closely the assumption of jointness and then proceed to a consideration of administrative factors which appear to play an especially important role in the current theory of highway finance.

Problems Raised by the Assumption of Jointness

The allocation between users and nonusers suggested by Dearing rests squarely on a multi-purpose interpretation of the highway function. In order to examine the issues raised by this interpretation, it is necessary to establish the conditions under which value-of-service allocations may be made. From the point

19"But when we consider that user taxation was conceived of expediency, born of necessity, and nurtured of politics, it is surprising that the offspring is as healthy and works as well as it does to serve sound economic objectives." Zettle, op. cit., p. 14.

20The value-of-service principle has significance to discriminatory pricing. Such practices rest on judgments which have little to do with the technical analysis of cost. The discussion in this section relates to the use of value-of-service in the allocation of "true" joint costs.
of view of technical cost analysis, there are two situations in which value-of-service allocations are appropriate: (1) joint supply and (2) collective demand. An examination of these distinctly different possibilities may provide the standards for evaluating the current allocation of costs between users and non-users.

Joint Supply

According to Wallace, "the essence of joint supply (cost) is the inability to increase or decrease the relative capacities except in the same proportion."\textsuperscript{21} A less refined way of expressing the same idea is that the emergence of more than one product at the margin of production is inevitable. In his admirable article, Wallace argued that a very small proportion of railway costs are joint costs; therefore, it is possible to apply cost-of-service principles in the fixing of railway rates so as to attain rates consistent with an optimum allocation of resources. This was essentially the same view held by Pigou at the time of his controversy with Taussig.\textsuperscript{22} Taussig argued that railway costs were joint costs and, hence, allocable only on the basis of demand or value-of-service principles, it appears that Pigou and Wallace


\textsuperscript{22}A. C. Pigou, "Railway Rates and Joint Cost," (with Taussig), Notes, \textit{Quarterly Journal of Economics}, XXI (November, 1906), 162-63, XXVII (February, 1912), 535, 687.
were correct in the analysis of joint supply in the railway industry, and that "controversy in this area was largely brought to an end."\(^{23}\)

In the transportation industries, true joint supply appears to be restricted to back-haul situations and to a special case, time jointness.\(^{24}\) Costs of right-of-way or "line" have been described as common costs.\(^{25}\) These general conclusions apply to highway transportation. Wide acceptance of the incremental cost solution for the allocation of highway costs among vehicle classes is a recognition of the view that highway costs are either special or common. In spite of the fact that the allocation among classes of vehicles is frequently described as a joint cost allocation, the procedures adopted in the current incremental analysis are consistent with cost-of-service principles.\(^{26}\) In any event, this question is not at issue. The point at issue relates to the two-fold allocation of costs between users and nonusers. There is a distinct difference between multi-beneficiary situations and multi-

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\(^{24}\) Wallace, op. cit., p. 598.


\(^{26}\) The conflicting terminology currently employed is described in the Appendix.
product situations. The analysis of external economies (collective consumption or satisfaction) in Chapter IV casts some light on this distinction because it provides a basis for value-of-service when there are incompatibilities on the demand side analogous to those which might occur on the supply side.

Collective Satisfaction

It was shown in Chapter IV that a value-of-service allocation conforms to standards of economic efficiency when there are external economies. That discussion, it will be recalled, required the use of subsidy (price-subsidy) when more than one person received benefit from the consumption activity of another. To make the concept of external economies consistent with standards of economic efficiency it was necessary to restrict the amount of subsidy (price-subsidy) to the amount actually needed to bring about the collective (optimum) allocation of resources. If the direct consumer's independent action leads to the collective allocation, no price-subsidy is required in spite of the fact that nonusers may benefit. Surpluses to other individuals are a welcome addition to social welfare. Such surpluses, it has been suggested, may be distributed on the basis of some general criterion of equity which may or may not have significance to the highway financial structure.

Frequently, however, it may prove necessary to employ price-subsidies in order to bring about the collective allocation. In such cases, it is in the interest of indirect beneficiaries to
share the cost of direct consumption with the actual consumer. The analogy with joint supply situations is obvious. This is the external economies logic for the use of value-of-service principles.

One of the important distinctions between joint supply and collective satisfaction is that the cost of the single physical product is indeterminate in the former, whereas it may be determinate in the latter. That is, the cost of a particular or single highway use may be known, but the cost of the physical product still may be allocated among multiple beneficiaries on the basis of value-of-service in the presence of significant external economies of consumption. If special and common costs can be assigned directly to particular products, they should be so assigned. Otherwise, an indeterminacy is imposed on the supply side which does not exist. The collective demand should be brought into relation with an appropriate supply schedule, not one based on the illusion that physical jointness of cost is imposed because there is more than one beneficiary.

Value-of-service pricing, then, is required in two distinct situations — joint physical cost and joint or collective satisfaction. Although this distinction has a special relevance to highway finance, it has implications to the financing of many governmental programs and to price theory in general. It represents a refinement growing out of the technical analysis of collective demand that may be of some interest to those interested in
the welfare implications of taxation and price discrimination. Although evaluation of these implications cannot be pursued without overwhelming the confines of this study, it is worth noting that the concepts of collective demand and external economies point the way to some new, albeit minor, excursions into abstract tax and price theory. Let us turn now to the implication of these distinctions to highway finance.

Implications to Highway Financial Analysis

The system outlined by Dearing and developed by others rests on a joint supply interpretation of the highway function. That is, a highway facility is assumed to create joint products and poses the problems associated with the allocation of joint costs. Once this jointness is established, direct cost assignment becomes impossible and the most we can expect is a round-about allocation on the basis of value-of-service or some other variation of benefits-received. Moreover, it is inevitable that the assumption of jointness will tend to cast the analysis in a framework which emphasizes equity.

The description of the highway plant as a multi-purpose facility creates a situation analogous to joint cost apportionment for public power projects. This analogy sometimes is cited by writers attempting an allocation of costs between users and non-
It is interesting that well-known techniques of public power cost allocation such as the alternative cost avoidance method have not been applied to the allocation of costs between users and nonusers. Possibly this is because the highway plant does not have a multiplicity of purposes as does a public power project. It has a single purpose — highway use. According to the multi-purpose interpretation of the highway plant, there are three separate products — highway use, general welfare and increases in land value. No one can deny the significance of the road plant in providing for, say, postal service, nor can it be denied that highway facilities increase land values. But to make this the basis for a joint cost apportionment misses the point. If costs can be allocated to a dairy truck, they can also be allocated to a mail truck. Nor would general welfare be served if highways were not used.28 In particular situations it may be necessary to subsidize or encourage highway use and development in response to ex-


28Some examples of true jointness have already been pointed out. Fire stops in cities and openings for light and air and for public utility rights-of-way are examples of jointness which may require an allocation to nonusers. These elements of jointness are recognized by the benefits-received approach, but to this writer's knowledge have never played a role in the actual allocation and determination of costs. It appears that the multi-purpose view overlooks true joint costs and implies a jointness which does not exist to other costs.
ternal economies or collective demand. However, this is a ques-
tion apart from that of the traditional cost allocation among
users and nonusers which appears to be based on the idea that
highway costs are joint costs.

The analogy with public power appears to be inappropriate.
A more apt analogy might be made by comparing the highway system
to the railroad network. Clearly, the railroad network provides
all the values cited above to justify an allocation of costs to
nonusers. Railroads and other industries provide diverse benefits
enjoyed by society in general and specific benefits to particular
land owners, but it is never suggested that these industries allo-
cate costs to various groups on the basis of such benefits.

It may be argued that external economies associated with
highway use are of much greater significance than those associated
with other industries. Thus, a contribution from others than the
actual users may be in order. If this is the case, the benefits-
received approach is much more palatable in spite of the fact that
it leads to a theoretically incorrect allocation of costs. How-
ever, all applications of the benefits-received approach imply
that primary routes create no external economies, while tertiary
routes create significant external economies. Since measurements

29 This comparison is usually made by the railroad industry.
Highways: Development, Use, Financing (Washington: Association
to give weight to this assumption have never been made, it is at best an extremely dubious hypothesis.

Evaluation of the user-nonuser allocation in terms of orthodox cost analysis leads to the general conclusion that such an allocation is based on an arbitrary definition of beneficiaries and not on the nature of highway costs. Although there may be grounds for subsidizing highway use through payments from others than users, this does not require an allocation of joint costs but a joint allocation of financial responsibility for costs which can be assigned directly. This helps to explain the predilection for equitable or reasonable allocations of cost. There is no such thing as an equitable assignment of costs except where there is jointness, and even here notions about equity are not particularly apropos.

Recent journal articles point up the theorists' disenchantment with the benefits-received approach.\(^30\) This attitude has not been shared by those responsible for presenting concrete proposals for the financing of highway programs. Though the incremental approach to cost allocation among vehicle classes conforms very closely to the standards of the theorist, all recent studies have continued to rely on an initial allocation of costs between users and nonusers. There continue to be obstacles in the way of a resolution between theory and practice. One of these ob-

\(^{30}\)Infra, pp. 197-200.
obstacles, the fallacy of the joint cost interpretation, has been described. Although this invalidates the theoretical basis for the user-nonuser allocation, it does not explain what appears to be the real basis for such an allocation. It is felt that the strength of the benefits-received approach can be found by considering the administrative problem imposed by the tax collecting machinery.

The Administrative Problem

In approaching the highway problem, it is inevitable that the sources of revenue for financing the program will be considered. As these sources of revenue are considered, there is a distinct possibility that administrative considerations may impose limits or restrict the scope of the general theoretical analysis. It becomes more or less obvious, for example, that the property tax must be used to some extent for the financing of secondary and tertiary roads. Since this particular source of revenue usually goes into a general fund, it is not difficult to imagine that payments out of that fund for the maintenance and construction of highways are for the "general welfare." The view is consistent with constitutional requirements that general taxation be for a "public purpose." In the case of Citizens' Saving and Loan Association v. Topeka, 20 Wall. (U.S.), 655 (1875), the Supreme Court invalidated a Kansas statute which permitted municipalities to loan money to private concerns. For a brief discussion of the public purpose requirement see Harold Groves, Financing Government (4th ed.; New York: Henry Holt & Co., 1954), pp. 377-80.
this conception to an allocation of costs between users and non-users based on the view that highways create general social values. This reasoning, of course, is backwards. The source of revenue has become the basis for the cost allocation, whereas the cost allocation should provide the basis for determining the source of revenue. Economic, administrative and legal considerations become hopelessly confused, and a resolution of issues becomes impossible because the preconceptions are not in the open.

Whether the property owner stops at a toll gate to pay a toll or whether he pays an increased property tax, the cost of the highway is still charged against that individual. Whether he is a user or a non-user would appear to make little difference. Richard Zettel has recognized this administrative problem, but its implications to the user-nonuser allocation have not been set forth. Zettel points to the administrative problem imposed by the "variability of costs and the uniformity of user taxes." Uniform taxes necessarily cannot "earn" enough on access roads to justify the investment. Raising the user tax rates to the level of access or secondary road costs would result in excessive "earnings" on primary roads. It is quite logical from an administrative point of view to fix user tax rates at the level of primary road unit costs and to rely on some other source for meeting the higher unit costs on less densely traveled routes. But, again, all this has

32Zettel, op. cit., p. 7.
nothing to do with the economic allocation of highway costs. In a complete highway program there appears to be a place for nonuser tax sources, but not for a nonuser cost allocation. Basically, the cost allocation is among users. It is felt that many of the issues in highway finance can be resolved by an explicit recognition of this obvious administrative problem. The problem is not whether highway pricing is theoretically correct, but whether it is administratively feasible.

**Equity**

Most highway specialists continue to give reasons other than problems of tax collection in making the case for nonuser tax support. In addition to the multi-purpose assumption, it appears that a case for a division of highway costs between users and non-users may be found by considering equity. After allowing for a subsidy dictated by external economies, it may be found that some communities or areas still cannot afford an adequate system of highways. The improvement of highways in such areas is a response to notions about justice, and the revenue cannot be derived on the basis of an economically efficient system of taxes and charges. Here the aim is to redistribute welfare, and the revenues must be derived on the basis of criteria relating to distributive justice. One criterion of distributive justice is that windfalls of one sort or another ought to be taxed away. Thus, the benefits-received by various individuals may be considered a proper measure of their contribution toward payment of the highway bill. The
danger in this approach has already been pointed out. It replaces economic efficiency with some preconceived notion of tax equity which could result in an unintended misallocation, especially in the area of commercial trucking. If highways were not so competitive with other transportation agencies, the argument for considering only equity would be somewhat stronger. Moreover, "since highway specialists rarely consider the equity of tax alternatives, their arguments are often discredited by those who must deal with the tax universe." Nevertheless, the benefits-received approach does focus attention on "who gets what and how much." In evaluating the equity of the system of highway finance it is important to know the answers to such questions. Furthermore, investment decisions must reckon with both total benefits and total costs. Although the concept of benefits-received is not an appropriate basis for cost allocation, an acceptable highway program probably could not be developed without considering and measuring the diverse and diffuse benefits that accrue to various groups and individuals.

**Interpretation of the Benefit Theory of Taxation**

Criticism of the benefits-received approach does not, by any means, imply rejection of the benefit theory of taxation. Indeed, earlier discussion concerned with the establishment of gen-

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\(^{33}\text{Ibid., p. 7.}\)
eral principles postulated the benefit theory of taxation as a condition of economic efficiency. The criticism of the benefits-received approach is related to the failure to interpret the benefit theory of taxation in a manner consistent with economic efficiency.

Basically, the point that has been raised in this discussion refers to the premature and unnecessary application of value-of-service to highway finance. It must be remembered that both value-of-service and cost-of-service must be considered in a proper application of the benefit theory of taxation. The failure to maintain a proper relationship between these two pricing principles appears to be a crucial shortcoming of the benefits-received approach.

Much of the difficulty is related to the intermingling of two distinct purposes for value-of-service pricing. Value-of-service may be used to (a) allocate the cost of joint products, or (b) allocate the cost of a separable service or product among more than one beneficiary. In the former case there is joint production, in the latter there is joint consumption or, as we have called it, collective satisfaction. Both situations create allocation problems. Where there is joint production, value-of-service is used to allocate total costs among two or more products whose separate costs cannot be determined directly. Where there is joint or collective satisfaction, value-of-service is used to al-
locate shares among individuals who benefit jointly from the use or consumption of a good or service whose costs of production may be separable and determinate.

It has been maintained that the highway system produces one service, highway use. Of course, there are many varied beneficiaries of this highway use. There is no jointness on the production side, but there may be collective satisfactions on the consumption side. Therefore, the cost of a physical unit of highway use is known and is assignable to a particular highway user. This is not recognized by the benefits-received approach which brings value-of-service into the picture at the outset in order to allocate costs which in reality can be assigned directly. If those costs which can be assigned directly are in fact assigned, the role of value-of-service would be clarified. Once costs are directly assigned to particular units of service, external economies of consumption might require a value-of-service allocation of the cost of a separable unit of service among two or more individuals. In effect, external economies call for a subsidy to the user calculated on the basis of value-of-service to the nonuser. The calculation of a subsidy on the basis of value-of-service is quite a different matter than the allocation of joint costs on the basis of value-of-service. Subsidies are given to airlines, but airline costs do not have to be allocated. The benefits-received approach makes no distinction between the determination of subsidy and the allocation of joint costs.
These considerations will be elaborated in a subsequent section. At this point, it is enough to note the implications of the analysis of collective demand presented in Chapter IV to the present theory of highway finance and to governmental programs which rely on various interpretations of the benefit theory of taxation. In approaching problems of allocation, it is important to maintain a distinction between cost, subsidy and equity. All three notions are usually hopelessly confused with the result that allocations are inevitably open to attack.

Summary

The implication of the entire discussion is that the user-nonuser allocation of costs is an unnecessary step. There is a possibility that deduction of the nonuser share of costs from the total may distort the allocation between vehicle classes. Administration imposes the need for an allocation among sources of revenue which may be described as user and nonuser revenues. However, these problems should not impinge on the allocation of costs. The proper place to consider administration is after costs have been allocated, not before. Whether or not this conclusion would seriously affect the present system of highway finance which is based largely on the benefits-received approach is not known. In all likelihood, the practical impact of doing away with the user-nonuser allocation of costs would not be very great. However, the least that can be accomplished is to focus attention on the rele-
vant issues and to address particular problems to those best able
to solve them. The user-nonuser distinction is primarily an ad-
ministrative tool.

The distinction between users and nonusers also has some
significance when we consider the need for subsidy in order to re-
fect valid external economies and the equity of a particular sys-
tem of highway finance. But again these factors have little sig-
nificance to the initial allocation of costs. It is important to
remember that costs are allocated to those physical units of out-
put which impose costs. The tastes, incomes and institutional
status of individuals do not provide a basis for cost allocation
as the benefits-received approach implies. At a later point it is
held that benefits-received confuses and intermingles the supply
and demand sides of the highway equation.

Let us now turn to some proposed modifications to the
benefits-received analysis. The chief feature of the modifica-
tions that have been offered to date is that they make a stronger
distinction between the supply and demand sides of the equation
and seek to apply traditional cost-price analysis to highway fi-
nancial problems.
CHAPTER VII

THE PRICING APPROACHES (MARKET VALUE)

Attempts to apply traditional market standards to highway finance have received increasing attention in recent years. It is not clear whether the market approach to highway finance is proposed as an alternative or as a modification to the benefits-received analysis. Advocates of a market oriented supply and demand analysis appear to reject the benefits-received alternative, but have failed to provide a complete structure based on a consistent set of assumptions. The so-called pricing approaches deal with particular problems and special circumstances. The most complete and lucid proposal, set forth by Brownlee and Heller, has been severely criticized for its failure to deal with the problem in a comprehensive manner. Thus, we find a relatively small group of writers who express dissatisfaction with the present theory of highway finance but who are unable to provide an acceptable alternative.

This part of the discussion is a general review and evaluation of the various pricing approaches. Like the preceding review of the benefits-received analysis, it attempts to sort out basic assumptions and preconceptions and deliberately avoids consideration of the techniques needed to implement the various proposals. It is felt that this procedure exposes relevant economic
issues, leads to a solution of much current conflict and provides a further basis for adoption of a revised theory of highway finance.

To add perspective, the discussion begins with a review of the "commercial concept" of highway finance. This is followed by an analysis of the more sophisticated marginal cost pricing proposals which have appeared more recently. Finally, the differences in the benefits-received and pricing approaches are compared, evaluated and it is hoped resolved.

The Commercial Concept

Current pricing approaches appear to have grown out of the "commercial concept" of highway finance. The chief advocate of the commercial concept, Shorey Peterson, set forth his views a few years before the benefits-received analysis became firmly entrenched.1 Peterson reached his conclusions on the basis of an historical interpretation of the changing nature of the highway function. According to Peterson, the advent of the motor vehicle brought about a basic change in the highway function which called for a new approach to highway problems. The new approach involved acceptance of the idea that highway service was unlike other basic

governmental services and ought to be provided in accordance with ordinary business standards. In other words, financing in terms of general welfare should be replaced by financing on a commercial basis. The general policy conclusion was that highways should be financed entirely from user revenues and should be developed in response to traffic demands and the profit and loss criteria of private business.

According to the commercial concept, highway user tax rates would be set high enough to cover full costs. Peterson described it as the Neo-classical long run solution. It amounted to pricing on the basis of the average cost of all highways. This conclusion was open to attack by commercial operators who, rightly or wrongly, claimed little responsibility for secondary or tertiary roads. Although there is an interdependence among various types of highways, this interdependence was discussed in the most general terms, and no measurements or analysis of the extent to which primary road users also relied on secondary roads was provided. It is possible to detect the failure to take account of the fact that use of the property tax or other nonuser revenues does not necessarily imply that users are escaping responsibility for costs which they impose.

\[2\text{Ibid., p. 419.}\]

It is not necessary for our purposes to evaluate Peterson's historical interpretation of the changing function of the highway plant, but this writer suspects that the commercial concept is based as much on the appearance of a new source of revenue which accompanied the motor vehicle as on a basic change in the economic function of the road plant. To be sure, there were important changes whose chief impact probably was to diminish the validity of an approach which emphasized external economies or collective demand. The existence of external economies implies that traffic and highway development need to be encouraged through subsidy. Since the advent of the motor vehicle, highway policy by and large has been based on a response to increasing traffic rather than on the need to develop traffic. If Peterson's thesis is interpreted in this manner, it appears to have considerable validity and implies that there should be no nonuser or general support of the highway function. Peterson guarded his conclusion by pointing to special instances where general revenue contributions appeared to be justified. Nevertheless, there was no place in his frame of reference for the analysis of external economies and his entire argument ultimately rested on the hypothesis that there are no external economies justifying payments from individuals other than the users themselves. This defect along with the failure to recognize the administrative problem imposed by the need for uniform tax rates is characteristic of all current pricing proposals.
The commercial concept was rejected by the benefits-received school partly because it did not recognize what appeared to be valid indirect benefits. Perhaps a more realistic reason for the rejection was the fact that Peterson's proposal was overhauled by the railroad community and turned into what has been called the "public utility" concept. Railroad management accepted Peterson's qualified conclusion that user rates should reflect full costs and addressed itself to the problem of defining (and inflating) highway costs. Advocates of the commercial concept defined highway costs as "maintenance, administration and supervision, policing and traffic control and an annual depreciation charge on all portions of the plant subject to exhaustion in service-rendering capacity." Railroad management along with a few impartial observers extended the concept to include interest on the entire unamortized investment and a charge for taxes foregone because the property is publicly owned. Some even suggested that the highway sys-

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Dearing uses the terms "commercial" and "public utility" method interchangeably. Charles L. Dearing, *American Highway Policy* (Washington: The Brookings Institution, 1942), p. 202. Although both appear to be based on a similar view with regard to the nature of the road plant, their aims were quite different. It is probably best to maintain a distinction if only to do justice to Peterson's excellent article.

5 Allen, *op. cit.* , p. 270.
tem be operated so as to yield a "fair return on a fair valuation." In such hands, the commercial concept was grotesquely misinterpreted and amounted to foisting all the institutional paraphernalia of public utility regulation onto the highway function.

Like the commercial concept, the public utility method was advocated as a method for achieving efficient resource allocation. Economic resource allocation was to be achieved through "equalization" aimed at placing the various transportation agencies on an equal footing. Economic efficiency could hardly be achieved by depriving motor vehicle transportation of valid economic advantages or by fastening upon it the noneconomic and uneconomic elements of public utility regulation. The public utility method became involved with the question of who ought to pay, and the analysis of highway cost deteriorated to reasoning from the railroad analogy.

If analogies are to be made, it is felt that the railroad analogy is superior to the analogy with public power implied by the benefits-received analysis. The basic premise of the public utility concept that highways serve the motorist and create values similar to those of the railroads represents a clearer conception of the road plant than that of the Federal Coordinator. Neverthe-

6These and other views as to what ought to be included in highway costs are reviewed in The Coordinator's Report, pp. 45-55. Also see Appendix.
less, in its attempt to bring about equalization, the public utility concept tended to juxtapose cost responsibility for highways against highway user revenues and, in the hands of the railroad community, lost whatever validity it might have had.

Following publication of the reports of the Coordinator and the Board of Investigation and Research, the issue was resolved in favor of the benefits-received approach. Although the public utility interpretation appears to be discredited, there has been a recent revival of the commercial concept.

Recent Pricing Proposals

In 1950, Peterson restated his ideas and argued for abandonment of the current view which appears to emphasize general and indirect social effects rather than direct costs and utilities. According to Peterson:

The interest of the public in effective and economical transportation calls for encouraging each agency to exploit its potentialities without special favor or burden. This result is promoted when highways are administered, as fully as practicable, in terms of transportation service rather than general social effects. The more closely specific values and costs are recognized, both in developing roads and charging for their use, the better the result is likely to be . . . the desirable goal should not be obscured by the difficulties involved or by preoccupation with the older, more political view of highways.7 (Underlining supplied.)

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A few economists and highway specialists have joined Peterson in maintaining that highway finance should recognize specific values and costs. These writers advocate a more rigorous application of supply and demand analysis to highway financial problems. This approach appears to have been encouraged by the growing problem of traffic congestion and by the increasing popularity and development of the incremental-cost approach to the allocation of highway costs. Traffic congestion suggested the use of prices as rationing devices, while the direct assignment of incremental costs to users pointed to the possibility of a pricing scheme somewhat more consistent with the marginal cost standard. These two possible applications of orthodox price analysis have led to two related supply and demand proposals. The first we shall call the "short run" approach because it assumes a relatively inelastic supply and focuses attention on the utilization of a fixed plant. The second we shall call the "long run" approach because it emphasizes the allocation of resources on the assumption that most costs are variable and leads to prices established on a cost basis.
The Short Run Proposal

The short-run approach to highway pricing considers the problem of highway development to be distinct from that of an efficient utilization of a given highway plant. According to this view, the function of user charges and fees is to ration and allocate traffic within the existing plant. Demand is the active element in the rate-making machinery, since "the highway problem is essentially one of peak load." The pricing criterion suggested by Buchanan requires the equation of price to short-run marginal social costs. Short run marginal social cost includes: (1) "the direct marginal money costs imposed by a user" and (2) "the indirect additional burdens or costs that are imposed on other users" (congestion or external diseconomies of private highway use).

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8The proposal was presented by James E. Buchanan, "Pricing of Highway Services," National Tax Journal, V (June, 1952), 97-107. Although this is the only complete exposition, Buchanan cites Peterson, "Highway Policy on a Commercial Basis," op. cit., and James C. Nelson, "Highway Development, the Railroads and National Transportation Policy," American Economic Review, XLI (May, 1951), 495-505. Nelson and Peterson, however, appear to be more closely associated with the Brownlee-Heller long run proposal. The long and short run approaches are not really alternatives; each emphasizes the solution of different problems. Therefore, all writers cited in this and the following section probably are in substantial agreement at least on broad issues.

9Buchanan, op. cit., p. 106.

10Ibid., p. 100.
Direct marginal money costs are defined as "that portion of total maintenance costs which vary directly with road usage."11

Using generally accepted pricing principles, Buchanan reaches the following conclusions concerning the relative charges which should be placed on highway users:

1. Secondary road users who cause little congestion should be required to pay less per ton or vehicle mile than primary road users.
2. Heavier and larger vehicles should be charged higher rates than lighter and smaller ones because both the direct and indirect components of marginal social cost are greater.
3. Slower vehicles which add more to congestion should pay higher rates than faster vehicles.
4. Vehicles known to travel more during congested time periods should be charged higher rates. Higher rates should be charged on weekends and holidays and during rush hours.12

The administrative problem in establishing and enforcing such a system of prices is recognized, and Buchanan admits the impossibility of adhering to all these criteria. Although a comprehensive plan of the sort envisioned by Buchanan is obviously impractical, most would agree that the possibility of application to even a few situations merits consideration. Although the general pricing principle utilized in the short run approach seems to be perfectly valid, some question may be raised as to whether the problem is solely one of rationing. Assuming that peak loads were leveled out and congestion were eliminated, there would still be

11Ibid.
a longer run pricing problem which would not be solved by applying Buchanan's short run pricing principle. One difficulty that is immediately apparent is the assumption that maintenance costs are the relevant short run marginal money costs. This implies that marginal costs are equivalent to differences in total variable costs rather than to differences in total costs. Basically, this question is related very closely to a problem that continues to obscure all marginal cost pricing proposals, namely: What is the appropriate time period for calculating marginal cost? This problem is examined in a subsequent section.

Moreover, the existence of peak load involves additional construction expenditures which are directly assignable to the peak load traffic and which ought to have a place in the price structure. This does not imply that highway pricing should eschew problems requiring the rationing of a fixed plant, but emphasizes the fact that highway construction is a marginal process. It appears that a comprehensive system of pricing for highway services ought to consider something more than the hour to hour and day to day fluctuations of traffic. This is especially true when the imposition of rigorous short run price discipline appears to be a remote possibility.

One of the aims of the short run approach appears to be to distribute traffic evenly over the system. Charging higher rates on some roads and lower rates on others does not at all ensure that this objective can be accomplished because many roads are
complementary — the decision to use one includes the decision to use the other. The administrative advantage of thinking in terms of "bundles" of service is obvious. Shoes and shoe strings can be sold separately in two stores, but it is much easier to sell them together in one store. It is better still to package them in a single bundle. For analytical purposes it is often helpful to deal with "road segments," but Buchanan and most others advocating the pricing approach do not make the necessary adjustments for the interdependence of roads. However, it should be noted that this criticism of the "road segment" approach is based largely on the administrative problem of pricing for such segments and that excessive concern with interdependence of roads could lead us back to the public utility concept which grouped all roads for pricing purposes.

Another difficulty with the short run proposal is the assumption that demand is sufficiently elastic that a reasonable schedule of prices would bring about the needed adjustments. Buchanan's views on this point are not clear. In one connection he writes that "since the demand for highway services is probably inelastic over the relevant price range, the optimum pricing structure would yield greater revenue than is currently collected." At another point he states that if motorists

\[13\] Ibid., p. 104.
utilize approximately the same amount of highway services at a zero price as they will at a price which covers marginal social costs of providing the services there is little economic justification for prices as rationing devices. But this is evidently not the case.\textsuperscript{14}

In spite of this inconsistency concerning the elasticity of demand, it is fair to assume that Buchanan's analysis is based on the latter statement which implies an elastic demand. However, Buchanan provides no evidence to support the hypothesis that the demand for highway service is elastic. An equally valid, perhaps more valid, hypothesis is that the demand is highly inelastic.

The question of the elasticity of demand is important from the point of view of practical application but does not detract from the theoretical analysis which must assume some change in quantity demanded in response to a change in price. Moreover, the demand of commercial operators probably is much more elastic than that of passenger vehicle operators. It follows that marginal cost pricing

\textsuperscript{14}Ibid., p. 99.
on either a short or long run basis would have a greater impact on commercial operations than on other uses of the highway.\textsuperscript{15}

Although little substantiation can be offered, it is felt that the supply of highway service, especially through rural areas, is relatively more elastic than the demand for such services, and that there is somewhat more hope in bringing about adequate adjustment by emphasizing the supply side. A clear implication of Buchanan's proposal is that something can be done about demand, but that little can be done about supply. The assumption of an inelastic supply appears to be more appropriate for city streets than for rural highways, and this indicates that Buchanan's approach could be applied with more success to metropolitan

\textsuperscript{15}The degree of elasticity of demand of commercial operators is still an open question. In addition to the possibility of demand inelasticity, there is another difficulty related to the efficacy of ordinary user taxes in bringing about the results that would be achieved by actual tolls or prices. Increased gasoline taxes, for example, might have some affect on the amount of travel, but they would have no affect on the distribution of travel.

The possibility of achieving rationing is also limited by the fact that there may be sound reasons for levying highway user taxes for other purposes. In addition to a "price" for the highway service, the gasoline tax, for example, could include a levy for school or other general fund purposes. "The automobile is no more sacred than other property, and taxes against it in excess of the benefits which it enjoys from the highways may be as just and reasonable as taxes on other objects for the general upkeep of government which are levied against taxpayers . . . ." Alfred G. Buehler, Public Finance (3d ed.; New York: McGraw-Hill Book Co., 1948), p. 7.
transportation problems. However, in the cities where peak load and congestion problems are severe, the administrative limitations to a rationing scheme are greatest. 16

It is interesting to note that short run pricing does not require a user-nonuser allocation of costs. Indeed, the approach requires no cost allocations beyond the short run costs which have been described. Buchanan does not offer any help as to how the indirect costs (costs of congestion) can be measured. It is possible that congestion should not be treated as a social cost but as evidence of a large or excess demand. In a subsequent section the complex character of the economics of congestion is discussed in some detail. The analysis of congestion is complex because it involves more than the usual price-quantity relationship implied by Buchanan. A change in quantity usually brings about an inverse change in quality. Thus, with each additional unit of traffic we are dealing with a different product. The quality of the service in an over-crowded restaurant usually is inferior to that of a half-full restaurant. From the point of view of the individual, the most desirable highway may be one with no other vehicles on it. In order to consider price-quantity relationships, it is necessary first to establish an index or standard of quality. This

16 For some interesting policy proposals for applying Buchanan's reasoning to the parking and congestion problem see C. L. Harris, "Automobile Taxation and Congestion," American Economic Review, XLVII (March, 1957), 152-54.
is enough to indicate that there may be more to the analysis of congestion than external diseconomies of consumption.

In spite of the analytical complexities introduced by considering congestion, Buchanan's proposal to treat it as a social cost would probably appeal to most economists. However, some would object to the inclusion of external diseconomies without consideration of external economies. Buchanan's framework includes social cost without considering the parallel concept of social benefit. Presumably, the price that individuals pay reflects fully the social benefit derived from motor vehicle transportation. One can readily appreciate the reaction of the benefits-received school to this kind of an assumption. The commercial concept along with Buchanan's pricing proposal appear to assume that external economies of use are insignificant insofar as highway transportation is concerned.

The discussion has emphasized the difficulties and issues arising out of the short run pricing proposal. Some of these difficulties are administrative, others relate to findings of fact which this study does not presume to evaluate. For example, an answer to the question of the elasticity of supply and demand is important to any approach which seeks to utilize prices as rationing devices or as allocators.

With the exception of these problems, the chief criticism is that the short run proposal considers only a part of the highway problem. It does not consider external economies and refers
too much to total analysis or, conversely, too little to marginal analysis. The strength of Buchanan's proposal is the treatment of peak load situations. But it is felt that a satisfactory solution of highway financial problems should consider the fact that highway construction is essentially a marginal process, and, therefore, marginal money costs ought to include more than outlays for maintenance. Moreover, the questions raised by congestion are considerably more complex than Buchanan's discussion would lead one to believe.

**Long Run Pricing**

Some of the difficulties in the short run pricing approach are overcome when the pricing procedure considers a longer period of time. The incremental cost analysis for assigning the user share among vehicle classes represents a long run solution to a part of the highway pricing problem. In the incremental cost analysis demand is a relatively passive factor, and costs are allocated on the assumption that there is no excess supply or demand. If it is also assumed that highway services are produced under conditions of long run constant or increasing costs, the pricing problem becomes one of determining the average cost of the service provided. In essence, "full cost" allocation becomes the basis of price setting. This procedure resembles the commercial

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17 See Chapter IX for a description of the incremental cost solution.
concept that has already been described. The chief difference is that recent procedures rely on a comprehensive classification of roads and on a detailed assignment of incremental or special costs to various classes of users. Thus, rate differentials closely reflect differences in the costs imposed by various users.

One of the objections to this procedure is that the incremental analysis currently in vogue presupposes an allocation of costs between users and nonusers and, therefore, distorts the absolute level of the cost assignment. Another objection is revealed by Buchanan's proposal; namely, the need to consider congestion, peak load problems and other factors related to a less than perfectly adjusted plant. In contrast to Buchanan's proposal which emphasizes demand and the utilization of a fixed plant, the incremental cost approach emphasizes supply and results in a rate-making procedure which reflects a passive allocation of all costs. Since the highway plant is seldom perfectly adjusted, the long run cost-prices established by the incremental analysis do not reflect many valid short run conditions. Both the short run pricing proposal and the long run incremental analysis leave something to be desired in the way of a complete solution.

A partial resolution of the two approaches has been set forth in an analysis by Brownlee and Heller at the 1955 meetings of the American Economic Association. This presentation is of special significance, not only because it represents the most recent step forward, but also because it provides an opportunity for various authorities to set forth their views. Since the record of this meeting represents the most recent exchange of views among a group of widely accepted authorities, it sets the stage for a delineation, evaluation and, perhaps, resolution of the issues currently confronting highway financial analysis.

The Brownlee-Heller Proposal

Brownlee and Heller do not attempt to formulate a complete solution to the highway problem. A very significant limitation was imposed by confining the analysis "to the trunk highway problem where the services provided are for more or less continuous movements of people or goods." The writers believe that both public attitudes toward highway taxes and the institutional arrangements for state highway financing (e.g., earmarking and, ordinarily, separate handling

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20 Brownlee and Heller, Ibid., p. 233.
in the legislative process) suggest that the public recognizes the "price-like" nature of highway user taxes.\textsuperscript{21}

Accordingly, the financing of trunk highways ought to recognize the similarities between the highway problem and a host of comparable problems to which economists have applied some rather ancient ideas; namely, those of "good old supply and demand analysis."\textsuperscript{22}

With this conception of the problem, the authors attempt to show that the highway problem "should and can be resolved by government primarily in terms of the pricing process reflecting direct costs and direct benefits."\textsuperscript{23} The actual pricing scheme that is set forth by Brownlee and Heller is aimed at rationing highway services and at providing information that would be useful in "directing production of these services." Therefore, the pricing procedures would consider the "disutility of congestion as well as the costs of constructing, maintaining and policing various parts of the system."\textsuperscript{24} Congestion which reflects short run maladjustments is brought into relation with the long run supply prices reflected by the incremental allocation of costs. Although

\textsuperscript{21}Ibid.

\textsuperscript{22}Ibid.

\textsuperscript{23}Ibid., p. 249.

\textsuperscript{24}Ibid., p. 236. Brownlee and Heller do not elaborate on the cost standard underlying their analysis. However, it appears that they have program cost in mind. Program cost is described in the Appendix and evaluated in a subsequent section.
the authors do not fully explain the content of the supply and demand functions, it is possible to set forth the main outlines of the framework.

On the demand side, the utility of highway services is assumed to depend on such factors as "the kind of vehicle driven, the speed of travel, the distance traveled, fuel and maintenance costs per unit of distance, the inherent safety of the highway at various speeds and the passengers' comfort."\(^{25}\) The distance traveled on a highway of given quality is assumed to measure the quantity of service taken at the price being charged for that highway. Therefore, "it should be possible — in principle — to describe the prices that the population would be willing to pay for different amounts of various services."\(^{26}\) This schedule is the demand side of the equation.

One of the interesting features on the demand side is the manner in which congestion is handled. Whereas Buchanan treated congestion as an indirect cost imposed on other motorists, Brownlee and Heller consider congestion as a demand factor which brings about a deterioration in the quality of service. This appears to be a superior approach because it casts the problem in a context amenable to measurements by highway engineers. It is far more difficult to evaluate the "headaches, stresses and strains" im-

\(^{25}\)Ibid., pp. 237-38.

\(^{26}\)Ibid., p. 238.
posed by congestion, than it is to evaluate the deterioration in the quality of the service. The additional costs required to bring the service back to its original quality (extra lanes, etc.) are the additional costs attributable to congestion. Presumably, prices would reflect these additional construction costs.

Brownlee and Heller do not consider the proper pricing policy during the interim before the construction is undertaken. Implicit in their approach is the assumption that a wide-awake management authority will anticipate the congestion and meet the demand without much delay. It may be possible to maintain the quality of service by pricing temporarily along the demand curve or rationing the relatively fixed supply of a given quality. Rationing might mean that prices may have to be considerably higher than those indicated by the additional construction costs required to eliminate congestion. In short, the possibility of short run rationing is not fully recognized. However, this short-coming may have only academic significance. There are practical difficulties that stand in the way of short run rationing. Even private businesses often allow their shelves to go empty before resorting to short run price rationing. Moreover, congestion creates the conditions for self-imposed rationing on the part of the motorist. Whether the price is raised or the quality of service is allowed to deteriorate, the motorist must bear part of the cost of congestion. The failure to deal with short run rationing does not appear to be a significant defect in the Brownlee-Heller analysis.
For the sake of completeness, there is no difficulty in adding short run considerations to the Brownlee-Heller analytical machinery.

In examining the cost side, Brownlee and Heller cite engineering studies and conclude that highway costs vary with axle load and with the number of passages. Thus, charges for one type of vehicle as compared with another will vary with axle load. Charges levied against any particular axle load will vary with the number of passages (distance traveled).

Basically, the proposal seems to require an assignment of cost increments to various classes of users and payments in accordance with the use of those increments. Rates based on the incremental cost assignment are then corrected for the deterioration of quality due to traffic congestion (which simply amounts to additional incremental assignments) to complete the pricing scheme.

Although Brownlee and Heller attempt to bring the demand side of the equation into the rate-making procedure, the attempt is only partially successful. It should be noted that the proposal contemplates rate variations only after changes in demand have had an impact on actual construction activity. The cost standard employed is not marginal cost but program cost which yields rates appropriate to a well-adjusted plant. Rates based on program costs might be appropriate if adjustments in supply could be made immediately and perfectly. However, indivisibilities along with the time element may preclude such perfect adjustments. These ad-
justments are considered by Buchanan whose proposal is based on the assumption that demand, not supply, should be the active element in the rate-making process. Although the practical difficulties in the way of short run rationing are obvious, the Brownlee-Heller approach may appear to be incomplete because it does not recognize the short run problem. It remains, then, to complete the incremental cost structure advocated by Brownlee-Heller.

The Brownlee-Heller proposal raises two questions which are examined in the ensuing sections. The first relates to the validity of program cost as the cost standard. Brownlee and Heller do not defend or even define their cost standard. The second question relates to the manner in which short run phenomena and indivisibilities are brought into relation with rates established on the basis of program cost.

The Case for Program Cost

Marginal cost is the appropriate standard for pricing purposes. In actual applications, the relevant marginal cost depends on the nature of the operation and on the frequency with which particular kinds of decisions are made. From the point of view of applications, the short and long run cost curves are so much analytical machinery, useful in demonstrating the principle, but of little help in the application. This section deliberately

\[27\text{Supra, p. 25.}\]
eschews the usual theoretical machinery in favor of an applied interpretation of the marginal cost standard.

Marginal cost may be defined provisionally as the difference in total costs at two consecutive levels of output. Alternatively, it is the cost which would not have been incurred if the last unit, block of units or class of units were not produced. The latter formulation includes special costs within the definition. As a general rule, marginal cost is defined on the assumption that the output is homogeneous. Therefore, all costs are common, and marginal cost varies with volume of output. Where there are special costs associated with different classes of output, it is a simple enough matter (in theory) to deduct these special costs, leaving only common costs. Thus, the special costs may be added to marginal costs to yield the additional cost involved in the production of an additional unit, block of unit or class of unit. The term marginal cost as used in this section includes special cost. (At a later point this conception is abandoned.) Marginal cost defined in this way represents the increment which is relevant to price-making in a multi-product situation. Special costs may also have a relationship with volume in which case marginal cost is the sum of two components, each of which is a marginal cost. Defined in this way, marginal cost refers to the additional cost of handling additional traffic without the need for specifying the class or type of traffic.
Buchanan's proposal is based on the assumption that the plant is fixed. The implication is that highway construction is a "single shot" affair and, therefore, involves indivisibilities which defy marginal analysis. But highway construction is a continuous process. We are seldom considering either a fixed plant or a completely new plant. To have any real significance, marginal cost pricing must refer to those additional costs over which the management authority has control. These additional costs include, even over a short period of time, a large amount of construction expenditure. Although these construction expenditures become sunk or fixed costs, they are continually being made and, therefore, are continually at the margin. Decisions relative to the expansion or contraction of the plant are daily occurrences. It appears to this writer that expansion or contraction of the highway plant is largely incremental and, therefore, can be brought into relation with marginal analysis. Although it may be true that many projects call for total analysis as, for example, the construction of a completely new limited access freeway, it is equally true that most construction represents incremental changes in supply in response to incremental changes in demand.

Buchanan's reasoning parallels that of Hotelling who refers at one point to Dupuit's well-known "free" bridge.²⁸ The

bridge described by Hotelling has excess capacity, and the additional cost for handling an additional vehicle is negligible. Hotelling concludes that marginal cost pricing requires a zero toll. This is the case only if the bridge has no place in the program or plan of the bridge authority. In short, it must be a bridge without a future. In the light of its planning period, however, the management authority may be committed to additional costs considerably in excess of zero. In commenting on this illustration, Troxel writes:

If the bridge is given (i.e., already built), toll prices can be used to ration the potential output during the service life of the bridge. Insofar as the traffic flow does not reach the maximum potential flow, then the tolls obviously have no allocative significance in this case. But when a condition of a given bridge is assumed, nearly everything in the allocative relations is excluded from consideration. Unless the cost-output calculations apply at the time when the location, size in traffic capacity, and other design features are chosen, nothing much in costs is involved in a bridge organization. The critical time for choices of toll prices, then, is in the planning stage prior to bridge construction. This is the critical time if efficient allocations are in point. . . allowed to be expressions in the design and investment choices, toll prices are means of allocation control.29

The burden of Troxel's discussion is that prices must be established in relation to a planning period. In other words, current pricing depends on current plans. In a similar vein, Lerner maintains that marginal costs are planning costs.

The only costs that are relevant are costs the incurrence of which is in question. They are, therefore, all prime. It should be noted that depreciation quotas and supplementary costs are not mentioned so that pseudo problems connected with the difficulty of distinguishing prime from supplementary costs dissolve into thin air. The problem of transition from short to long period disappears.30

"Costs the incurrence of which is in question" are the costs that could be avoided if the decision to maintain or increase output were not made. Such costs represent resources at the current margin or resources which have alternative uses and whose fate is currently in question. It appears to this writer that this represents a reasonable interpretation of the marginal cost standard for use in applied situations.

"Costs the incurrence of which is in question" can be found by examining the program or plan of the authority. The plan or program is continually in question and represents both production and planning (short and long run) costs. The highway authority usually plans in terms of a ten, fifteen or twenty year program. If the program is well conceived and not affected by a backlog of highway "needs," it is geared as evenly as possible to the demand that is expected to present itself at a series of future dates. Thus, there is a program cost for each of a series of years which is related to the demand (a series of outputs) expected to present itself. If the demand develops as anticipated,

the highway plant will operate as near to the optimum as possible. However, from time to time the program will be revised in response to changes in the outlook, and program costs will either be increased or decreased. Rates based on program costs will reflect Lerner's conception of the marginal cost standard. If demand declines and additional construction is not required, program cost will decline to the level of maintenance; if demand increases, program cost will increase so as to include the cost of added capacity. To the extent that rate variations are administratively feasible, rates may be varied in response to variations in program cost.

The difficulty with program cost is obvious. It is valid only on the assumption that demand has had an impact on program cost and that some sort of an adjustment has been made. This assumption may be questioned. Particular roads or the system as a whole may be characterized by congestion (excess demand) or excess capacity (excess supply). Such conditions may arise because of (1) short run excess supply or demand, (2) indivisibilities of a "permanent" nature and (3) peak load. Although these factors are closely interrelated, each may call for a particular kind of price policy.

Before examining these possibilities, it may be helpful to distinguish between "temporary" and "permanent" indivisibilities. Temporary indivisibilities are those that can be eliminated by increases or decreases in demand or supply. For example, additional
lanes are added in anticipation of the demand a few years hence. There is excess supply of a temporary nature because of the indivisibility. This situation also exists for new roads, as well as for roads that are being contracted. These "lumps" are not permanent. Permanent indivisibilities appear on secondary roads. Typically, such roads have excess supply because of an inadequate demand coupled with the fact that roads must have certain minimum design features to withstand the weather and to provide a reasonable minimum quality of service. Such roads have permanent excess capacity.

In the ensuing discussion, permanent indivisibilities are treated separately. However, temporary indivisibilities are treated along with the analysis of changes in demand. Analytically, changes in demand and temporary indivisibilities pose the same problem; namely, short run excess supply or demand.

**Short Run Excess Supply or Demand**

If there were no peak load problem or permanent indivisibilities on the supply side, excess supply or excess demand could be removed through appropriate adjustment of the plant. Changes in demand would lead either to excess capacity or to congestion. An attempt to eliminate such conditions through price discipline involves insurmountable administrative problems. Although short run price policies would not be feasible from the practical point of view, it is felt that some strong theoretical arguments can be
advanced in support of the view that price discipline is not a necessary condition for effective short run utilization of the highway plant.

An adjustment to excess capacity and congestion occurs more or less automatically because traffic has a tendency to distribute itself so as to minimize and equalize marginal real costs. It is felt that the significance of this adjustment has been overlooked by highway financial analysts. Congestion raises real costs to the motorist; excess capacity reduces such costs. The motorist, in attempting to minimize real costs, will find and use that route which has the lower marginal real cost. Of course, the possibility of such an adjustment is limited by the number of alternate routes. Thus, the pleasure driver has many alternatives and is more likely than others to select the least congested route. In a sense, then, there is a limited automatic adjustment for excess capacity and congestion. Increasing highway congestion in recent years, for example, appears to have led to a significant shift from day to night driving on the part of commercial operators.

Another aspect of this automatic adjustment is the fluctuation in user tax earnings. If rates are established on the assumption of optimal operations, congestion will result in "profits" to the highway authority while excess capacity will lead to "losses." The profits will provide revenue for needed expansion and the losses will provide a signal for contraction. It appears,
then, that variations in rates are not a necessary condition for an adjustment of the plant. The accumulation of profits may be interpreted as a reflection of rising marginal costs while the incurrences of losses may reflect declining marginal costs. This reasoning is not obvious and requires some elaboration.

The adjustment described above is a reflection of the intimate relationship between the volume of traffic and the quality of service. Although rates are not varied, the motorist receives a lower quality of service on a congested highway and a higher quality of service on a highway which has excess capacity. The effect is much the same as that which would be obtained if the quality standard were maintained and price variations were used to adjust the volume of traffic. Instead of price variations, the adjustment may occur partially through quality variations.

Highway engineers classify roads depending on the quality of service they provide. The most widely used classification is one which distinguishes between "tolerable" and "intolerable" roads.31 As a general rule, the highway authority is committed to a tolerable standard. An intolerable road may become tolerable if the quantity of traffic is decreased. Similarly, an increase in traffic brings about intolerable conditions on a road which was

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31For a discussion of the technical standards and procedures employed by engineers in the development of "tolerable" and "intolerable" classifications see American Association of State Highway Officials, A Policy on Design Standards (Washington: American Association of State Highway Officials, 1950).
tolerable for the pre-existing volume of traffic. It may be argued that the relationship between volume of traffic and quality of service is continuous. That is, a highway capable of providing \( N + K \) tolerable service units, provides \( N \) high-quality service units when only \( N \) vehicles present themselves. This points up the relative nature of the terms excess capacity and congestion and implies again that a limited adjustment mechanism is "built-in."

The addition of a vehicle imposes additional "real" costs on other vehicles although the additional money costs or outlay of the highway authority may be quite low. Every diminution of the space available can represent an increment of cost imposed on other vehicles. Thus, the marginal cost imposed by each vehicle is a function of the space occupied. Since every vehicle is marginal, prices could be established on the basis of costs allocated in accordance with relative space-occupancy.\(^{32}\) Space-occupancy provides a means for translating real costs into money costs. Troxel is the only writer to have suggested this approach as a reasonable

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\(^{32}\)The possibility of allocating common costs on the basis of space-occupancy is described in Chapter IX. It is felt that this technique is more consistent with the marginal cost standard than the usual vehicle-mile or axle-mile allocations. Of course, distance traveled has such a close relationship to space occupied that vehicle-miles or axle-miles adjusted for differences in the geometric dimensions of vehicles may represent a reasonable alternative. Special costs have nothing to do with this allocation. Increments associated with differences in weights may be isolated and assigned before common costs are allocated.
basis for the allocation of common costs. The preceding discussion provides a marginal cost argument for the space-occupancy approach to the allocation of common costs.

The burden of the argument presented above is that the adjustment process may not require elaborate price variations because there are variations in real cost which move in the same direction as marginal money costs. When there is excess capacity, both marginal money and "real" costs are low; when there is congestion both are high. Revenues derived from user charges would follow a similar pattern. Roads requiring expansion would earn an excess of user revenue while those requiring contraction would show a deficit. An alert highway authority, basing its program on traffic and demand studies, could achieve utilization at or near optimum if there were no peak load problem or indivisibilities on the supply side. New highways reach optimum utilization relatively quickly and highways with much excess capacity deteriorate to standards consistent with the demand for their use within a year or two.

It appears, then, that a policy of maintaining rates at the program cost level suggested in the preceding section has con-

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33 Troxel, op. cit., pp. 262-69. Mr. Leland James of Consolidated Freightways, Portland, Oregon, in his capacity as Chairman of the Taxation Committee, Western Highway Institute, led an informal discussion on the subject in 1948. This discussion is summarized in U.S., Bureau of Public Roads, A Factual Discussion of Motortruck Operation, Regulation and Taxation (Washington: Government Printing Office, 1951), pp. 109-110. The summary dismissal of Mr. James's proposal is discussed in Chapter IX.
siderably more to commend it than the usual argument of adminis-
trative feasibility. Although rate variations in response to all
situations characterized by excess supply and excess demand would
accomplish very little, it may be desirable in some instances to
add price discipline to the "built-in" adjustments already de-
scribed. In any event, the discussion would not be complete with-
out giving some consideration to price or rate variations in re-
sponse to short run variations in demand and supply.

If the plant is perfectly adjusted, rates will be estab-
lished at the program cost level already described. It has also
been suggested that the common costs be allocated on the basis of
space-occupancy. However, changes in demand will lead either to
excess capacity or congestion. If these conditions cannot be re-
moved easily through the normal operation of the highway program
or through the automatic adjustment that has been described, it
may be desirable to raise or lower rates to a short run marginal
cost basis. In order to describe the nature of this adjustment,
it is helpful to accept the engineer's distinction between toler-
able and intolerable service.

An increase in traffic reduces the quality of service to
intolerable standards and additional maintenance and construction
must be undertaken. Similarly, a decrease in traffic increases
the quality of the service, and it may be possible to reduce cer-
tain classes of expenditures, especially replacements, without
abandoning the tolerable standard. In the case of congestion,
marginal money costs are rising and highway prices might be adjusted upward. That increment of traffic which creates the intolerable condition may be related to that increment of cost required to return the road to a tolerable condition. This is the marginal money cost of added capacity, and rates may be adjusted to this level. Thus, the rates of a continually expanding highway system would be determined by dividing the current cost of adding capacity by the increment of traffic which brings about the need for added capacity. Marginal costs determined in this manner may be above or below the program cost or rate, depending on whether the highway authority is confronted with increasing or decreasing costs. It is possible that pursuit of this rate-making policy would result in losses for the entire operation because the costs of added capacity (marginal costs) might fall below the average cost of the entire operation (program cost).

Thus, marginal money costs can be determined by relating that increment of traffic which brings about an intolerable situation to that increment of cost required to re-establish a tolerable condition. Pricing on this basis conforms perfectly to the marginal cost standard and is desirable if reasonably accurate calculations can be made by highway engineers. If the congestion cannot be removed immediately, it may be desirable to raise rates until the quantity of traffic becomes consistent with a tolerable highway condition. In this event, the marginal money costs may
represent a lower limit while value-of-service to the increment of traffic bringing about intolerable conditions may represent an upper limit.

If it is possible to associate an increment of traffic with the increment of cost required to maintain tolerable conditions, the program cost standard may be abandoned in favor of a more sophisticated marginal cost standard. In this connection it should be noted that program cost is the cost of maintaining a tolerable standard and does reflect the marginal cost described above. The practical difficulty to a true marginal cost standard has to do with the problem of relating that increment of program cost to the increment of traffic which brings about the intolerable condition. These increments probably could not be determined except on a very large block basis which would come close to program cost. The traffic increment would be this year's block of traffic; the cost increment would be this year's costs (annual program cost). Thus, a practical attempt to apply the marginal cost standard probably would lead to program cost. If engineers can make the estimates required for a more rigorous marginal cost calculation, program cost may be replaced by the more refined alternative. All things considered, it is felt that program cost is an adequate standard if the excess supply or excess demand is of a temporary nature. Surpluses and losses on particular roads will
continue to accrue until adjustment is established. However, these conclusions do not hold for situations characterized by permanent indivisibilities and peak loads.

**Permanent Indivisibilities**

It is reasonable to suppose that Brownlee and Heller restricted their analysis to so-called "trunk" highways because of the permanent indivisibilities which exist on secondary roads and because of the administrative problem of collecting higher than average prices for the use of such roads. In a subsequent section it is shown that much of the current conflict in highway financial analysis revolves around the question of secondary roads.

Secondary roads cannot "earn" enough user revenue for their support. This problem has already been described as an administrative problem imposed by the need for uniform user rates. However, there is a marginal cost basis for operating secondary roads at a "loss." Secondary roads may have permanent excess capacity because they cannot be constructed on a small enough scale. Thus, there are decreasing costs, and marginal cost pricing requires that rates be maintained at the low marginal cost level under such conditions. However, the marginal cost argument is not especially strong because the demand for secondary roads probably is inelastic and, therefore, the excess capacity cannot be removed through increases in traffic brought about by low rates.

Nevertheless, a formal adherence to price theory requires low rates in the presence of such permanent indivisibilities.
This policy would lead to losses due to marginal cost pricing. The problems raised by such losses were described in Chapter V. The solution is a system of lump sum taxes not to exceed the value-of-service or consumer surplus to the user of the secondary road. This implies that roads having decreasing costs might be financed through use of the two-part tariff. A low user charge based on marginal cost might be combined with a fixed charge or lump sum tax to cover overheads. The gasoline tax is an appropriate candidate for the marginal rate while license taxes, driver's license fees, property taxes on automobiles, special assessments against those abutting property owners who use the road and many others appear to be candidates for the lump sum charge. It is felt that automobile license taxes and drivers' license fees are best suited for this purpose because their purchase is voluntary; moreover, these taxes probably have little impact on use. Thus, we may be sure that the payment does not exceed consumers surplus and that the facility is being utilized as efficiently as possible. Of course, this does not preclude the use of any other lump sum tax provided it is paid by the user and does not exceed consumers surplus. The implications of these conclusions to the highway financial structure will be described at a later point.

[34] Supra, p. 132-33.
Peak Loads

Peak loads represent a special problem involving the phenomenon of time jointness. The provision of capacity for the rush hour also provides capacity for the off hour in fixed proportions. Primary highways on the Interstate System are designed for the thirtieth highest hourly volume expected during the year.35 This design criterion means that holiday travel determines the standards of American highways and that the motorist pays a holiday price throughout the year.

Pricing procedures appropriate to peak load situations have been described in connection with public utility rate-making.36 Moreover, the Buchanan peak load proposal has been described and evaluated. It is unnecessary to retrace the work already done. However, a few comments are in order.

Elimination of peak loads does not involve conceptual problems that have not been described by others, but application to highways does involve significant administrative problems. Although there may be opportunities for peak load pricing that ought to be examined by highway administrators, it is likely that the problem is solved as well as it can be by the "built-in" adjust-

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35 American Association of State Highway Officials, op. cit., p. 28.

ment. Motorists do not drive headlong into congestion unless their demand is highly inelastic; if possible, they tend to arrange their affairs in order to avoid the traffic. Reasonable rate differentials probably would have little impact on the peak load problem, although other solutions of a more general nature are possible, e.g., subsidized transit systems.

The peak load problem on highway facilities is an aspect of a peak load society. Suppose, for example, that some slept while others worked, that meals were served continuously, that factories operated on two or three shifts, and that some played golf on Tuesday morning or went to church on Saturday night. The saving in capital is enough to stagger the imagination and probably overshadows by far the advantages of mass production during the peak load period. Since the peak load problem pervades every aspect of contemporary society, any attempt to completely eliminate peak load on highway facilities is completely visionary. The decision to design roads for the thirtieth highest hourly volume that occurs during the year implies that the American motorist is willing to pay holiday rates throughout the year. In reaching this rather dismal conclusion relative to the peak load problem, it is not implied that peak load pricing should be abandoned. In some instances, appropriate peak load price policy might result in a more effective utilization of the highway system.
Issues Raised by the Pricing Proposal

It appears that the failure to consider the short run problem is not a crucial shortcoming of the Brownlee-Heller proposal except for the case of secondary roads. Moreover, there is no difficulty in adding short run and peak load elements to the price structure suggested by Brownlee and Heller. Basically, the preceding discussion provides the theoretical underpinnings for the Brownlee-Heller proposal.

Since the proposal is a more elegant statement of procedures that are widely accepted in the allocation of costs among vehicle classes, the discussants who commented on the Brownlee-Heller paper voiced no serious objections to the pricing model. Thus, William D. Ross felt that the "Brownlee-Heller paper recommends the incremental cost approach without referring to it by name."37

There were strong objections, however, from the more ardent advocates of the benefits-received approach who maintained that Brownlee and Heller had abstracted the most difficult part of the problem — secondary and tertiary roads. Although the reasons are diverse and sometimes not clear, there is general agreement among most authorities that primary roads should be financed primarily through user charges. There is also agreement (among

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37 Ross in Brownlee and Heller, op. cit., p. 258. The North Dakota, Louisiana and Kentucky studies cited in the Appendix rely on an incremental cost analysis.
impartial observers) that the incremental cost analysis is a sound method for the determination of user tax rates. Since Brownlee and Heller confined their analysis to primary roads and suggested that these roads should be financed by user charges reflecting incremental costs, no new issues were raised nor were any old issues resolved. The discussion revolved around the related questions of indirect benefits and the financing of secondary roads. These controversial aspects of the problem are discussed briefly in the following sections.

**Indirect Benefits**

Brownlee and Heller imply that the benefits-received analysis is inappropriate. Their point of view on this matter is summarized in the following illuminating paragraph.

Most attention has been focused on the alleged benefits of highways to persons who do not use them. It has been argued that because better highways reduce the prices that consumers pay for certain goods and also reduce the costs to the military for providing a given level of national defense, a portion of highway costs should be borne by persons not directly

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38 The motor carrier industry has developed the "cost-function" method of highway cost allocation. This method is closely related to the incremental cost method although it leaves room for many arbitrary assumptions. Cf. *Study of Motor Vehicle Taxation in North Dakota* (Bismarck, North Dakota: North Dakota Motor Carriers Association, 1952).

In this connection, it is interesting to note that public officials as well as motor carrier groups are agreed that the "gross ton-mile" method is inadequate. It came as a surprise to some (including this writer) that the incremental cost analysis resulted in rates more favorable to commercial trucks than the gross ton-mile method. Conference with Charles Lockyer, Bureau of Business Research, University of Kentucky, Lexington, Kentucky, June, 1957.
using the highways. That highways may cut transportation costs undoubtedly is true; but this truth does not warrant special taxes for highway purposes levied against persons who do not use the highways. Insofar as truckers pay for using the highways, those persons not directly using the highways can help pay highway costs indirectly through the price system. If appropriate charges for highway use were levied against the military, nonusers would also pay indirectly for the highways from general tax funds spent by the military for highway services. The alleged benefits of highways to those who do not use them directly are primarily illusions arising from failure to charge highway users appropriately for the services provided by the highway system. 39

Brownlee and Heller imply a broader interpretation of the benefits-received approach than seems appropriate. With the exception of some early and now out-moded attempts to allocate highway costs on the basis of savings in transportation costs, impartial advocates of the benefits-received approach do not hold that such savings should play a role in the allocation of highway costs. 40 The reasoning that consumers pay reduced prices and, therefore, should share highway costs is cited only by special interest groups. 41 Although proponents of the benefits approach do

39 Brownlee and Heller, op. cit., p. 236.

40 Pioneering studies in Oregon represent the first and only significant attempt to allocate highway costs on the basis of time and cost savings and price reductions. John Beakey and C. B. McCullough, The Economics of Highway Planning, A Report for the Oregon State Highway Department (Salem, Oregon, 1937). Although measurements of time and cost savings may be an inadequate basis for cost allocations, they are significant from the point of view of planning new facilities.

not go this far, it is also fair to conclude that no one really knows how far they do go.

The view that governmental users can pay the same rates as any other user is a distinct improvement over the benefits-received approach which appears to assume that governmental uses impose costs of a different nature than those imposed by other uses. There is no doubt that government use plays an important role in the justification for a user-nonuser allocation of costs. However, it is not the only justification. Brownlee and Heller apparently feel that the whole question of collective demand and the nonuser share is resolved by recognizing that governmental users should pay the same rates as other users. But the question is not so easily cleared away. There are still external economies associated with use which may justify a subsidy to the user. Suppose that downtown merchants, real estate developers or others, including the government (which by and large is the coordinating authority providing for the satisfaction of such demands), are anxious to bring about an increase in traffic. Brownlee and Heller do not dispose of such situations except, perhaps, by assuming that they do not exist. Thus, one critic pointed out that highway policy must recognize "the obvious influence of highway programs on the development of new industrial and residential centers."\(^{42}\) In a somewhat vaguer context, Groves maintained that

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\(^{42}\) Soloway in Brownlee and Heller, *op. cit.*, p. 260.
We use taxation rather than direct charges precisely because indirect benefits are important in this area; highways have sometimes been thought of as exceptions because they afford a large measure of direct benefit . . . . But we cannot get away from indirect benefits — hence taxes — even here.43

Although Brownlee and Heller recognize the existence of the indirect costs associated with traffic congestion they do not mention the possibility of indirect benefits (external economies of consumption). It hardly seems appropriate to consider social costs without providing a frame of reference for social benefit. Highway policy "must be concerned with some important aspects of social costs and social benefits which are not reflected in the market place if we are to have some useful concept of an optimum."44 External economies may not be of great importance in the total highway picture, but the analytical machinery proposed by Brownlee and Heller eliminates factors which appear to weigh

43 Groves in Brownlee and Heller, op. cit., p. 252.
44 Soloway in Brownlee and Heller, op. cit., p. 252.
heavily in the minds of most students of highway finance. In this writer's view, Brownlee and Heller are on stronger ground than their critics with regard to the actual existence or importance of external economies, but it is also felt that a place must be found for them in a comprehensive highway financial plan. The Brownlee-Heller approach does not dispose of the most valid argument for a nonuser contribution. A satisfactory highway policy cannot be based on a cavalier dismissal of indirect benefits.

Secondary Roads

A more severe limitation of the Brownlee-Heller proposal is the decision to restrict the proposal to primary roads. It is the cost of secondary roads which advocates of the benefits-re-

45 However, James C. Nelson appears to be in general accord with Brownlee and Heller. He cites with disapproval the fact that "many engineers and some economists are still immersed in studies seeking to segregate the benefits that are accorded by highways to highway users (direct benefits) and those that are accorded to nonusers (indirect benefits). The corollary they try to establish is that some considerable part of the demand for highway service is by nonusers who should therefore pay a corresponding portion of aggregate costs, even in the case of principal highways." Nelson goes on to say that the situation would be much more satisfactory "if the ordinary rules of private markets were observed." Nelson in Brownlee and Heller, op. cit., pp. 253-54.

46 The strength of this argument depends on the extent of external economies. One writer who is not especially associated with either school writes that "benefits derived from highway development are not to any significant degree something apart from the user of highways by motor vehicles . . ." Wilfred Owen, Auto-

ceived analysis insist on allocating between users and nonusers.

Groves, the most outspoken critic of the pricing proposal, implies that the writers have avoided the important issues:

My reservations are related to the fact, that the authors have abstracted from or simplified out of or ignored a very large part of our problem. The analysis abstracts from the problem of "access" roads and ignores the fact that a very large part of the highway system is and apparently must be operated at a profit or loss so to speak.47

The implication of this criticism is that "losses" on secondary roads must be covered by nonuser or general tax contributions. None of the participants recognized that the use of general taxes does not necessarily imply the existence of general or indirect benefits. One of the participants felt that Brownlee and Heller simply abstracted the user-nonuser question out of the analysis.

Confining the paper to what is referred to as the "trunk highway problem" does not eliminate the authors the first fundamental difficulty encountered in any practical effort to develop an economically sound highway financial plan for the support of highway improvements. I refer to the problem of allocating total highway costs between highway users and the general public. The highway user cannot theoretically or practically be assessed the full cost of low traffic volume connecting highways. Some of the benefits are realized in forms other than the direct use of these roads.48

47 Groves in Brownlee and Heller, op. cit., p. 251.

48 Ross in Brownlee and Heller, op. cit., p. 257. Ross does not elaborate on the reasons which make the user-nonuser allocation necessary.
Brownlee and Heller have nothing to say about this problem. It appears, then, that there are still two important issues that must be resolved before an economically efficient system of highway finance can be established. The first relates to the treatment of external economies while the second relates to the problem of financing secondary roads. Both issues are bound up in the user-nonuser allocation of highway costs. The advocates of the pricing approach have brought their analysis a long way from the original commercial concept but have failed to replace the benefits-received method primarily because of the failure to provide a general solution. "A solution must be found for all systems."49 The discussion surrounding the Brownlee-Heller proposal brings the issues to the fore. It is appropriate now to evaluate the issues and to develop the framework of a comprehensive solution which conforms to standards of economic efficiency.

49 Ibid.
CHAPTER VIII

RESOLUTION OF THE ISSUES AND A REVISED
THEORY OF HIGHWAY FINANCE

The preceding discussion brings the issues to the fore. Current controversy appears to center around the related problems of indirect benefits and the financing of secondary or low-volume roads. The refinements in the pricing approach that have been suggested can have little significance until these two basic issues are resolved. Once the various elements of the problem are clearly identified and segregated the current controversy may be clarified and, perhaps, resolved. The debate described in the preceding section emphasizes areas of disagreement and may tend to magnify the significance of the current controversy. In order to gain perspective, then, it is appropriate to consider the rather wide area of agreement. This may provide the basis for a resolution of the issues and for a revised theory of highway finance.

It is possible to delineate three related questions concerning which there appears to be general agreement: (1) the quid pro quo, (2) the allocative significance of highway user tax rates and (3) equity. Consideration of these areas of agreement leads to the conclusion that the current conflict must relate either to questions of fact or to the means for the attainment of economic efficiency.
Areas of Agreement

The Quid Pro Quo

The most striking point of agreement among most authorities is that highway finance should be based on some conception of the quid pro quo. To some, the quid pro quo implies a standard of tax equity and the benefit theory of taxation. To others, the quid pro quo implies economic efficiency and a relationship between supply and demand. The difference between a price based on supply and demand and a tax based on the benefit theory of taxation is obviously not very great. A cost-of-service application of the benefit theory of taxation leads to long run cost-oriented prices. This similarity helps to explain the general agreement that highway user tax rates should be predicated on the so-called incremental method for the allocation of highway costs. However, this agreement breaks down when the financing of other than primary or high-volume roads is considered. There is a difference of opinion as to whether the principle of charging the user can or should apply to all roads. Therefore, logically, there may be differences concerning the total level of cost assigned to highway users.

Allocative Significance of Highway User Tax Rates

Those who are concerned with an effective utilization of the existing plant properly suggest that rates should be utilized in order to foster the elimination of peak loads and excess ca-
pacity. Thus, the full cost rates implied by the incremental allocation might be modified in those instances where either higher or lower rates would help to bring about a more efficient distribution of traffic. More effective use of the present plant might lead to a substantial decline in highway costs. No objections have been voiced to these modifications in the price structure provided they can be administered without too much difficulty. Even the most efficiency minded eschew tedious and costly toll, trip-ticket, or reporting devices designed to impose rigorous price discipline at the expense of the "free" public highway. This does not preclude special reporting devices for commercial trucks or a system of limited peak load rates. The toll gate is a particularly costly and undesirable device except in special circumstances. Nevertheless, there is agreement that special prices for travel over particular routes at particular times are desirable if they can be administered without making a fetish of the highway financial structure.

It appears, then, that proponents of both the benefit and pricing approaches recognize the price-like nature of highway user taxes. Although there are varying degrees of emphasis, all parties appear to agree that highway user tax rate differentials are significant to resource allocation in the domestic transportation system, and that such rates should encourage an efficient utilization of the highway plant. Although advocates of the benefits-received approach do not accept the pricing proposals, they
do not deny that highway user taxes have allocative significance. The rejection of the pricing proposals has been based more on the misleading view that pricing principles involve adoption of a narrow market optimum to the exclusion of a social optimum.

**Equity**

Neither approach appears to be predicated on redistributive considerations. This writer has not found a single reference to "ability to pay," the "rich and the poor" or any other indication that interpersonal comparisons or redistributional considerations weigh heavily in the thinking of highway analysts. Nevertheless, the benefits-received approach may lead inadvertently to a redistribution of income or, in terms of the previously existing distribution of income, a misallocation of resources. The practice of extracting payments for any and all benefits that might accrue may serve only to reduce the payments assessed against those who actually impose the costs. One might hazard the cynical and perhaps unfair opinion that the ardent espousal of an extreme form of benefits-received logic by the commercial trucking industry is more closely related to this possibility than to the desire to promote either economic efficiency or equity.

Judging from the work of the more objective advocates of the benefits-received approach and all of the advocates of the pricing approach, it is reasonable to conclude that most authorities do not conceive the highway user tax structure as a means for
redistributing income. A corollary of this conclusion is that there seems to be no objection to the pursuit of a policy aimed at economic efficiency.

**Toward a Resolution of the Issues**

Since there appears to be agreement or at least no explicit objection to a policy aimed at the attainment of economic efficiency, the disagreement must relate either to questions of fact or to the means for the attainment of economic efficiency.

The most important unresolved question of fact relates to external economies. In their rush to apply market standards, the price theorists have failed to recognize the possible existence of valid external economies or collective demand. On the other hand, proponents of the benefits approach insist on considering all sorts of real and alleged benefits, and they make this the basis for a multi-purpose allocation of costs. In the one case not enough is considered, in the other too much is considered. Meanwhile, both groups have allowed administrative considerations to impose conditions on their analysis. Consideration of this conflict inevitably leads in one way or another to the problems posed by secondary roads. One of the chief shortcomings of the Brownlee-Heller approach is the failure to consider this problem. The issues surrounding the financing of secondary roads may be clarified by disentangling the various elements involved in secondary road finance. Much of the confusion or conflict appears to be re-
lated to one or all of the following: (1) the administrative problem, (2) decreasing costs or permanent indivisibilities and (3) external economies.

The Administrative Problem

An allocation of highway costs to nonusers is frequently justified on the ground that secondary roads are operated at a loss. According to the benefits-received approach, this loss arises because secondary roads yield indirect benefits or have a social significance beyond their ability to earn highway user revenue. Thus, indirect benefits are invoked as an argument for a sharing of highway costs between motorists and other groups on the secondary road systems. As a general rule, this allocation is not made for primary roads.

The implication of this logic is that the private demand for such highways does not justify their existence. This may or may not be the case. The only way to determine whether or not this is the case is to erect toll gates at the entrances to secondary roads. Although this cannot be done, one would hardly question the hypothesis that the users of such roads would be willing to pay rates considerably higher than the user charges currently levied against them. Highway user tax earnings on secondary roads are no measure of the ability of such roads to pay their way. In most instances a price for such roads can be calculated. However, the determination of a price or charge represents a different problem than the collection of the price or
charge. For example, the payment may be made in the form of a lump sum charge. A special road assessment or a portion of an individual's property tax devoted to roads in the district for which the tax is collected is not much different than an automobile registration fee, a portion of which is returned to the government which has jurisdiction of the registration. The fact that the property tax is sometimes described as a general fund tax does not necessarily mean that general fund expenditures do not yield discrete benefits to individuals, nor does it imply that the general fund is used for the maximization of some vague conception of social or general welfare which cannot be brought into relation with the price system.

Although there may be valid economic reasons for the operation of secondary roads at a loss, it appears that the bulk of the so-called nonuser share represents a response to an administrative problem. User charges which must be uniform cannot be made to reflect the higher unit costs of secondary roads without at the same time overcharging for the use of primary roads which have lower unit costs. Property taxes, special assessments and other forms of local revenue derived on the basis of a benefit principle are simply a crude means of collecting from the user that portion of his highway bill that cannot be collected in the form of ordinary user charges. External economies or indirect benefits probably represent a small portion, if any, of the so-called nonuser contribution. The bulk of the current nonuser con-
tribution can be thought of as a payment from individuals receiving direct benefits and imposing direct costs. If the nonuser contribution is interpreted in this manner, it appears that much of the difference between the two competing approaches to highway finance is imposed by an administrative problem which has become entangled with the questions of indirect benefit and social value.

**Indivisibilities**

A more valid argument for a subsidized secondary road system is found by adhering to the marginal cost standard. Because of permanent indivisibilities, secondary roads usually operate under conditions of excess capacity and decreasing costs. Primary roads may also be characterized by decreasing costs, but these are of the theoretical long run variety and are not so obvious as those associated with the permanent excess capacity on secondary roads.

Theoretically, rates should be kept at the low marginal cost level. A reasonable approximation might be achieved by maintaining rates high enough to cover such items as snow removal, spring painting and routine pavement maintenance. Although such low rates probably would accomplish very little (because of the inelasticity of demand), they do point the way to the use of the two-part tariff which combines a marginal cost price with some form of lump sum tax which is non-marginal. The lump sum tax is appropriate wherever there is excess capacity associated with the so-called stand-by function of highways.
External Economies

External economies may require that individuals other than users share the financial responsibility for the costs imposed by highway use and development. External economies have economic significance only when failure to consider them would lead to a smaller amount of highway use than is desirable. If such economies were not considered, the highway authority would feel pressures from various nonuser groups to expand or develop this or that road or system of roads. Thus, downtown businessmen, real estate developers, and various other groups including other governmental agencies will make their desires known. Silence on the part of these groups indicates that the benefits they receive from the highway plant are more in the nature of surpluses, rents, and windfalls. The possibility of taxing these surpluses is considered in a subsequent section.

Advocates of the benefits-received method argue that the existence of indirect benefits warrants an allocation of total costs between users and nonusers. This reasoning is obscure since it is not based on a well-defined concept of indirect benefits. Although indirect benefits are inherently difficult to measure and evaluate, earlier discussions indicate that there is a possibility of placing some limitation on policies that might be undertaken in the name of social value or the public interest. Many of the benefits and costs associated with highway use are internal or direct and can be reflected through the market mechanism, for example,
the direct benefit and direct cost associated with the use of the highway by governmental vehicles. Similarly, reductions in marketing and distribution costs and the economies of specialization associated with highway use may be reflected through direct use of the highway plant. Obviously, such uses do not require any different imputation of costs and from the point of view of highway finance do not imply a different system of charges.

The fact that highways play a significant role in economic growth and in providing rising standards of living also may justify a nonuser share. Developmental programs which yield diffuse benefits are not considered in this study or by the advocates of the benefits-received approach. In such instances nonuser support is an essential condition for effective highway development. Clearly, an economically underdeveloped area cannot rely on the demand of highway users to promote highway development. In considering economic development care must be taken not to place the cart before the horse. Although a different situation may have existed historically, current highway development in the United States reflects a response to the demand for highways on the part of motorists. Only the more extreme advocates of the benefits-received approach cite economic growth and development as an argument for the allocation of highway costs to others than motorists. However, there are situations when the development of particular areas or enterprises might require the encouragement of particular streams of traffic. Thus, the growth of shopping centers, real
estate promotions, or relatively underdeveloped sections of a state or even of the nation may call for contributions from groups other than highway users. It may not be easy to draw a line between general economic development or growth and the more specific forms of development which yield benefits for which particular individuals or groups of individuals are willing to pay, i.e., external economies as that term has been used in this study. If, after taking into consideration the external economies with which this study is concerned, the highway plant still seems inadequate, it may be necessary to attempt an evaluation of the more diffuse benefits that might accrue through general highway development. This study is typical of modern welfare economics in that it offers no standards for the evaluation of such developmental advantages.¹

Failure to limit or to define the role of indirect benefits is the chief difficulty with the benefits-received approach. Advocates of the benefits-received approach imply that indirect benefits are of little significance on primary roads where all costs are allocated to users, but are of great significance on

¹ It has been held throughout that excessive preoccupation with the more diffuse and general forms of benefits may lead to a system of highway finance that does not conform to the requirements of economic efficiency. The entire emphasis has been on the development of standards for the limitation of the indirect benefits that may be cited for a particular public policy. The implications of such limitation goes far beyond highway finance and is of especial interest to those concerned with the excesses that are characteristic of "pork barrel" and other programs undertaken in the name of social welfare.
secondary roads where a part of the costs are allocated to non-users. If these indirect benefits were ever defined, it probably would be found that primary roads create indirect values of a similar order and, perhaps, of a greater magnitude. It might even be found that the nonuser share of costs ought to be larger on the primary than on the secondary systems. Such a finding would create havoc with the whole benefits-received approach. It hardly seems appropriate to adopt a market optimum for one set of roads and a social optimum for the other.

Although it appears to be desirable to define and place limits on the benefits which are considered by highway financial policy, it does not follow that highway finance should be adjusted to market standards. Proponents of the pricing approach go to the other extreme and deny either the existence or importance of external economies. Basically, they embrace a market concept of the optimum. This view is unacceptable to advocates of the benefits-received approach who claim that secondary roads yield indirect benefits. A more valid objection already cited is the need for a nonuser share in order to encourage particular streams of traffic. Advocates of pricing are silent on both counts and lose the debate, so to speak, by default.

**Emergency Capacity**

Highway requirements of national defense undoubtedly play a role in the thinking of those who justify a nonuser share in terms of the indirect or social advantages. Brownlee and Heller
have noted that the cost of providing a service for governmental vehicles can be determined and assigned to the particular vehicles in question. This is not a completely satisfactory answer because national defense and other public services may require stand-by capacity in the event of emergency. Stand-by capacity of this sort is quite different from the excess capacity associated with permanent indivisibilities. Stand-by capacity for emergencies contemplates potential use, while excess capacity due to permanent indivisibilities is imposed by the inability to provide a smaller facility.

If national defense, postal service, fire and police protection, or other functions which may be associated with emergencies require a larger capacity than that required by the normal flow of traffic, there will be excess capacity most of the time. Under these conditions, marginal cost prices for ordinary or private use will result in losses. Such losses cannot be defrayed by levies against users without making them pay for a larger facility than they require. Such a solution would not conform to the criterion that no one can be made worse off. Losses associated with the excess capacity imposed by national defense must be covered through the employment of those taxes and tax standards that are appropriate for the financing of defense needs. In practice, this contribution would take on the form of a nonuser contribution. However, it must be noted that the availability of the highway
plant for possible emergency uses does not provide a *prima facie* case for a nonuser share. The whole of industry is available for possible emergency uses. In some instances particular industries may be subsidized or protected so that they may continue to be available for emergencies. Such subsidies are justified only if they are a necessary condition for making such industries available. If highway location and design are not affected by defense, postal or other services which require stand-by capacity, highways should be paid for by those users whose requirements do have an impact on costs. The defense and postal establishments simply enjoy a welcome indirect benefit which does not qualify as an external economy requiring a subsidy to highway users. Many industries, including the railroads and the steel industry, are as vital to the national defense as highways. It seems inappropriate to single out highway users for a national defense subsidy. To cite potential national defense needs as an argument for a subsidy to highway users is sheer sophistry unless it also can be shown that these services require a significantly different allocation of resources than that selected by private users. Again, this is a question of fact which this study does not presume to answer. However, a casual examination indicates that a nonuser share for defense purposes would rest on exceedingly shaky grounds.

In time of war, roads and bridges must withstand the movement of heavy equipment and provide the means for evacuation of our cities. At the time the new Interstate Highway System was
proposed, state highway authorities were asked to list their highway needs and a tentative program was established in terms of these needs. The program was forwarded to the Defense Department for adjustment in the light of defense requirements. No changes were suggested except for certain access roads to military installations and defense plants. The testimony given by Major General Paul F. Yount, Chief of Transportation, United States Army and Defense Department, before the House Subcommittee on Public Works in 1956 is especially revealing. After outlining the needs of the military, General Yount said:

It has been the constant view of the Defense Department that the highway system needs of the national defense should be provided for by integrating the defense needs into the normal civilian highway program . . . .

The trend has been toward heavier weapons. In this connection our objective is to distribute the military vehicle loads on the pavements and bridges so that defense highway requirements are within the requirements for efficient and effective highway transportation to serve our peacetime economy . . . .

The so-called Defense Highway System appears to have been proposed by the commercial trucking industry, not the Department of Defense. The following answer to a question put by Senator Gore during the Senate Hearings is also revealing:

Senator Gore. The suggestion has been made to me, and I believe before the committee, that it might be desirable to have an entirely new system of defense
highways which, in time of emergency, could be completely closed to other traffic but which in peacetime could be available to civilian traffic. What would be the position of the Department of Defense with respect to that?

General Yount. I don't believe there would be justification for that, Mr. Chairman, because it has been our constant opinion through the years that the needs of the Nation and the needs of national defense were essentially the same.3

General Yount's testimony not only provides an illustration of the type of material that must be evaluated in reconstructing collective action and in identifying significant external economies, but casts some doubt on the validity of a defense share of highway costs. Similar conclusions may be in order relative to fire and police protection and for the postal service. It may be reasonable to assume that the minimum requirements for movement and social intercourse have been met many times over, especially in those states whose highway programs reflect the political strength and agility of rural groups. Nevertheless, these are still questions of fact which can be determined by defining minimum social needs and relating these needs to the demands and requirements of private motorists.

A Provisional Conclusion

Once the various elements of the problem are clearly identified, the difference between the two approaches to highway finance reduces to the role assigned to indirect benefits in highway financial policy. It appears that resolution of the issue posed by indirect benefits may be achieved through an application of the standards set forth in detail in the earlier chapters of this study. Conflicting views as to the place of indirect benefits inevitably arise in the consideration of governmental programs which satisfy both private and collective demands at the same time. The problem does not call for a choice between market and public allocations or between the price system and the tax system. The problem relates to the manner and the proportions in which private and collective elements are combined.

Although a conclusion relative to the significance of external economies is not reached in this study, it is quite possible that external economies do not play a significant role in the provision of highway facilities. In this eventuality, the entire highway bill would be paid by the motorist. Though the bulk of authority that has been cited in this study appears to hold a different view, a minority of some stature appears to accept the view that the user should pay the entire highway bill. Included among the minority who have been cited are Peterson, Owen, Brownlee, Heller, Nelson and, of course, the railroad community.

Peterson's conclusion is based largely on an historical interpre-
tation of the changing highway function. Owen's opinion is based on a partial recognition of the administrative problem, and Nelson's appears to derive from a considerable amount of practical experience. The conclusions of Brownlee and Heller relate only to primary highways. It is felt that implementation of the welfare standards suggested in this study probably would substantiate the minority view on the question of indirect benefits or external economies. In this connection, it should be noted that a finding that there are no significant external economies would require only that highways be financed in terms of "direct cost and utility," and that arguments relative to the need for nonuser shares in order to reflect indirect benefits and general social values are superfluous. As a practical matter, it may be impossible to adjust highway user taxes into conformity with a user pay all principle, and toll gates are clearly out of the question. Indeed, the present highway structure relying on user taxes for primary roads and local revenues (supplemented by distributions of user taxes) for secondary roads conforms roughly to a user pay all principle.

Notwithstanding the possibility that a user pay all policy may be indicated, it is important that indirect benefits or external economies receive careful consideration. The discussion emphasizes the importance of considering indirect benefits on the one hand and of limiting their scope on the other. It is felt that the conception of external economies and collective demand
employed in this study satisfies both conditions. An economically efficient system of highway finance should recognize both private and collective demands for highway services. If the demand is private, appropriate rates can be determined through the use of traditional pricing procedures. If the demand is collective, appropriate taxes may be determined through the use of the Voluntary Exchange Theory. The welfare basis of both procedures has been described and the possibilities for application have been assessed.

Perhaps the most significant practical conclusion is that the traditional allocation of costs between users and nonusers is primarily a response to an administrative rather than an economic problem. Such allocations represent a time-consuming and incorrect step in highway financial analysis. To the cost analyst, the only justification for such an allocation must be found in the assumption of jointness or in the existence of significant external economies. The pervasive jointness ordinarily associated with the highway function appears to be an illusion imposed by the administrative problem. External economies may require that a portion of highway costs be borne by groups other than highway users, and in this case a nonuser allocation of costs is appropriate. However, attention is shifted from the identification of the beneficiaries of the highway plant to an identification of those who demand a particular configuration of the resources devoted to highways. Only by emphasizing demands for resources or for particular arrangements of resources can we be sure that the system of highway
finance promotes the attainment of economic efficiency. The burden of the discussion is that the Brownlee-Heller approach can be applied to the entire highway system provided external economies are recognized.

The analytical framework developed in the earlier chapters of this study has been employed throughout in the identification, segregation and evaluation of the various factors impinging on highway financial policy. In addition to illuminating some of the current conflict, the discussion provides the basis for a revised theory of highway finance. In order to complete the application of the analytical framework to highway finance, it is appropriate to set forth the main outlines of a revised theory of highway finance.

A Revised Theory of Highway Finance

The analytical framework suggested in the earlier chapters requires three progressive levels of analysis each of which relies on a particular set of judgments and/or measurements. These levels are: (1) the market allocation, (2) the "neutral" public allocation and (3) equity. Since redistribution appears to play a relatively insignificant role in highway finance, the ensuing discussion is concerned only with the market and the neutral public allocation.

The market left to itself will yield a particular system of prices and a configuration of resources. Relationships in this
area are assessed in terms of the economics of the market place. The specific rule for economic efficiency is marginal cost equal price. Although this rule is subject to a variety of interpretations, the Brownlee-Heller approach supplemented by certain modifications described earlier appears to be the most acceptable implementation of the marginal cost standard.

If there are external economies, a second level of analysis is required. This level is concerned with the measurement and evaluation of indirect benefits. Although all benefits must be assessed in a major investment decision, only those appropriately described as external economies have relevance to highway finance. This is necessarily a vague area involving measurements and judgments which are always open to question. However, some progress can be made by maintaining a close connection between external economies and individual welfare. Moreover, much care must be exercised so that only those benefits which have a significance to the allocation of resources are considered. Although they are extremely important in considerations about equity, benefits in the form of "price-determined" or Ricardian surpluses have no allocative significance. This limitation means that indirect benefits are those which call forth subsidy offers. In terms of highway finance, highway use creates benefits for which groups other than users are willing to pay. This level of analysis determines the extent of subsidy, if any, to highway use. In order to ensure that this part of the analysis does not get too far out of hand,
we may ask the following question: Does the allocation of re-
sources after indirect benefits are considered differ from the
market allocation of resources? If the answer to this question is
negative, there are no external economies which have to be taken
into account in the establishment of the price structure. If, for
example, the plans submitted by the defense establishment, the
school authorities or other groups which have an interest in the
highway system, call for a highway system no different than that
needed to handle passenger and commercial traffic, the market al-
location should rule and the entire cost of the highway facility
is allocated to highway users. In such cases, the indirect bene-
fits associated with the highway system are of the same order as
those associated with a privately owned and operated steel indus-
try. No one would deny the social significance of a thriving
steel industry. The fact that such an industry yields many and
varied benefits does not by any means imply that it needs to be
subsidized by the government or by other individuals who benefit
from its continued operation.

On the other hand, it is possible that external economies
would result in a different configuration of resources than that
provided by the market. Measures must then be taken to adjust the
market allocation so as to attain an allocation which reflects ex-
ternal economies. Conceptually, this may be done by a series of
subsidies from one individual (nonuser) to another (user), but it
is more likely to lead to a public revenue-expenditure program de-
signed to supplement the market allocation. If this program conforms to the Voluntary Exchange Theory, the system of highway finance will conform to the criteria suggested by modern welfare economics and described in an earlier section. If the final result does not conform to generally accepted standards of justice, it may be necessary to embark on a redistributive program which involves judgments not considered in this study.

If equity is put aside, there are two guiding principles for highway finance: (1) in the absence of external economies, marginal cost pricing and (2) in the presence of external economies, the Voluntary Exchange Theory. The possibilities for applying these standards have been investigated and do not require further elaboration at this point. A graphical summary of a revised theory of highway finance is presented in the ensuing section.

Outline of a Revised Theory of Highway Finance

The entire structure may be summarized graphically. In order to simplify the graphical presentation it is assumed that: (1) highway services are provided under conditions of constant cost, (2) there is only one class of vehicle, (3) highway costs vary directly with vehicle miles (an arbitrarily selected unit of measurement) and (4) there is no excess supply or demand. Assumptions 1 and 4 restrict the presentation to a static or long run allocation of all costs. These simplifications bring into relief the most controversial questions facing highway finance: who
should pay and how much? The problem as it is usually posed im-
licitly makes assumptions 1 and 4. The effect of relaxing any
one of these assumptions has been described in preceding discus-
sions. The approach that has been suggested requires a separate
analysis of market and collective allocations (external economies),
and, then, a combination of the two into a system of prices and
price-taxes which will foster the attainment of economic efficien-
cy.

The Market

The market allocation is illustrated in Figure 12. In
Figure 12, the horizontal axis measures vehicle miles traveled be-
tween two points, MC represents the supply price or marginal cost,
and \( D_x \) represents the demand of individual \( X \) for highway use.

If there are no external economies, the charge is \( P \), and
individual \( X \) pays all highway costs. An "as if competitive" prin-
ciple is appropriate. The proper procedure requires an incremen-
tal analysis of highway costs. A highway is designed for traffic
originating at one point and terminating at another. Thus, there
is an ideal location and design form determined by the nature and
volume of the traffic which is to use the highway. Costs or sup-
ply schedules can be derived for this design form. Deviations
from the design form in order to provide for other demands impose
additional costs which may be related to those demands.

Though there are difficult technical problems in applying
this principle, there are no conceptual difficulties which have
not been resolved in earlier parts of the study. Techniques for the calculation and assignment of cost increments are already in a fairly advanced stage of development. A completely satisfactory solution will require further development and refinement of the incremental cost technique. In any event, techniques for reasonable application appear to be available.

Rates established on the incremental cost basis may be varied depending on the existence of excess supply or demand, peak loads, and indivisibilities. General procedures appropriate to such situations have been described. Specific relationships for practical application of the marginal cost standard are described in the following chapter.

Collective Demand (External Economies)

External economies are considered in Figure 13. Here the independent or private demand of X is the same as before, but there is an indirect beneficiary, B, who gains because of X's use of the highway. The demand of B is depicted by $D_b$. Although the nature of $D_b$ is described in detail in Chapter IV, an additional explanation at this point may prove helpful.

Individual B may represent a downtown merchant, real estate promoter or some governmental agency which has an interest in encouraging the use of the highway plant. Let us assume that B is a downtown businessman who has a distinct interest in the promotion of farm to city traffic. The demand, $D_b$, of the downtown businessman is for the same service that individual X (the motor-
SUMMARY OF A REVISED THEORY OF HIGHWAY FINANCE

Figure 12. Private Demand (The User Share)

Figure 13. Collective Demand (The Nonuser Share)

Figure 14. Windfalls (Equity)
ist) demands; namely, X's use of the highway. The businessman does not plan to use the road except to reach X or to have X reach him. Both demands may be measured along the same horizontal axis because both demands are for the same service.

At the prevailing price (P), individual X would take only q units of service. The demand, \( D_b \), of the businessman is such that he is willing to offer a subsidy to X for an additional increment of travel. Following conventions established in Chapter IV, the two demand curves may be summed vertically to yield \( D_c \), the collective demand. The equilibrium amount is Q and the apportionment of costs is indicated by the area \( OQVP_b \) and \( OQWP_a \). The allocation of shares is akin, but not at all identical, to the traditional user-nonuser allocation of costs.  

Actual determination of the subsidy poses significant problems of measurement. The subsidy is determined at the margin and will not be offered unless it brings about a reallocation of resources (increase in traffic). That is, if a subsidy offer

\[ 4 \] It is important to note that the subsidy is a payment for actual or potential use of the highway. Highways are built to be used by motor vehicles and for no other important purpose. This writer sees no function of the highway system other than the creation of place utilities. Whether it be national defense, the desire for adequate postal service or the demand of commercial motor vehicle operators, the aim is the same; namely, actual or potential movement between two points. The collective demand for highways, like the private demand for highways, is a demand for highway use.
would result in no or in negligible change, the subsidy is superfluous and charges for the road are assessed against the users of the road.

It is true that the downtown merchant may benefit from the unsubsidized use. But it does not follow that downtown merchants should (on efficiency grounds) defray part of the costs of the farm to city system. It is almost certain that rents of various sorts will be created. It is important to note the distinction between those indirect benefits which are true external economies and those which are rents or windfalls. Rents or windfalls have no impact on allocative relations and should not be allowed to determine highway financial structures. These surpluses may be reserved for redistributive purposes.

Silence on the part of businessmen is evidence that the indirect benefit is of a surplus character and does not have to be considered in a framework of economic efficiency. If the subsidy is required, businessmen will exert pressure on the legislature or the highway authority to provide expanded facilities. As a general rule, collective action of some sort will be required. The task of the highway analyst is to reconstruct the pressures and the collective action.

The highway financial analyst receives a program from the legislature along with the record of legislative and executive hearings and other evidences of collective action. The program is a result of traffic studies initiated by the highway authority and
the views of various groups which are affected. A careful scruti-
ny of the program and the hearings may indicate the nature of the
external economies which ought to play a role in highway finance.
By inference, the highway analyst can attempt to reconstruct ex-
change relationships involved in the collective action and within
wide limits may be able to determine appropriate payments. Before
him is always the following question: Does this group or individ-
ual receive a benefit which could not be received otherwise? If
so, what is the minimal amount that he would have to pay to bring
about a reorganization that yields this amount of benefit? Thus,
a distinction is maintained between costs and rents or surpluses.
The former have an impact on the highway financial structure; the
latter are referred to those who are concerned with the attainment
of an equitable distribution of income.

The problems are difficult, but not insurmountable. Bluf-
fing is likely to occur. The gains will be denied and the indi-
vidual in the strongest bargaining position may have his way. The
result may be uneconomic or noneconomic. But the poker player
knows that he cannot bluff all the time, that he cannot bluff in
the same manner more than once, and that others may bluff too. It
is not unrealistic to assume that the exchange relationship im-
plicit in collective action can have real meaning to the highway
financial analyst. If these arguments do not suffice, one might
reasonably ask how advocates of the benefits-received approach go
about isolating and measuring benefits. Although perfection may
be impossible, it is felt that the approach suggested is by far superior to the vague and often illusory conception of benefits so frequently brought into current highway financial analysis. At least a few limits have been set and some criteria have been established.

Many external economies are "internalized" through the market mechanism and do not have to be considered. For example, downtown businessmen may provide parking facilities for X when he comes to town. Shopping centers provide policemen and make specific requests for traffic aids aimed at encouraging business. Real estate developers and many others undertake projects on their own or request that specific projects be undertaken. To the extent that such "internalization" occurs, the problems posed by external economies is resolved.

The Combination

Figure 13 also shows the appropriate combination of prices and taxes. The rectangle $OQVP_b$ represents the subsidy to be collected on the basis of the Voluntary Exchange Theory and requires the procedures described in the preceding section. The price, $P_a$, represents the amount to be collected from motor vehicle users in accordance with use of the highway system. User rates are below marginal cost reflecting the correction or subsidy for external economies. Individual X takes $Q$ amount of travel, whereas he would have taken only $q$ if the subsidy were not offered. A combi-
nation of prices and taxes of the sort described in Figure 13 may be envisioned for any governmental program involving both private and collective or public magnitudes.

**Windfalls, Surpluses and Rents**

Figure 14 represents the situation when there are indirect benefits or rents, windfalls and surpluses but no significant external economies. The horizontal summation of $D_x$ and $D_b$ yields the collective demand, $D_c$. At price $P$, both $D_c$ and $D_x$ yield a quantity $Q$. At output $Q$ the marginal rate of substitution of businessmen for additional increments of traffic is zero. An increase in traffic beyond $Q$ does not yield any additional advantages to the indirect beneficiary. As soon as one of the marginal rates of substitution becomes zero, external economies drop out of the resource allocation picture and any further benefits are of a surplus character.

In Figure 14, no subsidy is offered and $X$ pays for the highway. The shaded area represents a windfall or rent which may or may not be extracted depending on equity. This windfall belongs to the family described by Marshall as "pecuniary external economies" and has no significance for economic efficiency. These rents and quasi rents, of course, would provide an excellent source of revenue for redistributive purposes. However, the argument for draining off rents for this purpose applies with equal force to rents of any sort. Indeed, the notion that "like things should be treated alike" along with principles of tax equity such
as "neutrality" or "reasonable classification," imply that rents associated with the highway function should be treated in the same manner as other rents. It appears that a system of highway finance based on standards of economic efficiency has no particular place for such rents, and their inclusion while other rents are excluded may not even conform to common standards of justice.

On administrative and opportunistic grounds, the case for the extraction of such rents is much stronger. They are usually easier to measure than other rents and do represent an opportunity to pluck the goose which is likely to squawk least. For example, the uncapitalized unearned increments associated with a new highway program are easy to measure and in this writer's opinion represent an excellent source of tax revenue. This opinion is based on opportunistic and administrative grounds coupled with a notion about justice. However, such opportunistic taxation should not be related to the highway tax structure which, it appears, can conform to economic efficiency.

To avoid misunderstanding, it is necessary to repeat a qualification that has already been made. If, in anticipation of an increase in rents, individuals or firms seek to affect the allocation of resources, say, through re-routing of a road, costs are clearly assignable and the situation is taken into account by the incremental analysis. However, the values accruing to busi-
nessmen because of the re-routing are created at a cost and can hardly be described as rents. Even here, it is a calculation of cost not rent that determines the charge.

These, then, are the main outlines of a revised theory of highway finance. With the establishment of general applied principles, the task of the economist is complete. Administrators must assess the possibilities and determine the means for implementation of these principles. However, to leave the administrator with general principles and no suggestions would be unfair. It is appropriate now to attempt some speculations relative to the impact of the revised theory on highway analysis, administration and policy. The subject matter of the following chapter is operating principles and working hypotheses. Consideration of these principles and hypotheses leads to a new frame of reference for the application of the revised theory of highway finance.
One of the important conclusions of this study is that the initial allocation of costs between users and nonusers is a time-consuming and incorrect step in highway financial analysis. The nonuser share is primarily a reflection of the administrative problem created by the need for uniform user charges for highways having widely varying unit costs.

External economies warrant a joint apportionment of costs between users and nonusers, but this apportionment must follow, not precede, the allocation of costs to users and among classes of users. Premature application of value-of-service principles may distort the highway user tax structure by allocating a portion of the directly assignable highway user costs to nonusers. This is a significant conclusion from the point of view of technical highway analysis because it eliminates entirely the initial arbitrary procedure with which most analyses begin. It is suggested that direct cost assignment to users ought to be the first, not the second, step in highway financial analysis. At a later point, external economies may be taken into account by breaking down the unit cost of serving the user into a "price" to be paid by the user and
and a "price-tax" to be paid by the indirect beneficiary. If the price for highway use cannot be collected through a system of easily administered charges, it may be necessary to employ other than highway user taxes for collection purposes. However, in a subsequent section it is held that the use of other sources for this purpose is not necessary.

The basic element in the highway tax structure is a system of marginal cost prices. Considerable attention already has been devoted to the question of marginal cost pricing for highways. But not enough has been done in the way of placing the marginal cost principle within the grasp of those who are responsible for the establishment of a practical system of highway finance. This chapter attempts to develop a workable marginal cost framework for the financing of highways. Establishment of this framework requires the integration of economic theory, highway design, highway cost, highway finance and highway administration. This is a large order, and to this writer's knowledge the ensuing discussion represents the first attempt to provide a solution in which design, cost, financial and administrative relationships are integrated with one another and with economic theory. To be sure, the solution is based on some tenuous relationships but no claims are made that cannot be tested empirically.
Working Relationships Required by the Revised Theory of Highway Finance

It has been suggested that a highway user tax structure consistent with the marginal cost standard might be based on an allocation of program cost. Let us assume that program cost is not affected by a backlog of highway needs or by public works programs designed to provide employment. In any event, adjustments for these factors may be made. Basically, program cost is the cost of satisfying current and anticipated demands. A series of program costs can be related to a series of demands which present themselves over time. It is possible to envision a series of optimal highway plants emerging into the future. Temporary congestion and excess capacity are eliminated by a "built-in" adjustment described earlier. If such conditions persist for any length of time, they will have an impact on program cost and will lead either to higher or lower rates until the plant is adjusted. Permanent excess capacity and congestion require modification of the initial rate structure. The chief modification is for secondary roads which have high average program costs but low marginal costs. This situation exists because the minimum design form for withstanding the weather and for the provision of minimal service imposes a huge indivisibility which creates excess capacity. Our pricing criterion requires that rates for such roads be maintained at the low marginal cost level and that the program cost standard be abandoned. Similar adjustments for congestion and peak loads
may be made. After all adjustments have been made, the price structure may deviate considerably from the initial allocation of program costs.

A discussion of the economic significance of the incremental cost approach has been avoided deliberately. Basically, the incremental cost method involves a direct assignment of special costs along with an apportionment of common costs. To have empirical validity, these cost assignments usually are based on engineering design criteria. Although it is true that economic problems and engineering problems are different, it is also true that they are closely related. The physical limits with which engineers deal are also limits to applied economic analysis. We must begin, then, with the establishment of basic physical relationships. These relationships are embodied in highway design criteria. Design criteria may then be converted into physical cost relationships, and these in turn may be converted into economic cost-price relationships. Finally, cost-price relationships must be combined with administrative relationships in order to provide a complete solution. The problem is largely one of arranging various categories into a single, comprehensive framework that integrates the factors impinging on the highway program. The relationships that shall be considered fall into three classes:

1. Design-Cost Relationships (physical conditions of supply),
2. Cost-Price Relationships (marginal cost prices),
Design-Cost Relationships

Highways are three dimensional — they have length, width, and thickness. The horizontal dimensions require geometrical design and the vertical dimensions require structural design. All variations in highway cost due to variations in either traffic volume or to the size, weight and performance of vehicles can be related either to structural or geometric design. Geometric design deals with the visible dimensions of a highway — length, width, curvature, gradient and alinement. Structural design refers to pavement characteristics — surface, base and subbase. Fundamentally, the geometric design of a highway is a function of volume of traffic and dimensions of vehicles. Assuming given soil

and weather conditions, structural design is a function of the axle load of vehicles and the number of repetitions of the axle load (volume of traffic).

Volume or capacity relationships for the geometric design have been established. These relationships are not so "lumpy" as one would suppose. When a two lane highway becomes congested, the jump to a four lane highway is not inevitable. The two lanes may be widened, grades and curvature may be reduced and many other elements of geometric design may be varied in an attempt to adjust the design to the traffic. With the exception of very low-volume facilities, optimum geometric design is quite feasible. However, optimum utilization of a given design is another matter.

Volume or capacity relationships for structural design or pavement thickness are not known. The structural or weight-related design, for example, may be affected by the number of repetitions of a particular axle load, i.e., volume of traffic. The only volume relationship that is known for the structural design relates to an "infinite" (indefinite) number of repetitions of a

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2 These relationships are described in The Highway Capacity Manual.

3 The Maryland and other road tests have examined the relative effect of controlled axleloads on pavement performance. These tests are discussed in The First Progress Report, p. 69.
particular axle load. Present practice stems from empirical relationships determined through field tests and trial and error experience. One of the chief difficulties in structural design relates to the evaluation of soils. Since soils are not so important when the pavement is constructed of rigid materials, like concrete, the structural design of rigid or concrete pavements has been reduced to something approaching mathematical precision. In flexible or bituminous pavements, the stress is transmitted through the pavement to the subbase; in rigid pavements the stress is dissipated on the concrete surface. The stress resisting characteristics of soil or subbase (which are variable from one mile to another) are more difficult to evaluate than those of a rigid con-

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4 However, "repetitional loading has become a factor in pavement design in recent years . . . ." Baker and Karrer, op. cit., p. 22.

Repetitional loading criteria are not well enough developed for use in the incremental analysis. "Total cost estimates for low-traffic roads can be obtained by the use of traffic-volume [geometric] design criteria, although cost versus load [structural] data are not directly available." Ibid., p. 57.

5 Professors Baker and Karrer have developed the following relationship which applies to rigid pavements: \( P = C W^s \), where \( P \) is the additional pavement cost incurred for a design weight of \( W \), \( C \) is the pavement cost for 1-ton axle design, and \( s \) is a constant. Thus, increments of structural cost are assignable to various axle loads by comparing the actual cost of construction to the cost of 1-ton axle design. However, it should be noted that a specific axle load is included in design only when that load is expected to appear with sufficient frequency to warrant infinite structural design. On the basis of this formula incremental costs cannot be assigned on the basis of "limited" repetitions of a particular axle load. Ibid., p. 58.
crete slab. It appears, then, that the analysis of the weight-related costs of flexible pavements will never be as precise as for rigid pavements.

In view of these problems, different methods and a considerable amount of judgment are required in order to isolate weight-related costs for a highway system having both rigid and flexible pavements. We shall see at a later point that the marginal cost pricing standard adopted in this study has some relevance to this allocation problem.

Primary or high-volume roads are designed so that weight costs can be isolated. Many of these highways are of Portland Cement construction, and those that are bituminous are of a rigid enough quality to allow the calculation of incremental weight costs. Most secondary roads have flexible pavements whose costs are much more difficult to assign. These low-volume highways which usually are bituminous are designed either to withstand the elements for a given number of years or to withstand infinite volumes of light traffic. Thus, the minimum structure of secondary roads is determined either by the elements or the minimum axle load which appears with a sufficient frequency to affect design standards. Secondary or low-volume roads are capable of handling mixed traffic in proportions that have not been determined. In Ohio, secondary roads are constructed for an infinite number of light vehicles and an unspecified but "limited" number of heavy
Thus, heavy vehicles on secondary roads do not impose weight costs provided they appear in "limited" numbers. It might be held that heavy vehicles cause more pavement deflection and, therefore, contribute more to the destruction of the road. However, pavement deflection is difficult to measure. Moreover, it is also possible that pavement deflection is not significant until it is repeated a certain number of times and finally reaches a critical point. In view of these considerations and the design practices that are now in use, it is reasonable to conclude that "limited" numbers of vehicles on secondary roads do not impose additional structural costs. If truckers do not violate weight laws and appear in small enough numbers the structure is not affected. The relevant limit is geometric, not structural.

It should be noted that this brief discussion of the elements of highway design is concerned with two extreme design standards — high-volume and low-volume. There are many roads of an "in-between" character. Design for such roads is based on a consideration or compromise of the design standards discussed above.

6 Conference with Mr. D. F. Pancoast, Ohio Department of Highways, Columbus, Ohio, June, 1957.

7 This means that engineers do not know at what point a given axle-load ought to be taken into account. When the heavier traffic exceeds "limited" numbers, an immediate jump is made to infinite structural design. The actual volume at which the increase in design standards is made will depend on the experience with particular roads in particular localities.
Similarly, cost allocations for medium-volume roads must be based on cost estimates derived from the known relationships that have been pointed out. In order to simplify the discussion, this chapter is limited to a system of highway finance composed of high and low volume roads designed in accordance with the standards described. These are referred to henceforth as the primary and secondary or state and local highway systems.

With this background we may establish a series of working relationships. The relationships are of two sorts — geometric and structural. It is around these relationships that a revised system of highway finance shall be constructed. The relationships described below are deduced from the criteria for highway design.

A. Geometric Relationships

1. Geometric design considers only horizontal or visible dimensions. These dimensions include width, length, curvature, gradient and alinement. The product of length and width is space. Curvature, gradient and alinement are considered by design only to bring about a more effective utilization of space. Curves and gradients are reduced so that sight distances can be increased and so that high operating speeds can be maintained. The facilitation of passing through curve and grade reduction contributes to higher operating speeds. Higher speeds increase the utilization of the available space. In short, geometric design provides
space as well as the conditions for the effective use of space. To the best of this writer's knowledge this is a new interpretation of geometric design.

2. Geometric design provides space for vehicles and nothing more. Space is available to all vehicles. Therefore, geometric design imposes only common costs, notwithstanding the fact that grade and curvature reduction is associated with heavy vehicles.

3. Changes in geometric design impose marginal costs which do not contain incremental or special costs. Marginal costs are common costs, not special costs.

4. Common or geometric design costs may or may not be significant to highway pricing depending on the amount of space available.
   a. If there is excess capacity, the marginal economic cost of space is below the geometric design cost of providing an additional unit of space.
   b. If there is congestion, the marginal economic cost of space is at least equal to the geometric design cost of providing an additional unit of space.

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The statement is unguarded. Geometric design provides public utility rights-of-way in rural areas and fire stops and openings for light and air in cities. It is assumed that these factors have no impact on highway design.
B. Structural Relationships

1. Structural design considers only vertical dimensions. Structural design is related to the axle-load of vehicles and, theoretically, to the number of times that load is applied.

2. Specific changes in volume of traffic are not considered in the determination of structural design.
   a. The structure of secondary roads is designed to the higher of two standards: (1) to withstand the elements over a given design life or (2) to withstand infinite repetitions of a given axle load.
   b. The structure of primary roads is designed to withstand infinite repetitions of a maximum legal axle load.

3. An additional increment of structure placed on a secondary road provides for infinite numbers of axle loads of the next highest class provided there are no geometric or space limits.
   a. The structure (but not the geometrics) of a secondary road is equivalent to the structure of a primary road designed for the same weight class of traffic. (This is a tautology.)
   b. The first structural increment (but not the geometrics) of a primary road is equivalent (in terms of structural capacity) to the structure of a sec-
ondary road designed for the lowest weight class of traffic. (This is also a tautology.)

4. Structural increments can be assigned to all weight classes below the legal maximum on primary roads. Such increments cannot be assigned on secondary roads where heavy vehicles appear in "limited" numbers.

5. Changes in structural costs are special costs. Structural increments may be added or removed along with the traffic to which they apply without affecting the structural requirements of the remaining traffic.

These relationships provide the basic ingredients in the development of a marginal cost system of highway finance. By relating the system to current highway design, the problem is placed in an empirical or applied setting. Let us turn now to a consideration of the cost-price relationships which emerge from the relationships that have been deduced.

**Cost-Price Relationships**

The starting point in an analysis of cost-price relationships is the segregation of special (structural or weight-related) costs. These special costs in turn become the common costs of the particular classes of traffic to which they apply. After all special costs have been segregated, the residual is the common geometric or space) cost incurred on behalf of all traffic. Once the assignment of structural costs is made, it is possible to deter-
mine the shape of the supply curve by relating changes in common (geometric) costs to changes in traffic volume.

In our simplified highway network, special (structural) costs are incurred only on the primary system. Let us assume that weight-related costs have been segregated in accordance with traditional incremental cost procedures. This study has nothing to contribute to the traditional incremental analysis of structural cost, and questions relating to the selection of alternative structural design forms for different weight classes are deliberately avoided. With the elimination of special costs, the entire highway network which we are considering is designed for a single class of traffic. With regard to structure, both primary and secondary systems are alike; with regard to horizontal geometrics, they are significantly different. The entire highway system is designed either to withstand the elements or to withstand infinite repetitions of the first or lightest vehicle class, say, passenger vehicles. With this structure, the limits which have significance to both design and economic analysis are geometric in nature. These geometric or spatial relationships have a special significance to the marginal cost standard.

The marginal cost basis for the allocation of common or geometric costs in accordance with space-occupancy was described in some detail in Chapter VII. There is a marginal money cost basis for a space-occupancy allocation of costs for roads which are
operating at optimum. An additional increment of traffic volume on a fully utilized road affects the geometric design and, therefore, imposes additional costs which can be measured. Since every vehicle is marginal, marginal costs are a function of the space occupied. A stronger statement may be made: Marginal costs are the costs of additional space. Spatial relationships are ideal for marginal analysis because displacements occur which are the result of the pressure of all units. The elimination of one unit provides space for all the others; the addition of one unit displaces others which may be measured at the margin.

The relationship described above becomes obscure as traffic volume declines and there is excess space. It may be reasonable to suppose that the relationship is continuous over a limited range of volumes near the optimum or "tolerable" standard. To project the relationship to situations where there is much space available requires a shift from a marginal money cost basis to a marginal real cost basis. Thus, any increase in traffic may impose marginal real costs on other traffic even if it does not affect highway design. Any diminution of space, regardless of the amount of space available, may be interpreted as imposing real costs on other vehicles. Pushed to an extreme, this relationship implies that all common costs should be allocated on the basis of

\[9\text{Supra, pp. 221-25.}\]
\[10\text{Supra, p. 221.}\]
space available to vehicles even though the operator has more space available than he requires or wishes to purchase. Marginal real costs on a highway with very much excess capacity are either very low or a complete illusion. On the other hand, this interpretation can apply to highways which have some excess capacity.

The real cost interpretation cannot be held where space is so abundant as to be "free" in the economic sense although it can be held where the space is "limited" but not "scarce." Since such distinctions are difficult to maintain, the ensuing discussion adopts the money cost interpretation of the marginal cost standard. The real cost interpretation has especial relevance to middle-volume roads which are not considered in this study. If secondary roads are assumed to have significant excess capacity and the primary roads are assumed to be operating optimally or with some congestion, the marginal money cost interpretation is appropriate. These assumptions and the money cost interpretation are adopted.

The money cost interpretation leads to an allocation of all common (geometric) costs of primary roads to vehicles on the basis of relative space occupied. The addition of an increment of traffic brings about a change in geometric design which can be converted into a cost. It must be remembered that geometric design includes much more than width. Of especial importance to optimal small adjustments are grade, curvature and alinement.
The marginal money cost of secondary roads which have permanent excess capacity raises a difficult problem. Hotelling's interpretation, described, earlier, leads to a zero marginal cost. Other interpretations would lead to average variable cost. A careful examination of applied marginal cost proposals reveals that the so-called two-part tariff turns out to include a variable charge based on operating expenses and a fixed charge based on overhead.\textsuperscript{11} Average variable or maintenance expense is not a marginal cost. But this seems to be the only interpretation of marginal cost that can be applied realistically in excess capacity situations. A more satisfactory term for this concept is average "out-of-pocket" cost. All serious attempts at realistic applications rely on the out-of-pocket concept.\textsuperscript{12} This is not acceptable under increasing cost situations, but it probably comes close when there is obvious permanent excess capacity. In any event, this standard is adopted without further defense. We now have two crude, but workable, marginal cost standards for two types of road. These are summarized below.

1. Unit program cost on the primary system represents an approximation to primary road marginal cost. The general conformance of primary system program cost to the marginal

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\textsuperscript{11} Supra, pp. 132-35.

\textsuperscript{12} Supra, p. 132.
cost standard was described in an earlier discussion.\footnote{Supra, pp. 214-220.}

It may be possible to derive a more sophisticated measure of primary road marginal cost by relating the cost of added capacity to the added increment of traffic. Since engineers who develop programs employ the added capacity classification, this is a distinct possibility. Nevertheless, the difference between unit program cost and marginal cost on the primary system may not be very great. It is assumed that unit program cost on the primary system is a reasonable measure of marginal cost for applied purposes.

2. Average maintenance cost on the secondary system represents an approximation to secondary road marginal cost. Average maintenance cost will be considerably below average program cost and losses will be incurred on the secondary system.

The two standards suggested above determine two extreme points on the traditional marginal cost curve. With their customary hardihood, highway financial analysts can "fill-in" the middle-volume portion of the curve employing a combination of the marginal money and marginal real cost interpretations. Meanwhile, the discussion is based on the extremes. It is possible now to summarize the more important relationships which shall be carried forward. The new relationships are:
A. Design-Cost Relationships

1. Special or structural cost can be segregated. The remainder is common (geometric or space) cost applicable to all traffic.

2. Common (geometric or space) cost relationships determine the shape of the supply function for the first weight increment of traffic.

3. The structure (but not the geometry) of the secondary system is equivalent to the structure of the first increment of the primary system.

B. Cost-Price Relationships

1. Marginal cost varies with space-occupance.
   a. On primary roads, marginal cost is the money cost of providing additional space. Unit program cost is a reasonable approximation for applied purposes.
   b. On secondary roads having significant excess capacity, marginal cost is the money cost of maintaining space (keeping the road open). The lump of cost required to keep the road open may be related to the lump of traffic that uses the road. Average maintenance cost is a reasonable approximation of marginal cost for applied purposes provided there is excess capacity.
The Role of Space-Occupance

It appears that space-occupance is the appropriate basis for the allocation of common costs. A space-occupance allocation presupposes the level of cost to be allocated. This level may be determined on the basis of the two crude marginal cost principles, average program cost and average maintenance cost. More refined measures are available especially when capacity must be added. In any event, both the level and the allocation of common costs conform to reasonable interpretations of the marginal cost standard.

Troxel appears to be the only writer to have suggested the use of space-occupance for the allocation of common costs. However, Troxel does not recognize the marginal cost basis of the argument, nor does he pursue its implications to highway financial analysis. Troxel also fails to recognize the significance of geometric design to highway cost allocation. Horizontal geometry is the basis for space-occupance. Others also are aware of space-occupance per se. Indeed, there is much research on the subject. However, the concept has not been integrated into highway cost analysis. It has been abandoned in favor of more complex tech-

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15 The Highway Capacity Manual is concerned specifically with space-occupance. A wealth of data on the subject are accumulated in this highway engineering classic.
niques which appeal to "common-sense" and which may, after all is said and done, lead to perfectly satisfactory results. However, economic theory and our welfare criteria dictate a different course.

Let us consider briefly the reasons for the abandonment of space-occupance and, then, turn to the alternative that is currently employed. Failure to adopt space-occupance as a conceptual tool appears to be related to a proposal advanced by Mr. Leland James of Consolidated Freightways, admittedly a spokesman for the commercial trucking industry. The rejection of Mr. James's proposal by impartial observers is an example of how a good idea can be lost because it has acquired a bad reputation. Mr. James suggested that all highway costs (geometric as well as structural) be allocated on the basis of space-occupance. According to James:

Strength standards (thickness of surface, base, structures and drainage) are determined by factors not related to the use made of the highway, i.e., the needs of national defense and resistance to the action of the elements.

Thus, the space-occupance concept was presented as an alternative to the incremental allocation of special costs. The ad-


17Ibid., p. 110.
ditional structure required by heavy vehicles, according to James's proposal, would be allocated to passenger vehicles as well as heavy trucks. Highway analysts still consider space-occupance as an alternative to the incremental cost solution currently employed. Thus, a recent study in Kentucky listed seven methods for the allocation of costs among users. Space-occupance, gross ton mile and incremental cost methods were included in this list. Gross ton mile and incremental cost were selected and two solutions were finally calculated. Space-occupance was rejected without discussion. Another writer associated with the work in Kentucky writes as follows:

Since the space-time theory neither reflects all of the factors under a cost occasioned study nor accurately measures value of service, it is not recommended that this theory be heavily relied upon in motor vehicle tax analysis.

The general attitude toward space-occupance appears to stem directly from the rejection of James's proposal by the Bureau of Public Roads. In its discussion, the Bureau does little more than criticize James's calculations:

It is evident that, if the space-time theory were to be employed in a motor vehicle tax study, much larger factors than those indicated in the

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discussion by Mr. James would have to be used to account for the actual space-occupancy of commercial vehicles. Very few students of the subject would dismiss all other weight-function costs from consideration on the ground that military needs and the action of the elements set the standards. . . . Nor can space occupancy or "space time" be successfully held to be a measure of value of service.

For the reasons stated, the use of the space-time theory in motor vehicle tax analysis is not recommended.20

The reader should note that difficulties in calculation are not cited in the rejection of space-occupance. Serious highway cost allocations today attempt to isolate special costs and to allocate common costs on the basis of axle-miles. The axle-mile measure probably is related very closely to space-occupance and these allocations may conform to the marginal cost criterion. However, current attempts are not based on a rigorous definition of common cost and special cost. Axle-miles are viewed simply as a means for allocating those costs that cannot be associated directly with a particular class of traffic. As a result of this failure to define common and special costs, the Bureau of Public Roads appears to have embarked on a procedure which requires highly complex allocations of common costs.

It appears that the Bureau hopes to "determine the added costs in connection with geometric design which are directly

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There are many fine points of theory involved in the distinctions between common and special costs and special and marginal costs. Fundamentally, a special cost is an element of total cost whose removal will not affect the cost or quality of those products which are still produced. The removal of a common cost will affect the quality or cost of all products. Marginal cost is the result of the pressure of all production on common costs. Although this does not do justice to the theoretical relationships, it is enough to understand the problems that might be raised by the current plans of the Bureau of Public Roads. Let us use an illustration.

The presence of heavy vehicles requires the reduction of curvature in order to increase sight distance for passing and for the maintenance of high operating speeds. The Bureau, it appears, is attempting to determine how much of the reduction in curvature is attributable to trucks and how much is attributable to other vehicles. Thus, costs of reducing curvature are treated as special costs. Curvature is a part of geometric design and is considered, according to our earlier hypothesis, in relation to the problem of achieving effective utilization of space. Costs of curvature reduction are common costs, notwithstanding the fact that curvature reduction is associated with an increase in commer-

\[21\text{The First Progress Report, p. 73.}\]
cial traffic. The marginal cost of serving commercial trucks is high, but these high costs are not necessarily special costs.

The commercial trucking industry might complain justifiably about a special cost assignment for curvature reduction. The same problem arises with regard to the reduction of grades. In both instances a higher design form is required presumably because trucks appear on the highway. But passenger operators also require reduced grades and curves. Grades and curves are reduced because of the pressure of all traffic. The presence of a passenger vehicle creeping along behind a truck is as much a reason for reducing curvature and grade as the presence of the truck. The concept of the margin is confused very easily with special cost. The result of such confusion leads eventually to joint cost allocations in situations where costs are common. This is another example of jointness imposed by faulty logic. Throughout this study we have found a predilection for jointness. Less allocation and more economic theory probably would have a salient affect on highway financial analysis. The Bureau's approach will lead to the assignment of the costs needed to achieve a four per cent reduction in grade to all vehicles and the additional costs of reducing the grade from four to, say, two per cent, to commercial vehicles. This appears to be a reasonable way to approach the problem. However, it does not recognize that geometric design is concerned with the provision and utilization of space and that space is available to all vehicles. Curves are reduced to facilitate move-
ment and movement has to do with space utilization. It may appear to the trucking industry that the Bureau's approach gives a windfall to passenger vehicles which now enjoy a two per cent grade for which they do not have to pay. It should also be noted that passenger vehicles which are lower than trucks may require more grade reduction in order to maintain sight distance.

An increase or decrease in grade reduction has an impact on the quality and cost of all services and products. Such geometric costs are common costs, not special costs. It appears to this writer that the Bureau is making a difficult problem out of some rather clear relationships. It is felt that a less complex, theoretically correct, approach might be achieved through the use of space-occupance ratios which are now available. With the exception of Mr. James of Consolidated Freightways, Troxel appears to be the only writer to have suggested seriously the use of space-occupance ratios. However, it appears that Troxel would use these ratios for the allocation of all those costs which cannot be allocated by some other means; this is the Bureau's approach.

The burden of the discussion is that all common costs should be allocated on the basis of space-occupance. The significance of geometric design is that it leads only to common costs which are assignable to all traffic. The following example is offered as an alternative procedure to that currently employed. Data from The Highway Capacity Manual indicate that a two-lane highway having a 4 per cent grade accommodates 800 light (less than
5 tons) vehicles per hour. This capacity is reduced to 450 vehicles per hour when 12 per cent of the traffic is commercial. Both situations provide a practical operating speed of 45 to 50 miles per hour. The new hourly traffic mix is 396 passenger vehicles and 54 commercial vehicles. Let X equal a space-occupance ratio to be assigned to commercial traffic. Then, \( \frac{800}{5} = 396 + 54X \), and \( X = 7.5 \). Each commercial vehicle displaces 7.5 passenger vehicles.

The marginal cost of an increment of commercial traffic is 7.5 times the marginal cost of an increment of passenger traffic. The geometric (common) costs of a road having a 4 per cent grade may be allocated in the ratio of 7.5 to 1. In this particular case commercial vehicles and passenger vehicles will share the geometric costs in approximately equal proportions \((\frac{396}{800} \text{ and } \frac{404}{800})\). This is an "opportunity cost" basis for the determination of marginal cost. The addition of a single commercial vehicle displaces space for 7.5 passenger vehicles. Such ratios are available and are described by Troxel and many others. In addition, the commercial trucks will receive an assignment of special costs for incremental additions to structure.

Space-occupance ratios might also be used for the allocation of special structural costs among the vehicles composing a special or heavier weight class. However, a space-occupance allocation of special structural costs does not rest on as logical a foundation as a space-occupance allocation of common costs because the volume-structure relationship is not known. On the
other hand, the volume-geometric relationship is known. It has been noted that some structures are designed for an infinite number of repetitions of a given axle load but for a "limited" but unmeasured number of heavier axle loads. It may be possible to assume a theoretical or abstract relationship of structural thickness and number of repetitions. If design thickness is conceived as a function of number of repetitions, it is logical to allocate special structural costs among vehicles in a given weight class on the basis of axle-miles (number of repetitions of the axle load).

Measurements of this relationship are not available. It is possible, for example, that a ten ton vehicle which travels 5,000 miles affects the structure more than five times the amount of another ten ton vehicle which travels only 1,000 miles. Since these relationships are not known, it would appear best to adhere to the axle-mile standard for the inter-class allocation of special structural costs. In any event, this is the current practice and there is no evidence to dispute this procedure.

The plan that is suggested, then, is an allocation of common costs on the basis of space-occupance and special costs on the basis of axle-miles. No new hypotheses have been developed in this section. The presentation of the case for space-occupance has relied wholly on hypotheses established in the design-cost and price-cost sections of this chapter. In presenting the case for space-occupance, some doubt has been cast on the procedures which
appear to have been adopted by the Bureau of Public Roads for the highway cost allocation study currently under way.

It has been noted that data for space-occupance calculations are available. The collection of prices established on the basis of such calculations represents another problem. Of course, this is not a new problem. Regardless of the allocative technique, the problem of collection must still be confronted. The administrative problem appears to be one of the most significant obstacles in the way of a rational price structure on a toll-free highway system. Let us now consider some price-administrative relationships which may be added to the design-cost and cost-price relationships that have been developed to complete the highway financial system.

**Tentative Price-Administrative Relationships**

The usual procedure in establishing the highway user tax structure involves the calculation of a "bill" (cost responsibility) for the motorist. Once the "bill" or cost responsibility is calculated, various taxes and tax rates are adjusted so that the "correct" amount is collected from each user. The amount collected may or may not have a close relationship to actual use depending on the role played by lump sum license or registration taxes. The gasoline and "third structure" taxes overcome much of this difficulty.
The current procedure is to establish the gasoline tax and minimum license fee at rates that will recover the costs assigned to passenger vehicles. The gasoline tax rate is uniform and applies to all vehicles. Thus, commercial vehicles defray a part of their cost responsibility through gasoline tax payments. Any deficiencies are "made up" through the use of graduated (but lump sum) license taxes and/or the addition of some form of third-structure tax whose administration requires reporting on the part of the motorist. This is a fair but vastly over-simplified statement of current procedures.

The term third-structure indicates the "one, two, three" order that these levies occupy in the minds of highway financial analysts. However, the third-structure taxes vary directly with use and, along with the gasoline tax, should be employed where cost is a function of use. The license or lump sum payments do not vary with use except as that use is imputed in the calculation of total cost responsibility. The "one, two, three" order reflects the historical development of the user tax structure, but not the economic relationships implied by these taxes.

This section represents the final step in the replacement of this administrative structure with a marginal cost structure. To achieve this it will be necessary to establish some price-administrative relationships. The revised applied theory of rate-making that has been established in the design-cost and cost-price sections is complete. The principles on which it is based do not
depend on any of the hypotheses that shall be developed beyond this point. Our problem now is to bring the administrative and financial structure into a relation with the applied principles of rate-making that have been developed.

In attempting to administer a system of highway finance without toll gates, we may take advantage of any fortuitous relationships that will further our purpose. The ensuing discussion suggests two price-administrative relationships that do not have as strong a logical foundation as the design-cost and cost-price relationships. The price-administrative relationships must be tested empirically. This is not an empirical study and such tests are not attempted. Nevertheless, the relationships that shall be suggested appear to have enough validity to qualify as tentative hypotheses awaiting empirical verification. The two price-administrative hypotheses are:

1. If there is but one class of vehicle, a single price for the use of both primary and secondary systems is more likely to conform to marginal cost principles than to average cost principles.

2. Gasoline consumption is as adequate a measure of space-occupance as any other that is currently available.
A Single Price for a Single Vehicle-Class System

To evaluate the single price hypothesis let us recall the two pricing criteria established in the cost-price section. These are:

1. Marginal cost on the primary system is determined by unit program cost.
2. Marginal cost on the secondary system is determined by unit maintenance cost.

Unit program cost on the primary system is considerably above unit program cost on the secondary system. This point has been made throughout this study relative to the administrative problem. However, average maintenance cost on the secondary system is considerably below unit program cost of the secondary system. Unit program cost on the primary system is likely to have a closer relationship to unit maintenance cost on the secondary system than to unit program cost on the secondary system.

In terms of economic theory, this involves saying that the marginal cost of a small plant operating with excess capacity is likely to have a closer relationship to the marginal cost of an optimally operating large plant than the average cost of the small plant has to the average cost of the large plant. This relationship assumes that average cost declines over the range embracing the small and large plants. A graphical demonstration is not necessary to grasp the nature of the relationship between the average
and marginal costs of small and large plants operating under conditions which involve significant economies of scale and a large proportion of fixed costs.

This possible relationship between the two marginal costs with which we are dealing provides a means for rationalizing the administrative problem. If it is hypothesized on the basis of the possible relationships described above that the two marginal costs are roughly equal, it follows that a single price can be charged for both primary and secondary roads in the absence of special structural costs. In addition to the logical relationship on which such a hypothesis might rest may be added the "built in" adjustment which leads motorists, especially pleasure drivers, to equalize marginal real costs by seeking out the least congested routes.

The implications of this hypothesis are significant. Although it cannot be tested at this point, it is presented for the consideration of students of highway finance. A crude empirical test indicates that the hypothesis warrants further examination. This test is summarized in Tables 1 and 2 which are based on data accumulated by the Ohio Highway Fiscal Study in 1950. The methods employed in deriving these figures are described in the Appendix.

Table 1 shows the annual program cost and annual maintenance cost for primary and secondary road systems. The primary system is Ohio's state rural highway system as it was classified in 1950. The secondary system is composed of Ohio's county and
TABLE 1
ANNUAL PROGRAM COST, MAINTENANCE COST AND TON-MILES PROJECTED TO 1962, BY RURAL ROAD SYSTEM, STATE OF OHIO
(all figures in thousands of dollars)

<table>
<thead>
<tr>
<th>Road System</th>
<th>Program Cost</th>
<th>Maintenance Cost</th>
<th>Ton-Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>$94,430</td>
<td>$26,258</td>
<td>39,007</td>
</tr>
<tr>
<td>Secondary^2</td>
<td>74,181</td>
<td>36,321</td>
<td>17,450</td>
</tr>
</tbody>
</table>

^1Estimates were made in 1950.
^2Includes county and township systems.

Source: Appendix, Table 3.

TABLE 2
ANNUAL PROGRAM AND MAINTENANCE COST PER TON-MILE PROJECTED TO 1962, BY RURAL ROAD SYSTEM, STATE OF OHIO
(all figures in mills)

<table>
<thead>
<tr>
<th>Rural Road System</th>
<th>Program Cost</th>
<th>Maintenance Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary</td>
<td>2.421</td>
<td>.673</td>
</tr>
<tr>
<td>Secondary</td>
<td>4.251</td>
<td>2.080</td>
</tr>
</tbody>
</table>

Source: Table 1
township road systems. This, of course, is a jurisdictional classification and is unacceptable for refined calculations or for strong empirical conclusions. Nevertheless, the primary and secondary road systems shown in Table 1 ought to reveal the general relationships in which we are interested.

Table 2 shows the unit costs which emerge from this collection of data. Calculations are made on a ton-mile basis. Unit program cost of secondary roads is double the unit program cost of primary roads (4.2 and 2.42 mills per ton-mile). However, unit maintenance cost of secondary roads is almost equal to unit program cost on the primary road system (2.08 and 2.42 mills per ton-mile). Further evidence of these relationships can be found through a careful scrutiny of the data provided in the Appendix.

These figures, along with the logic of economic theory, validate the establishment of a tentative hypothesis relative to the relationship of average and marginal costs on the highway system. If the applied marginal cost standards that have been adopted are acceptable and further empirical testing validates the relationship that has been suggested, a huge stride will have been made in the direction of applying the marginal cost standard to highway finance without the erection of toll gates. It is felt that more refined measures of marginal cost probably would have little affect on the general relationships that have been cited.

This relationship is adopted as a tentative price-administrative hypothesis. It is felt that it has as much, and probably
more, validity than many of the relationships with which highway analysts must work. We assume, then, that a single price on a single vehicle-class highway system composed of both primary and secondary roads is more likely to conform to marginal cost than to average cost standards. Let us now turn to the second price-administrative hypothesis.

Another Price-Administrative Relationship

The tentative price-administrative relationship with which this section is concerned is: Gasoline consumption varies with space-occupance. This is not a logically derived hypothesis. It is an empirical relationship which changes depending on engine efficiency, development of fuels, highway conditions and many other factors. But in attempting to administer a system of highways without toll gates, we may take advantage of any fortuitous relationships that will further our purpose. The hypothesis relative to gasoline consumption and space-occupance is of interest to the administrator, not the economist. Can this hypothesis be defended?

An integral part of James's aborted, and now forgotten, proposal was the relationship between space-occupance and gasoline consumption. Although James's figures have been severely criticized, no one has disputed the existence of the gasoline consumption-space-occupance relationship. James's figures indicate that the largest truck combination occupied 1.7 times as much space as a passenger vehicle and used 3 times as much gasoline. Both fig-
ures appear to be underestimated but the most severe underestimate is found in the space-occupance ratio. Let us relate James's figures to the following statement which appeared in the review of James's proposal:

Commercial vehicles reduce both the practical and possible capacities of a highway in terms of vehicles per hour because they occupy a greater road space and influence traffic over a larger area than do passenger cars. They also generally travel at lower speeds, especially on upgrades, thereby increasing the number of passing maneuvers that are necessary for other vehicles to maintain reasonable speeds on multilane facilities with uninterrupted flow; one commercial vehicle (includes only those vehicles having dual tires on rear axle) has approximately the effect of two passenger cars in level terrain, and of four passenger cars in rolling terrain.

For example: Approximately the same operating conditions will prevail on an expressway through rolling terrain when there are 1,500 passenger cars per lane per hour as when there are 115 trucks and 1,040 passenger cars per lane, a total of 1,153 vehicles.

In mountainous terrain the effect varies widely with the particular profile but, as an average, one commercial vehicle has approximately the same effect as eight passenger cars.22

It appears from these comparisons that commercial vehicles having dual tires on the rear axles are equivalent in terms of space occupied to 2, 4, or 8 passenger vehicles depending on the condition of the terrain. These ratios may be compared to 3, the ratio presented by James relative to the gasoline consumption of the largest vehicle. The reports and estimates of gasoline

consumption by type of vehicles made by various groups are, on the whole, remarkably similar.

One comparison made by the Bureau of Public Roads indicates the following passenger to commercial vehicle gasoline consumption ratios. Vehicles having a rated capacity of 20 tons — 8 to 1; vehicles having a rated capacity of 10 tons — 5 to 1; vehicles having a rated capacity of 5 tons — 3 to 1. (The miles per gallon for passenger vehicles was 14.3.) These ratios show a rough conformance to space-occupance ratios. These comparisons indicate a possible relationship that ought to be tested empirically. It is interesting that this more or less obvious possibility has not been examined more thoroughly. An empirical test is not attempted in this study, although the design for such a test involves no obvious difficulties. In order to demonstrate the possibilities of the relationship, it shall be adopted as an hypothesis for administrative purposes. It is not crucial to the main thesis of this chapter. In order to avoid misunderstanding, the hypothesis that shall be employed is stated as follows: Gasoline consumption provides as adequate a measure for pricing in accordance with space-occupance as can be had without the use of toll gates or elaborate reporting devices. (It is certainly superior to axle-mileage or ton-mileage.)

\footnote{Ibid., p. 101.}
Gasoline consumption in addition to providing another possible tool for marginal cost pricing makes possible a significant analytical short-cut. Let us assume that the relationship between gasoline consumption and space-occupance is "perfect." If this were so, common costs would not have to be allocated. The establishment of a gasoline tax at a rate determined by the level of the common cost assignment would result in marginal cost prices without the calculation of so-called cost responsibility for each vehicle. Common costs would not have to be allocated and space-occupance ratios would not have to be calculated. After special costs are segregated, the allocation task would be completed by establishing a gasoline tax designed to recover the common costs.

It seems that there is a good possibility of achieving two ends in one simple maneuver: (1) establish marginal cost rates and (2) obviate the calculation of total cost responsibility for each vehicle. Only special cost responsibility would have to be calculated. From the point of view of cost analysis, special costs can be assigned with more precision than common costs. Thus, the result may even lead to a more refined allocative arrangement at a lower cost in research time and money.

**Emergence of a Revised System of Highway Finance**

It is now possible to bring the relationships that have been developed into a complete, albeit speculative, system of highway finance and administration. These relationships are to be
integrated into the institutional fabric. The more important relationships are:

A. Design-Cost Relationships

1. Structural costs are special costs and can be isolated.

2. Geometric costs are common costs applicable to all vehicles.

3. The first structure (but not the geometrics) of a primary road is equivalent to the structure of a secondary road designed for the same (or lowest) weight class of traffic.

B. Cost-Price Relationships

1. Price should equal marginal cost.

2. Marginal cost varies with space-occupance.
   a. On primary roads unit program cost is a reasonable approximation of marginal cost for applied purposes.
   b. On secondary roads, unit maintenance cost is a reasonable approximation for applied purposes.

3. Marginal cost prices require the apportionment of the marginal cost level of common cost in accordance with space-occupance.

C. Price-Administrative Relationships

1. If a single price is charged for the use of both (primary and secondary) facilities, it is more likely to
conform to marginal cost standards than to average cost standards.

2. Gasoline consumption provides as adequate a measure for pricing in accordance with space-occupance as can be had without the use of toll gates or elaborate reporting devices.

It is important to note that the relationships are integrated. Highway design, price theory, and financial administration are now parts of a single matrix. This represents a new approach to highway finance and illustrates a pattern of analysis that may be helpful in the solution of the problems posed by the highly complicated relationships that are so characteristic of governmental programs. The three sets of relationships described above constitute a revised system of highway finance. They may be arranged in whatever manner appears to suit the institutional fabric and may be extended, refined and validated through further research and testing. It is felt that they represent a reasonable application of an abstraction, the marginal cost principle, to highway design, highway pricing and highway administration. To avoid misunderstanding, it should be noted that the price-administrative relationships are not tested, and that the structure is complete with or without these relationships. They are not crucial, but are helpful in demonstrating how administrative problems can be solved without greatly violating more fundamental relationships. In order to demonstrate the applicability of these rela-
tionships and to validate the groundwork that has been laid throughout this study, let us attempt a provisional synthesis.

A Synthetic System of Highway Finance

Assume at the outset that structural costs are isolated (A1). (Notations refer to the relationships described in the preceding outline.) Now, all costs are common (A2). Moreover, the primary and secondary systems are structurally alike (A3). Prices for these roads should equal marginal cost of service (B1). Economic space-occupance is the marginal cost of service (B2 and B3). Uniform rates established to cover the common costs of the primary system will result roughly in marginal cost prices on both systems (C1). Now, set the gasoline tax rate in order to cover the common costs of the primary system. The result is approximate marginal cost prices on all systems (C2).

Gasoline tax earnings on the primary system will cover all but incremental weight costs on the primary system. Gasoline tax earnings on the secondary system may cover maintenance costs but this is not assured. If the primary road system is congested, profits will be earned at the established rates. If highways are provided under long run increasing cost conditions, the profits yielded at the established rates may prove inadequate for optimal expansion. In this event, (1) the gasoline tax rate will have to be raised or (2) intolerable conditions may be allowed to persist until an adequate surplus is accumulated. If there is temporary
excess capacity, losses will occur and the plant will have to be contracted. Losses will also appear if there are long run decreasing costs on the primary system. Secondary roads will incur losses because of permanent excess capacity (indivisibilities). The amount of secondary road losses will be the difference between program cost and gasoline tax earnings. Such losses will be large or small depending on the amount of permanent excess capacity.

Regardless of the specific conditions under which they arise, the losses due to conformance with the marginal cost standard call for lump sum taxes which do not vary with use and which do not exceed consumers surplus. License taxes are ideal for this purpose. Their imposition would not interfere greatly with use, and they cannot exceed consumers surplus because they are voluntarily purchased. Since primary roads tend to operate under optimal or congested conditions, most of the losses will be incurred on secondary roads where excess capacity is prevalent. Therefore, the license tax is reserved for secondary road purposes.

Special structural costs must now be considered. Such costs occur on the primary system and are equal to the additional cost of providing additional structural increments. The current state of engineering knowledge indicates that structural costs vary with axle load; cost variation within a particular structural increment depend on the number of repetitions of the relevant

\[^{24}\text{Supra, pp. 133-37.}\]
axle load. Therefore, an axle-mile or third-structure tax may be levied and collected from the operator of heavy commercial vehicles. Administration of this tax will require reporting and may prove tedious to enforce. Therefore, it may be desirable to levy a lump sum license tax on light trucks in order to eliminate them from the third-structure element. However, the latter procedure violates the marginal cost standard.

To summarize, primary road finance relies on gasoline taxes levied on the assumption that all vehicles are of the lowest class and on third-structure taxes designed to recover structural costs imposed by heavier weight classes. Secondary road finance relies on gasoline tax earnings for all or a portion of maintenance expense and on license taxes designed to cover losses.

This completes the synthetic system of highway finance that might be established on the basis of the revised theory of highway finance. The system is based on a combination of logically derived principles, established empirical relationships and tentative, but reasonable, administrative relationships. It is not the result of historical accident, political pressures, doctrines of pre-emption, court decisions or common-laws. It is submitted in support of the contention made throughout this study that government financial policy can be approached fruitfully from the vantage point of abstract economic theory.
Some Speculations Relative to
Highway Financial Policy

Assuming that the basic relationships on which the model rests bear the scrutiny of students and administrators, it is interesting to consider some of the implications to public policy. This study does not purport to solve political and jurisdictional problems. Therefore, the following statements are speculations as to the possible implications to public policy.

On the whole, nonuser sources of revenue would be eliminated from the highway financial structure. A user pay all principle would be established for all cases except those where there are valid external economies. Nonuser sources are currently used by local governments. These sources of revenue would be released for other purposes and would be replaced either by increased gasoline tax distributions from the state government or by license taxes to be levied by local governments.

The reasoning also implies that license taxes should be determined and levied by local governments having jurisdiction over the registration. Serious reciprocity problems would not arise relative to license taxes reserved for secondary road purposes. Administratively, it might be more convenient to deal with licenses on a state level and to distribute the revenue to the local governments. Unless there are obvious advantages in the lat-
ter procedure, state governments might consider abandonment of the license tax field. From an economic point of view, license taxes appear to be more suitable for local road purposes.

The gasoline tax probably would continue to be levied and collected by the state governments and distributed among the various jurisdictions on the basis of gasoline consumption or highway use. The most important implication of this procedure is the partial resolution of the municipal financial dilemma. Municipal road and street programs frequently involve relationships among no less than four levels of government. The creation of financial autonomy for municipal road programs would undoubtedly do away with many of the complicated relationships which divide authority from responsibility to an extent that retards orderly municipal road development. Financial autonomy for the road programs of municipal governments would be virtually assured because the bulk of gasoline consumption is on city streets where congestion is severe.

In many states, municipal governments receive a pittance compared to the distributions meted out to their more rural and less congested neighbors. The situation appears to be much the same as it was in 1948 when Thomas MacDonald described the dilemma as follows:

Each year the collection of motor vehicle revenue from highway users presents a billion-dollar spending puzzle. For no sooner is the motorist's bill collected on the theory of supporting a service, than the State is obliged to heed the clamors for aid which are advanced by numberless administrative units. That funds are denied to a metropolitan district or granted
to submarginal rural counties is symbolic of political agility rather than transportation needs. The compromises and formulae which in many states result from inter-governmental clashes for state-collected revenue are not conducive to a coordinated spending program. . . . 25

Under present arrangements, the states probably would impose third-structure taxes. It may be desirable to allow the federal government to levy and collect such taxes at a level determined by the structural costs on the primary system. The federal government might distribute these funds to the states on the basis of heavy commercial traffic or in relation to joint federal-state programs. This procedure would partially eliminate the reciprocity problem which is most severe on the inter-state roads and would reflect the inter-state or federal significance of primary roads. If these alternatives were selected, the federal government would replace the present federal gasoline tax with a third-structure tax. This would release the gasoline tax for state and local road purposes. State government authorities have pressed for this revision for many years.

A federal third-structure tax may be no more tedious to collect and enforce than a series of state third-structure taxes. At least operators will fill out but one tax form, whereas now they must fill out many. As a practical matter, it might be desirable to include a structural cost in the license fees levied by

state or local governments in order to eliminate the huge numbers of small and middle-sized trucks from the third-structure element.

The lines of authority and responsibility are clear. There are still intergovernmental relationships, but these relationships are guided by clearly defined principles. The entire system is composed of and roughly conforms to a series of reasonable relationships, whereas the current system has no logical arrangement. Although the above discussion is speculative, a few hints as to the nature of the practical adjustments that might be made have been provided. Detailed analysis of these questions is left to those who are responsible for the administration of the highway user tax structure.

A Conclusion Relative to Resource Allocation

This chapter does not represent basic economic analysis. It simply indicates the nature of the relationships that might be established around essentially economic problems. The design-cost and price-administrative relationships must be developed by engineers and administrators. The cost-price relationships represent the task of the economist. Cost-price relationships were not developed in this chapter; they were developed throughout the course of the earlier analysis. In this chapter, cost-price relationships were integrated with other relationships which appeared to
have an obvious connection. This chapter is a demonstration in how economic theory may be "institutionalized" without losing its basic premises.

It would be interesting to undertake an empirical study to determine whether our synthetic system of highway finance requires compensation payments. Since it conforms to the marginal cost standard, its adoption should create more gains than losses. There may be no losers in this system. The motorist will pay a higher bill because we have eliminated the bulk of the present nonuser share. It is possible that the present nonuser revenue which is devoted primarily to secondary roads will be roughly equivalent to any increases in gasoline or license tax revenue for secondary road purposes. Secondary road users might simply trade one form of tax for another. This might be the case if the present primary road structure is "correct." Thus, it is possible that the allocation of resources is "correct" and that this study leads only to a rearrangement of institutional relationships. The validity of such a rearrangement ultimately rests on factors other than those with which this study is concerned.

On the other hand, if the commercial tax structure is "incorrect," the proposal will lead to a different allocation of resources. If the present nonuser share has led, in one way or another, to a distortion of the commercial rate structure, there is a possibility that the present allocation of resources is inefficient. This writer does not believe that the nonuser share has
had such an impact on the commercial structure. The basis for this opinion is that nonuser sources have been closely related to secondary roads and may have had no important impact on primary road finance or on the commercial rate structure.

The chief conclusion concerning resource allocation is to be found in external economies and the analysis of collective demand. We come back again to the questions of the proper level of commercial truck rates and the propriety of utilizing rents, windfalls and surpluses for highway purposes. Since such surpluses appear to have been restricted to secondary road finance, the impact on the commercial rate structure may have been minimal. Although many exceptions have been made to the analyses, procedures and techniques that are employed in the establishment of the highway user tax structure, it appears that the highway user tax structure has survived and remains a powerful tool for the attainment of economic efficiency. It is reasonable to agree with Zettel that

when we consider that user taxation was conceived in expediency, born of necessity and nurtured of politics, it is surprising that the offspring is as healthy and works as well as it does to serve sound economic objectives.26

The chief concern, however, is not with the decisions that have been made in the past, but with those that are about to be

made for the future. A vastly expanded Federal Highway Program has been inaugurated. The means for the financing of this program are still tentative. The Congress and students of highway problems are now awaiting completion of studies undertaken by the Bureau of Public Roads. This will represent the third federal study of highway problems and, like The Coordinator's Report, probably will establish a nation-wide pattern. The Congressional request for investigation and research is broad enough to allow for either a benefits-received or pricing approach to highway problems. Decisions made by the Bureau of Public Roads will have an important bearing on the possibilities for the attainment of economic efficiency. It is appropriate, then, to conclude this part of the study with a review of the Congressional Mandate for investigation and research.

The Congressional Mandate

The Federal-Aid Highway Act of 1956 raises many questions with which this study is concerned. It appears that a new national highway policy is in the process of being established. However, the Congress remains uncommitted on many matters. Completion of studies now being undertaken by the Bureau of Public Roads may have an important impact on the emerging national highway policy. The Bureau's work is authorized under Sections 210 (a) and (b) of the Act of 1956. These sections are cited as follows:
Section 210. Investigation and Report to Congress. (a) Purpose.—The purpose of this section is to make available to the Congress information on the basis of which it may determine what taxes should be imposed by the United States, and in what amounts, in order to assure, insofar as practicable, an equitable distribution of the tax burden among the various classes of persons using the Federal-aid highways or otherwise deriving benefits from such highways. (b) Study and Investigation.—In order to carry out the purpose of this section, the Secretary of Commerce is hereby authorized and directed, in cooperation with other Federal officers and agencies (particularly the Interstate Commerce Commission) and with the State highway departments, to make a study and investigation of— (1) the effects on design, construction, and maintenance of Federal-aid highways of (A) the use of vehicles of different dimensions, weights, and other specifications, and (B) the frequency of occurrences of such vehicles in the traffic stream, (2) the proportionate share of the design, construction, and maintenance costs of the Federal-aid highways attributable to each class of persons using such highways, such proportionate share to be based on the effects referred to in paragraph (1) and the benefits derived from the use of such highways, and (3) any direct and indirect benefits accruing to any class which derives benefits from Federal-aid highways, in addition to benefits from actual use of such highways, which are attributable to public expenditures for such highways.\textsuperscript{27} 

Our analysis casts some light on the economic implications of "an equitable distribution of the tax burden among the various classes of persons using the highways or otherwise deriving bene-

fits from such highways.*" The preconceptions, procedures and
techniques by which this purpose can be distorted have been de-
scribed at length. The basic questions involved relate to market
value, external economies and equity. Although Congress, correct-
ly, is concerned with equity, it is also fair to assume that it is
interested in economic efficiency. Such distinctions are not a
part of the political jargon, but they are (or ought to be) a part
of highway financial analysis, and it is to highway financial ana-
lysts that the Congress has turned. If the Bureau of Public Roads
adheres to the benefits-received approach or allows the jointness-
es that have been described in this study to interfere with an eco-
nomic allocation of highway costs, neither efficiency nor equity
will have been promoted. The responsibility will not rest on the
Congress or on its use of terms, but on the interpretations of the
Congressional language by those who are expected to make the in-
vestigation.

In establishing a highway program it is important that all
benefits including indirect benefits be considered and, if pos-
possible, measured. It is likely that there will be many indirect
benefits, especially in the form of windfalls, surpluses and
rents. It is reasonable to suppose that some groups will insist
that such surpluses be placed in the Highway Trust Fund. The
analysis in this study leads to the conclusion that the price of
such a policy is likely to be an economically inefficient system
of highway finance. Equity may still be served by taxing these
windfalls for redistributive purposes. There is no clear reason for redistributing income in favor of the "average" motorist or of the commercial trucking industry. If incomes are to be redistributed, there may be others who occupy a higher place on our social preference scales.

These are the worst possibilities. An incremental cost study is underway. There are some indications that the benefits-received approach will not have an important bearing on this part of the Bureau's study. The Bureau appears to have been struggling with the problem of limiting the role of benefits on the one hand and of considering them on the other. Although the Bureau has not announced its intentions relative to the nonuser share, some parts of The First Progress Report indicate that the final solution may conform to standards of economic efficiency. The following interpretation of Section 210 by the Bureau casts some light on this possibility:

These several provisions add up to the prescription for a very broad and thoroughgoing inquiry into the subject of equity in Federal taxation for highways. The requirement that the problem shall be examined from the separate standpoints of costs occasioned and benefits derived is an assurance that the approach to the subject will not be partial or one-sided.29

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28 The Bureau is expected to submit its final report on or before March, 1959. A second report is being prepared as this manuscript is written, but this report probably will cast little light on the basic issues. It is expected to be a technical report relative to incremental cost allocations.

29 The First Progress Report, p. 3.
This interpretation indicates that the entanglements involved in the benefits-received approach may be overcome by a straightforward cost analysis of the supply side of the highway equation. At a later point the cost analysis may be brought into relation with an independently derived demand side. This approach has been strongly advocated in this study. A further indication that the benefits-received approach may be replaced is found in the following statement:

Methods of analysis that have been followed by previous analysts will be explored and compared with an approach which utilizes the concept that the bulk of highway benefits to property, business, and the general public are transferred benefits or savings realized in the first instance by the motor-vehicle user.30

The Bureau implies in this statement that there may be some doubt as to the "methods of analysis that have been followed by previous analysts." Moreover, it appears that indirect or diffuse benefits are viewed as "transferred benefits" which do not have to receive special attention. This also is consistent with the criteria that have been established in this study.

Clearly, the Bureau is confronted with the problem to which this study has been addressed, and it may arrive at a solution which conforms to the standards that have been proposed. The new study may mark an important milestone by replacing the Coordinator's benefits-received framework with a cost-of-service or

30Ibid., p. 89.
pricing framework. However, at the time of The First Progress Re­
port, the Bureau was still without standards or criteria. This is
indicated by the interpretation of subsection 210 (b) (3) which
appears in the general context of the statements cited earlier.
According to the Bureau, subsection 210 (b) (3)
imposes the third major task of the investigation, by
requiring that the process of allocation take into
account the direct and indirect benefits derived by
"any class" from the Federal-aid highway program, in
addition to those derived from the use of highways.31

This is the benefits-received approach. It has been held
throughout that "the process of allocation" should be carried on
independently and without consideration of the benefits derived by
"any class." The idea that costs are costs and benefits are bene­
fits seems to be a rather difficult one for many to grasp. The
Bureau also describes the problem as involving first, an alloca­
tion among users and nonusers and, then, an allocation among vehi­
cle classes:

Of the two problems ... the solution to the
first—that of motor-vehicle and non-motor-vehicle
tax contributions—will be sought by evaluating and
comparing the benefits derived directly by motor ve­
hicles and those derived, directly or indirectly, by
abutting or adjacent property, the general public,
or other non-motor-vehicle beneficiaries.32

This statement of the problem indicates that the benefits-received
approach still weighs heavily in the thinking of the best authori-

31Ibid., p. 3.
32Ibid., p. 5.
ties. As yet, we do not know the nature of the resolution which will be provided by the Bureau. Although the Bureau's interpretations of the problem are contradictory, it appears that the problem has been recognized and, perhaps, that the issues have been joined. However, the issues are far from resolved. In March, 1959, we shall have the Bureau's answer. Meanwhile, the revised theory of highway finance developed in this study is offered as a means for resolving some of the issues that now confront the Bureau of Public Roads.

One final observation. Once economic efficiency, external economies, equity and administration are disentangled one from the other, it is possible to communicate and focus attention on the real issues. The relevance of the analysis of external economies to the requirements of the Congressional Mandate for investigation and research are so obvious as to scarcely require repeating. In a sense, then, we have tested the hypothesis that the abstract framework set forth in Part One has implications to public policy. Although the "fragile pots and pans" of modern welfare economics have been laid aside, at least some will agree that they have guided us to some worth-while down-to-earth conclusions.
SUMMARY AND CONCLUSIONS

This study attempted to establish and to apply to highway finance a framework of economic criteria for the financing of those governmental programs to which the term subsidy is often applied. In order to pursue this purpose, the concepts, standards, and procedures of modern welfare economics have been employed. Special emphasis has been placed on an individualistic ethic and on a concept of collective action which makes possible an abstract reconciliation of individual welfare and governmental action.

The chief difficulty with the reconciliation set forth in this study is that it fails to take into account the more dynamic, developmental, or growth relationships which exist between individual welfare and governmental programs. Therefore, subsidies in response to broadly developmental programs have not been related to individual welfare. On the other hand, the reconciliation appears to provide a fruitful means for approaching the problems of financing governmental programs in an economically efficient manner. The prices and taxes utilized in the financing of governmental programs are allocative devices, and they have significance to economic policies aimed at a wise or maximizing utilization of resources. Thus, this study has particular applicability to the fi-
nancing of traditional governmental programs aimed at the simultaneous satisfaction of both private and collective demands.

It has been suggested that such programs can be financed in accordance with the concepts, standards and procedures that have been established by modern welfare economists. The conception that taxation is a "burden" has been replaced by a more positive view which recognizes the implications of collective action to individual welfare as well as the volitional or non-coercive character of many types of collective activity. By recognizing that the individual cannot attain even selfish ends without submitting to some coercion, it is possible to bring a portion of governmental activity within the individualistically oriented framework of modern welfare economics.

Bergson, Arrow and many others have struggled with the problem of specifying a social welfare function without making interpersonal comparisons of utility. Arrow's pioneering analysis indicates that a comprehensive social welfare function cannot be specified without abandoning the rigorous limitations adopted by most modern welfare economists. However, this study has shown that Arrow's dismal conclusion does not necessarily imply that economic welfare analysis must be limited to the economics of the market place. The Marshallian concept of external economies provides an analytical means for extending modern welfare economics beyond the market place and into the realm of governmental activity. The logical resting place for external economies is col-
lective action. Collective action does not take into account all of the factors which impinge on social welfare, but it does take into account considerably more than the market place. Collective action reflects the voluntary choices of individuals who recognize their mutual interdependence. Thus, it is possible to establish an economic welfare basis for certain types of governmental activity without abandoning the notion that the individual should "have his way."

Through the use of the concept of external economies, it has been shown that the taxes and subsidies required by governmental programs can be evaluated in terms of either the Compensation Principle or the principle of unanimity developed in this study. A strong welfare basis for taxation has been found in the Voluntary Exchange Theory of taxation advocated by Wicksell at the turn of the century. The Voluntary Exchange Theory along with the marginal cost principle provide standards for the integration of both private and public sectors under the aegis of modern welfare economics and the individualistic ethic.

Once the various elements leading to governmental activity are clearly identified and analyzed, it is possible to resolve much of the conflict surrounding the question of subsidy through a simultaneous application of the two welfare standards — The Voluntary Exchange Theory and the marginal cost principle. Through the application of these two coordinate standards, it is recognized that governmental programs do not require a choice be-
between market and public allocations or between the price system and the tax system. The problem relates to the manner and the proportions in which private and collective elements are combined. The two standards set the limits as to what can and cannot be done in the name of social welfare by placing the individual squarely at the center of the stage.

Notwithstanding the opportunities created by adoption of the two standards, they help to solve only a part, and it is a very small part, of the total problem posed by governmental programs. The standards do not apply when the aim of public policy is to redistribute income, nor do they apply to public policies aimed at the welfare of future generations. It has been suggested that the former problem can be resolved by the adoption of ethical standards for the interpersonal comparison of utility. Although it may appear completely visionary, the idea has been set forth that the possibility of achieving unanimity or at least "partial" unanimity relative to distributional questions ought to receive more attention. In any event, interpersonal comparisons do not conflict with the individualistic ethic provided standards of equity can be developed. Not so, relative to futurity and posterity. It appears that in considering such factors there must be a shift in ethical premises, and the "burden" theory of government comes to the fore. Only the most extreme rationalization of the individualistic ethic can reconcile individual welfare to taxation which will not yield benefits to individuals until centuries have
passed. Notwithstanding the possibility that the individualistic ethic cannot be maintained in such instances, a welfare judgment can still be made if such programs have unanimous approval. However, these questions remained unresolved and this study casts little light on government taxation for redistributional purposes or for posterity. Although the two standards that have been set forth do not prescribe for such situations, they still provide a basis for the identification and classification of the judgments that are made in the establishment of public policy. Thus, the standards that have been developed have prescriptive significance in particular cases and normative significance in all cases.

The technical analysis of collective demand provided the forms which were combined with orthodox price analysis to give content to an analytical framework for the evaluation of governmental programs. The analytical framework consists of the tools and principles appropriate to the analysis of collective demand along with the tools and principles appropriate to the marginal cost standard. The suggested method of analysis involves first, an evaluation of the market allocation and second, an evaluation of those external economies which might lead to subsidy offers or compensation payments. External economies have been defined operationally, as non-market influences consideration of which will lead to subsidy offers and a reallocation of resources. Thus, rents, windfalls and surpluses were excluded because these elements have no impact on the allocation of resources. The identi-
fication, description, and measurement of external economies leads to the determination of the amount of subsidy required. In a purely collective program, this subsidy is conceived as a *quid pro quo* payment to government. In situations where both prices and taxes are required for the financing of particular programs, the *quid pro quo* tax payment is determined simultaneously with a marginal cost price.

In order to give content to the standards described above, a considerable amount of technical analysis has been employed. One of the contributions of this study is the establishment of analytical procedures for the conceptualization of collective demand. These procedures placed the Voluntary Exchange Theory within the general framework of modern welfare economics. The Voluntary Exchange Theory is an application to policy of the Compensation Principle, the abstract testing device employed by modern welfare economics. The technical analysis of collective demand also revealed some promising distinctions between value-of-service and cost-of-service pricing standards and shed some light on the theory of discrimination. The distinction between external economies and rents, windfalls and surpluses leads to a more satisfactory application of the benefit theory of taxation. Properly interpreted, the benefit theory of taxation can be a powerful analytical tool in the hands of the tax economist.

The relevance of these distinctions to highway programs is obvious. Accordingly, the two standards were applied in an
evaluation of the current practices employed in the establishment of highway financial structures and in the development of a revised theory of highway finance. The implications of the analytical framework were brought into full view through an analysis of the benefits-received and pricing approaches to highway finance.

There appear to be many conflicts and inconsistencies in the benefits-received approach. Included among these are (1) the predilection for joint cost allocations, (2) the confusion of administrative problems, equity and external economies and (3) an undefined concept of welfare. On the other hand, the pricing approach to highway finance fails to recognize external economies and attempts to impose narrow market standards to an area which traditionally is considered in relation to general welfare. As a result, the pricing approach is only a partial solution to the problem.

This study appears to have resolved some of these problems through the development of a revised theory of highway finance which takes into account both private and collective elements. Doubt has been cast on the traditional allocation of total highway cost between highway users and so-called nonusers or indirect beneficiaries. The existence of external economies may warrant a nonuser contribution (subsidy to the users), but this contribution should be determined by considering the demand, not the supply or cost side of the equation. The allocation of shares between users and nonusers should follow, not precede, the allocation of costs
among highway users. Moreover, the nonuser contribution should be
scrutinized carefully so that the user share is not diminished or
distorted by deductions for illusory indirect benefits or for in-
direct benefits which do not qualify as valid external economies.
To provide some practical guideposts for application of the re-
vised theory, highway design, price theory and financial adminis-
tration have been interrelated and integrated into a unified op-
erational framework. This framework consists of three sets of co-
ordinated marginal cost relationships: (1) design-cost relation-
ships, (2) cost-price relationships and (3) price-administrative
relationships. These relationships represent a revised system of
highway finance. Some speculations as to the impact of these re-
lationships to highway finance include: (1) abandonment of the
federal gasoline tax and inauguration of a federal third-structure
tax (2) abandonment of license taxes now levied by the state gov-
ernments and the adoption of such taxes by local governments, and
(3) sharing of the gasoline tax by local and state governments.
These possible implications were not presented as conclusions, but
as demonstrations of some of the possibilities that might emerge
from an application of the revised theory of highway finance. Po-
itical, jurisdictional, legal and other bases for the establish-
ment of a system of highway finance were eschewed in favor of
standards of economic efficiency.

The chief conclusion which has significance to the alloca-
tion of resources relates to the emerging federal highway policy.
It is to be expected that the appearance of rents, surpluses, and windfalls associated with the new highway program will lead to appeals for their taxation and for their inclusion in the structure of highway finance. This procedure might lead to the distortion of a price structure which, it appears, can be managed in the interest of economic efficiency. It has been suggested that policies for the taxation of such surpluses should aim at the attainment of equity and not at the unwitting transfer of windfalls from rentiers to the "average" motorist or to the commercial trucking industry.

Parts of this study are addressed to problems currently confronting the United States Bureau of Public Roads which appears to be struggling with the question of nonuser or indirect benefits. In addition, some problems which have a bearing on the highway cost allocation study now under way have been described briefly. The chief of these relates to the allocation of common costs associated with geometric design. It has been held that the current attempt to allocate geometric costs as though they were special costs creates problems which are not relevant to economic cost allocations. A more straightforward distinction between common and special costs possibly would eliminate some of the complexities that have arisen.

The application to highway finance is also presented in support of the hypothesis that modern welfare economics which claims to provide only abstract criteria can have some relevance
to down-to-earth policy questions. It is an especially useful tool for the identification and segregation of different phenomena. When all the parts of a problem are clearly exposed, new lines of communication are found, issues are resolved, and the stage is set for that maximizing state of human affairs — unanimity.
This Appendix contains a summary of the main techniques that have been employed in the allocation of highway costs between users and nonusers. The allocation among vehicle classes is discussed in Chapter IX. Although the discussion in the text leads to the conclusion that the traditional user-nonuser allocation is incorrect, the appraisal of the current theory of highway finance would not be complete without a description of the techniques that are employed. Moreover, this review should provide additional evidence of the arbitrary nature of the user-nonuser allocation of costs. Wherever possible, the techniques are illustrated through the use of data gathered in the State of Ohio.

With a few notable exceptions which will be pointed out at a later point, all complete highway financial analyses attempt an initial allocation of costs between users and nonusers. Considerable research has been, and continues to be, conducted in an effort to find a satisfactory solution to this problem. The principal methods that have come out of this research are: (1) Basic-Period, (2) Relative-Use, (3) Predominant-Use, and (4) Earnings-Credit. With the exception of the Basic Period approach, all of
these methods rely on a theory of highway finance more or less consistent with the benefits-received theory explained in the text.

**Basic Period Method**

The Basic Period approach is primarily of historical interest. It is usually associated with studies sponsored by the railroads, but it did play a role in the allocations made by the Federal Coordinator.¹ This writer is not aware of any recent application of this method. The Basic Period method relies on the contention that motorists should pay all annual highway costs in excess of the annual highway costs occasioned during a "basic year" prior to the advent of the automobile. Combined with the public utility concept, this amounted to a highway user tax structure that would provide enough revenue for everything except bridle paths.

One of the assumptions implicit in the procedure is that the highway system would not have been expanded if the automobile had not been invented. It is not difficult to point to numerous developments subsequent to the invention of the automobile that


The Federal Coordinator employed the Basic Period approach as one of the three alternatives, The Coordinator's Report, p. 18.
would have necessitated construction of improved roads whether they be designed for the automobile or for the horse carriage. To hold otherwise would be to say that all economic expansion and movement after about 1900 came as the result of the invention of the motor vehicle.

When the Basic Period approach has received serious consideration, it has been rejected because of practical difficulties. For how is the "basic" year to be determined? When did motor vehicle responsibility begin and non-motor vehicle responsibility end? Was it 1905, 1910 or 1920? It seems that no two parties would select the same year. Moreover, adequate cost data for early years are not available. The conceptual and practical difficulties have precluded the use of this approach in any recent work.

Solutions Based on Road Use

Recent proposals date to the 1936 road use surveys which were made possible by the federal anti-depression spending program. Traffic surveys were made in nearly every state and a wealth of road use data were gathered. Probably it was this accumulation

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2 In Highway Costs, Breed, Older and Downs select 1904 as the "basic" year, op. cit., p. 18.

of data that prompted students of highway finance to give more attention to solutions based on road use. The utilization of road use data to determine a nonuser share of costs implies that all values associated with highways are created through highway use. This appears to be at variance with the multi-purpose or benefits-received view. At any rate, it appears to this writer that the techniques are more palatable than the theory on which they are predicated. Since most procedures rely on similar data, it is convenient to make a very brief survey of the information usually needed to make a highway cost allocation between users and nonusers.

The Data

Roads usually are classified by the nature and volume of the traffic that they are designed to handle. This classification may be based on very rigorous engineering standards or on the jurisdictional classification of roads. Following current jurisdictional classifications, roads can be classified into two major groups: rural and urban. Each of these groups can be subdivided further into primary, secondary and tertiary roads which usually coincide with a corresponding jurisdictional classification such as, state, county and township. The road classification in Ohio is typical. An abundance of road use and cost data have been compiled for the Ohio classification shown below:
RURAL ROAD SYSTEMS
Primary (Rural State Highway System)
Secondary (County Road System)
Tertiary (Township Road System)

URBAN STREET SYSTEMS
Primary (Urban State Extensions)
Secondary (Other Municipal Arterials)
Tertiary (Municipal Residential Streets)

Of course, these classes can be subdivided further or combined depending on the relationships pertinent to the analysis. In the Ohio classification, for example, there is little difference in the characteristics of urban primary and secondary systems, and these may be combined. On the other hand, the state primary rural system could be subdivided into a Federal-aid high volume system and a non-Federal-aid middle volume system. More sophisticated classifications than the one shown above are now in vogue because of the more rigorous requirements of the subsequent incremental cost analysis.

The next ingredient is road use and mileage data by road classification. Linear miles, ton-miles, axle-miles and any other available road mileage and use data are helpful in arriving at the allocation. There is considerable debate relative to the most appropriate unit for the user-nonuser allocation. 4

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Cost data also must be developed for each road classification. Most analyses follow the Federal Coordinator and maintain that the cost allocation should be based on "annual" cost of the highway system. The usual concept is described as follows:

In dealing with a capital facility that has a long life, annual cost over the period involved is the cost concept ordinarily utilized. In the case of highways, annual cost would include outlays for construction amortized over the life of the various facilities, administration, maintenance, depreciation, and possibly such items as imputed interest and property tax equivalents.5

Consideration of what should and should not be included in highway cost would take us far afield.6 Because of the difficulties in calculating annual cost, most studies use either annual historical expenditures or projected annual program costs, the latter being the most popular in recent years.7 Thus, a recent study made in North Dakota was concerned with future rather than with historical costs or annual costs.8 Moreover, there is considerable evidence


6The problem is discussed in a theoretical context in Chapter VII.

7For a discussion of a method that may be used for calculating the annual cost of a small road segment see Harold W. Hansen, "A Procedure for Determining the Annual Cost of a Section of Rural Highway," Public Roads, XXVI (April, 1951), 2-5.

to support the contention that projected program costs for a program as long as fifteen or twenty years come very close to annual costs.\(^9\)

Program costs are developed by the engineering staff. At the outset, the engineers accept certain highway design standards against which the present road plant is compared. Roads are then classified as tolerable or intolerable; next, the cost of making the system tolerable is estimated. This figure is an estimate of existing highway needs. Since some roads will become intolerable during the period under consideration, a replacement study is made and an additional cost element is estimated. On the basis of traffic projections, an added capacity cost element also is estimated. To complete the estimate, maintenance and administrative costs are included at amounts based on projections of present maintenance costs. The total program includes separate estimates of (1) existing needs, (2) replacements, (3) added capacity, (4) maintenance and (5) administration.

The basic road use and cost data employed in an Ohio study are shown in Table 3. This information is arranged by the Ohio road classification in 1950. Wherever possible, these data will be used to illustrate the various techniques that have been employed. Let us now turn to these techniques.

<table>
<thead>
<tr>
<th>Jurisdictional Road System</th>
<th>Program Cost</th>
<th>Linear Miles</th>
<th>Ton-Miles (000)</th>
<th>Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Rural</td>
<td>$94,430,000</td>
<td>16,073</td>
<td>39,007,524</td>
<td>$5,875.07</td>
</tr>
<tr>
<td>County</td>
<td>51,281,000</td>
<td>28,790</td>
<td>13,241,866</td>
<td>1,781.21</td>
</tr>
<tr>
<td>Township</td>
<td>22,900,000</td>
<td>41,066</td>
<td>4,208,259</td>
<td>557.64</td>
</tr>
<tr>
<td>Total Rural</td>
<td>168,611,000</td>
<td>85,929</td>
<td>56,457,649</td>
<td>1,962.21</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Arterials</td>
<td>74,334,000</td>
<td>5,519</td>
<td>34,888,145</td>
<td>13,468.74</td>
</tr>
<tr>
<td>Municipal Residentials</td>
<td>26,393,000</td>
<td>10,851</td>
<td>10,844,760</td>
<td>2,432.31</td>
</tr>
<tr>
<td>Total Urban</td>
<td>100,727,000</td>
<td>16,370</td>
<td>45,732,905</td>
<td>6,133.15</td>
</tr>
<tr>
<td>Total-All Systems</td>
<td>$269,388,000</td>
<td>102,299</td>
<td>102,190,554</td>
<td>$2,632.85</td>
</tr>
</tbody>
</table>

Unit Cost: Cost Per Mile | Cost Per Ton Mile (Mills)

- Rural: $2.420815
- Urban: $2.433710
- Total: $2.635645

Notes:

- Estimates were made in 1950 for a highway program extending to 1975.
- Municipal arterials include urban extensions of state highways and other municipal streets carrying heavy volumes of traffic.

Sources: Column (1) Ohio Department of Highways and Automotive Safety Foundation, *An Engineering Study of Ohio's Highways, Roads and Streets*, A Report to the Ohio Program Commission (Columbus, Ohio, 1951), chap. II.
- Column (2) Ohio Department of Highways, "A Road and Street Inventory of Ohio, 1950" (Columbus, Ohio, 1950). (Unpublished tabulations.)
Relative-Use

The most widely known approach is associated with Thomas H. MacDonald, former Commissioner of the United States Bureau of Public Roads. Commonly called the Relative-Use method, it is predicated on the theory that traffic on any given segment of road can be divided into "access," "neighborhood" and "through" components, and that cost responsibility can be assigned to the property owner, community and motor user on the basis of these components. For example, a study of traffic on a given segment of road might indicate that 100 motorists per day were driving "through," that 50 motorists per day were engaged in "neighborhood" driving, and that 50 were gaining "access." Accordingly, 50 per cent of the cost of the road segment would represent the user share, 25 per cent the community share, and 25 per cent the share of the property owner. The distribution could be weighted to consider the average weight of vehicles comprising each component.

This sort of analysis depends on the definition and measurement of the three components of traffic. The neighborhood element is especially difficult to define. This element must be defined by relating it to a neighborhood area, the size of which must be determined on the basis of some judgment of what a neighborhood comprises.

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Such a solution may appeal to one's sense of equity and reasonableness. But it implies that a passenger vehicle operating through a particular geographic area should be charged a different rate than one operating in a neighborhood or access function in spite of the fact that both use the same road. There is nothing in the nature of the service to indicate that a different service is provided to different users on the same segment of highway. If only passenger vehicles use the road, any distinction must be made on the basis of the use to which the service is put. The allocation is based on components of traffic arbitrarily defined and, as its name implies, is based on relative use, not on the cost of providing the service.

To those who accept the logic of the benefits-received approach to highway finance, the Relative Use method represents a satisfactory means for allocating "joint" highway costs. The method has not been utilized widely because of practical difficulties. It requires that the entire area (usually a state), or a sufficiently large area to serve as an adequate sample, be zoned into neighborhood areas and that an elaborate origin-destination

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11 A recent study made in Louisiana attempts to employ the Relative-Use method in conjunction with the Earnings-Credit method. William D. Ross, Financing Highway Improvement in Louisiana (Baton Rouge, Louisiana: Division of Research, College of Commerce, Louisiana State University, 1955), p. 40.
survey be conducted in each zone. Such laborious and expensive surveys are of great value to the highway tax analyst, but usually are not available. Efforts to apply the logic of the Relative-Use method without encountering these practical shortcomings have led to the adoption of the Predominant-Use method.

**Predominant-Use**

The most popular device for allocating highway costs is a modification of the Relative-Use approach. This, the Predominant-Use method, assigns responsibility for the entire cost of the access system (defined as the township, road district, municipal residential or tertiary system) to nonuser groups and responsibility for the entire cost of the through system (usually defined as the primary or state administered system) to motorists.\(^{12}\) It is recognized that the through system provides some access and that the access system accommodates some through traffic. However, it is argued that the through component on the access system offsets the access component on the through system and that no serious error is made in the total cost responsibility assigned to the two major groups. The cost of the neighborhood system (defined in most studies as the county system) is apportioned on the basis of

a constant basic access cost per linear mile, determined by the cost per linear mile of the access (township) system. Thus, a nonuser share on the neighborhood system is determined by the cost per mile of the access system. Costs in excess of this amount are imputed to motorists. Table 4 illustrates the solution for the Ohio highway system.

This method is subject to the same general criticisms that were pointed out with respect to the Relative-Use method. In addition, it contains some elements which are not consistent with the theory on which the approach is based. In the first place, the assumption that the access component of the through system offsets the through component of the access system cannot be justified; measurements to give weight to such an assumption have never been made. Second, the assumption that the cost per mile of the access or tertiary system represents a basic access value per mile is difficult to justify. It would seem that the access value should be less than the total cost of the tertiary or access system. It is usually admitted that the cost per mile of the access system includes a through component. And yet, this cost per mile is applied to the secondary system as a basic access value. Furthermore, if the cost computed in this manner is, in fact, a basic access cost, it would seem that this basic cost per mile would apply to the through system as well as to the neighborhood system.
TABLE 4
THE PREDOMINANT-USE SOLUTION

<table>
<thead>
<tr>
<th>System</th>
<th>Program Cost</th>
<th>Nonuser Factor</th>
<th>Nonuser Share</th>
<th>User Share</th>
<th>Per Cent User</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Rural</td>
<td>$94,430,000</td>
<td>0%</td>
<td>0</td>
<td>$94,430,000</td>
<td>100%</td>
</tr>
<tr>
<td>County</td>
<td>51,381,000</td>
<td>$557.64 per mile</td>
<td>$16,054,000</td>
<td>35,227,000</td>
<td>69</td>
</tr>
<tr>
<td>Township</td>
<td>22,900,000</td>
<td>100%</td>
<td>22,900,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Urban</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Municipal Arterial</td>
<td>74,334,000</td>
<td>0%</td>
<td>0</td>
<td>74,334,000</td>
<td>100</td>
</tr>
<tr>
<td>Municipal Residential</td>
<td>26,393,000</td>
<td>100%</td>
<td>26,393,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$269,338,000</td>
<td>xxx</td>
<td>$65,347,000</td>
<td>$203,991,000</td>
<td>75%</td>
</tr>
</tbody>
</table>

Source: Table 3.
Earnings-Credit

Through the Earnings-Credit solution, an attempt is made to overcome the obvious objections to the Predominant-Use method. The Earnings-Credit principle may be stated as follows: If the road user tax rates adequately reflect the costs imposed by motor vehicles, the user share of road and street cost can be measured by the tax revenue earned on roads and streets. Thus, user revenue earned on each system is "credited" to that system. The extent to which the "credit" falls short of total cost, determines the nonuser share.

Accepting the need for a user-nonuser cost allocation and the traffic component framework of the benefits-received approach, the Earnings-Credit solution appears to be about the best that has been offered. Actually, the Earnings-Credit solution reflects the point that was belabored in the text; namely, that there is a significant administrative problem imposed by the need for uniform user tax rates. The solution would be helpful even if a user-nonuser cost allocation is not made, because it focuses attention on how much revenue has to be collected from users through other than uniform user taxes. Moreover, this kind of analysis is necessary in order to determine the manner in which user revenue is to be

distributed among various road systems and governmental jurisdictions. The Earnings-Credit approach appears useful as an administrative tool which can be brought into play after all costs have been allocated to those who impose them. Although it may be used to determine appropriate sources of revenue, it does not provide a basis for the allocation of costs.

A variation of the Earnings-Credit approach was employed by Simpson in the Ohio study. Called the Standard Cost method, it involved the definition of a standard or representative road whose costs might reasonably be assigned entirely to motorists. The cost per ton-mile on this road is then applied to ton-mileage for all other roads and systems and a user revenue figure is obtained. The deficiency in revenue necessary to pay for all highway costs is borne by groups other than users.¹⁴

Recent Studies

Recent highway studies in North Dakota, Louisiana, and Kentucky already have been cited. These studies probably are the best examples of current highway financial analysis. All rely on the incremental cost method for the allocation of costs among vehicle classes and all make a cost allocation between users and non-

users. Koenker in North Dakota relied on both the Predominant-Use and Earnings-Credit methods.¹⁵

The Louisiana study made by Ross utilized the Relative-Use and Earnings-Credit methods.¹⁶ Utilization of two or more methods is justified because of the arbitrary nature of the solutions. It has never been claimed by highway analysts that the allocation of costs between users and nonusers is scientific, but it has been maintained that it is a theoretical necessity. For example, Koenker writes as follows:

Not only, however, are highway services joint products with respect to user and nonuser; they are also joint with respect to the many and varied classes of users. As in the case with most joint products there is no neat means of assigning the specific benefits and costs . . . .¹⁷

The idea that highway costs are joint costs in almost every respect is still very much with us. Recognition of these difficulties led Lockyer in Kentucky to conclude that it is best not to give too much attention to the allocation between users and nonusers. Lockyer chose to adopt the "long-standing public decision of a growing nonuser contribution."¹⁸ The historical trend

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¹⁵Koenker, op. cit., p. 16.
¹⁶Ross, op. cit., pp. 40-41.
¹⁷Koenker, op. cit., p. 15.
¹⁸Lockyer, op. cit., p. 46.
of nonuser tax sources devoted to roads indicated an annual increase in nonuser contributions of three per cent. The allocation between users and nonusers was predicated on this finding. Actually, a cost allocation was not made, but an historical and institutional fact was recognized. Although the Kentucky study admittedly fails to solve the problem, it does not rely on strained rationalizations.

Yet in view of the value judgements and arbitrary assumptions and decisions required by all other known methods of solution, this historical approach appeared reasonable. We have simply accepted the value judgement of the people of Kentucky as to how much nonusers should contribute.19

Moreover, the subsequent incremental analysis was carried on without deducting the nonuser share. That is, the allocation of all costs was made initially to motor vehicles. At a later point, the incremental cost assignments were reduced by a proportion representing the nonuser share of cost. Thus, much of the distortion created by the usual deduction of a nonuser share of costs was eliminated.20

The Kentucky study does not miss by far the procedures advocated in the text. By relating the nonuser share to an institutional situation, it appears to recognize the fundamental reason

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19Ibid., p. 48.

for a nonuser contribution. Unfortunately, the study is apologetic for its procedures and embraces, in principle, the benefits-received approach as evidenced by the following quotation:

It is generally recognized that a well-founded and reasonable division of expenditure responsibility between users and nonusers is a basic prerequisite to formulating an equitable system of highway taxation. The theoretical soundness of apportioning the user tax requirement only among users without regard to nonuser responsibility is questionable . . . . The multiple benefits accruing from highways constitute the difficult problem of distributing costs among beneficiaries . . . . The problem is to determine just how much of the whole benefit may be properly allocated to one of the groups, say highway users, benefiting jointly with others.  

In almost one breath the study refers to (1) nonuser expenditure responsibility, (2) distributing costs among beneficiaries and (3) allocating the whole benefit among joint beneficiaries. Each of these statements refers to the same problem and they are used synonymously. Obviously, they are not synonymous and serve only to point up the confusion that attends the multi-purpose or benefits-received approach to highway problems.

Nevertheless, the procedures used in the Kentucky study represent a step in the right direction. The study demonstrates the possibility of a direct cost assignment to users and recognizes that the deduction of a nonuser share of total cost tends to introduce a distorting element in the user tax structure. If the procedures used in Kentucky become widely accepted, there is

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a possibility that the traditional user-nonuser allocation will be recognized for what it really is: An administrative necessity which should not enter into the allocation of costs.
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AUTOBIOGRAPHY

I, Milton Zach Kafoglis, was born in Lexington, Kentucky, May 2, 1925. I received my secondary school education in the public schools of Lexington, Kentucky, and my undergraduate training at the University of Kentucky, which granted me the Bachelor of Science degree in 1949. From the University of Kentucky, I received the Master of Arts degree in 1951. In October, 1951, I enrolled at Ohio State University, where I specialized in the Department of Economics and completed the requirements for the Doctor of Philosophy degree.