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The Economics of Transportation Planning in Urban Areas

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I. *Urban Peak Problems*

One would think that investigations of peak phenomena should be at the very heart of urban transportation studies: The rhythm of urban traffic movements occurs daily, is predictable within very fine limits, is extremely pronounced in many instances, and causes high costs, confusion, and congestion. It primarily affects passenger transportation to and from work and is therefore a rich source of irritations and complaints. In fact, peak-hour commuter service may be regarded as the great underdeveloped area of the entire transportation industry.[1]

Clearly, something needs to be done and yet so far little systematic attention has been given to this core problem. Zettel and Carll point out that most of the contemporary metropolitan studies mention it only in passing:

> The Pittsburgh report is somewhat philosophical about the congestion problem: "When these many movements overlap in time and space, and there are too few travel facilities, crowding and traffic congestion result. This is an almost inevitable result of growth and progress. Who would want to empty streets and sidewalks?" Or, as the Chicago study says: "There is natural

NOTE: Section I, "The Relevance of Economics," of the author's original version contained discussion of sociology, urban planning and other subjects which, while of considerable interest, were not deemed particularly relevant in the present volume. This part of the paper was therefore deleted to conserve space, by editorial decision, but is available upon request from the author.

[1] "Long range planners, government officials, and members of the general public alike may reasonably ask why a technology capable of producing jet passenger aircraft, manned satellites, hydrofoil ships, nuclear-powered ocean vessels, and a great array of complex weapons can not also be called upon to do something rather handsome for the weary and long-suffering commuter." Clark Henderson, *New Concepts for Mass Transit*, Stanford Research Institute, Long Range Planning Service, Menlo Park, California, December 1961.

competition for the use of highway and mass transportation facilities," adding, "people are bound to get in one another's way." But few attempts are made in these studies to consider whether congestion is in fact worsening, or is being reduced, by the current efforts to provide and maintain transport services.... There is notably lacking in these studies—both in the initial statements and in final reports that have been made—any extensive analysis of the development of congestion over time.[2]

With this general background in mind, the writer wishes to discuss briefly some current research on the economics of peaks.[3] The purpose is not so much to report on definitive findings, but rather to outline promising approaches. It is hoped that this will stimulate scholarly interest in the field.

PEAK PHENOMENA

Extreme diurnal peak demand patterns can be observed throughout transportation: they are manifested by vehicles on freeways, passengers in subways or buses, people in terminal lobbies, aircraft parked at gate positions or using runways for take-off and landing. But they are also quite common elsewhere; for example, in telephone, electric power, gas and water systems, retail establishments, hotels. Daily peak patterns are widespread throughout the economy.

Peak patterns are best portrayed by means of graphs. Figure 1 shows just one day's results of traffic counts which Richard Carll and Wolfgang Homburger, of the Institute of Transportation and Traffic Engineering, University of California, have been carrying out at strategic locations in the Bay Area since April 1959. The westbound peak into San Francisco reached almost 40,000 people per hour in the morning, but the eastward, homebound peak in the afternoon is sharper still, with a flow rate of 45,000 people per hour.

Note that if shorter intervals were chosen for measurement and diagrammatical representation, for example, ten minutes or five minutes, the peak patterns would be even more extreme.[4] Within limits, peak

[2] Richard M. Zettel and Richard R. Carll, *Summary Review of Major Metropolitan Transportation Studies in the United States*, The Institute of Transportation and Traffic Engineering, Berkeley, 1962, p. 21.

[3] Tillo E. Kuhn, Charles A. Hedges, and David C. King, *The Economics of Peaks: Concepts, Statistical Tools and the Example of Electric Power*, Technical Report, Institute of Transportation and Traffic Engineering, Berkeley (forthcoming).

[4] "Each weekday morning between the hours of 7:00 and 10:00, 1,430,000 people go to work in Mid-Manhattan. This large volume of individual travel trips converging in the 7.9 square-mile area during peak periods establishes the capacity requirements for the physical facilities .... The severity of the peaking problem can best be appreciated by examining the critical ten-minute periods. Between 8:55 and 9:04, 20% of the workers in Mid-Manhattan arrive at their jobs, while 32%

extremes are a function of the time interval chosen for observation. Traffic flows look rather tame when they are expressed as annual or average daily volumes as is done in the majority of reports. Dramatic fluctuations of the type shown in Figure 1 occur on many traffic arteries, five days a week, year after year, in practically all the large cities on the globe, whenever people go to work and return home.

STATISTICAL DEFINITIONS AND CONCEPTS

Among the most useful mathematical concepts in peak research are:

1. For descriptions of fluctuations: *cycle* (a periodic movement in a time-series); *oscillation* (fluctuation about the mean value of the series); *amplitude* (the value of the ordinate at its peak or trough taken from some mean value or trend line); *peak* (the maximum value of a periodically varying quantity during a cycle; a high point in the course of development, especially as represented on a graph).
2. Measures of central tendency: the familiar *arithmetic mean*, *median*, and *mode*.
3. Measures of dispersion: *average deviation*, *variance*, and *relative dispersion*.
4. Measures of skewness and peakedness: *negative* and *positive skewness*, *kurtosis* (measure of "peakedness" of a curve).
5. Demand and capacity concepts: *load factor* (the ratio of the average load to the peak load); *capacity* (a difficult and ambiguous concept; it is generally interpreted as "maximum output," or "rated output," or "maximum output under prescribed performance conditions"); *capacity factor* (the ratio of average load to capacity); *utilization factor* (the ratio of peak load to capacity).

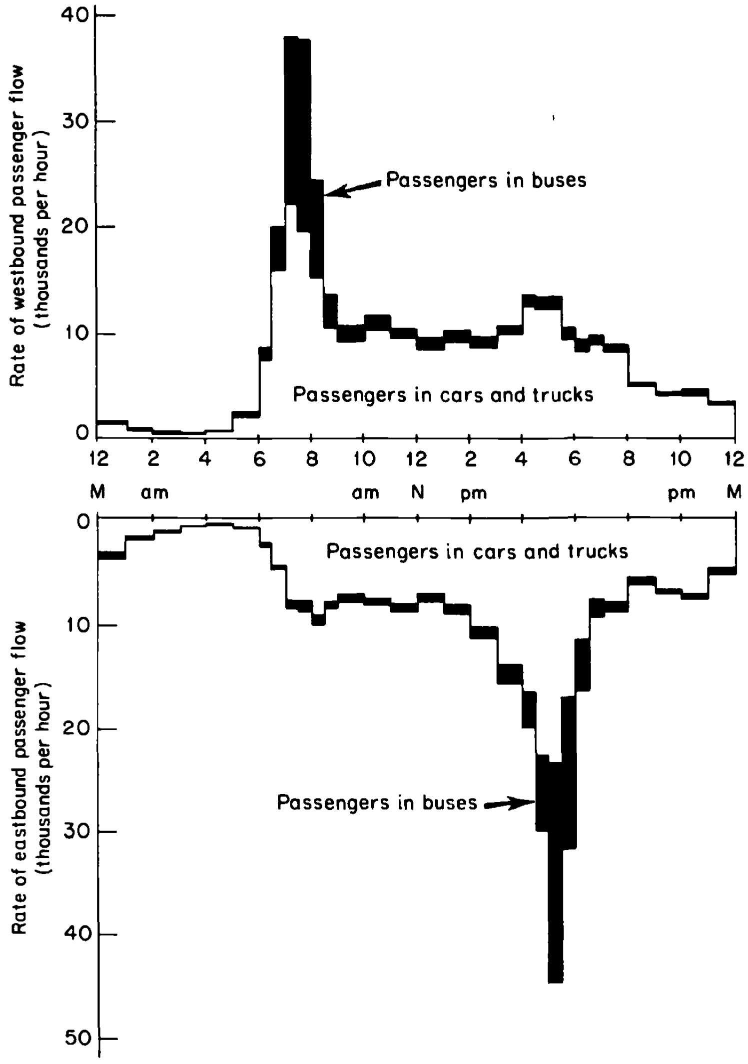
SOME APPLICATIONS AND FINDINGS[5]

Analyses of diurnal traffic cycles on the San Francisco-Oakland Bay Bridge, were made with the quarterly data collected and tabulated by Messrs. Carll and Homburger. Some of the findings were: On the Bay Bridge, "oscillation" is a high percentage of "amplitude"; a 3:00 to 4:00 a.m. count may yield fewer than 200 vehicles, but volumes of

depart during the period 4:55–5:04. . . . It is important to note that headquarters offices and service industries, which give rise to the sharpest rush-hour peaks, are the activities which are expanding most rapidly in Mid-Manhattan . . . . As professional, administrative and clerical functions continue to expand, we must look forward to experiencing greater peaks, with all the associated problems of congestion." New York-New Jersey Transportation Agency, *Journey to Work*, New York and Trenton, 1963, p. 18.

[5] This section is based on a special progress report by David C. King (unpublished).

Figure 1
Rate of Passenger Flow Across
San Francisco-Oakland Bay Bridge,
Typical Weekday, January 1963



SOURCE: I.T.T.E. Traffic Survey A-16.

over 7,000 vehicles in *one direction* have been attained during an evening peak hour.

On the Bay Bridge, peaks are obviously "suppressed." Peaks have been spreading into the earlier and later hours of the rush period as congestion discourages drivers from traveling at the time most convenient to their personal schedule. Over the years, the high portions of the traffic volume curves have therefore changed from "leptocurtic" (sharp, peaked), into "platycurtic" (flat-topped) shapes.

The electric power industry has always been greatly concerned with peak problems and has developed more advanced concepts and solutions than other technologies. There is a remarkable difference, however, between the approach to peak demand of electric power and that of highway transport industries. Electric power companies are prepared, perhaps under the edict of regulatory authorities, to meet absolute peaks if necessary. Strenuous efforts are made to avoid "brownouts." They may, however, take steps to discourage peak use (through interruptable power contracts) and to encourage off-peak use (through various inducements). In the highway field, however, peak demand suppression occurs regularly. It is not even clear what degrees of suppression are regarded as tolerable or intolerable from the technical, economic and community points of view.[6] Some highway bridge authorities *encourage* peak use through cheaper commuter tickets.

There is debate on the meaning of "highway capacity." One recent technical report[7] on the Bay Bridge derives annual capacity from assumptions on hourly lane capacity and the proportion of total daily traffic represented by peak-hour traffic. For example, the Bay Bridge capacity is assumed to be 1,500 vehicles per lane per hour, or 7,500 vehicles in the peak direction. The annual capacity is then 45 million vehicles. But if a capacity of 1,800 vehicles per lane per hour is stipulated, the annual capacity of the Bridge would be as much as 54 million

[6] The American Association of State Highway Officials states: "A freeway is intended for the rapid movement of large volumes of traffic with safety and efficiency . . . but it seldom is feasible to provide facilities with a capacity to accommodate the peak-hour volumes at such speeds so that the running speeds at such times are lower. Thus, the freeway design speed should reflect the desired running speed during nonpeak hours, but not so high as to be wasteful since a large portion of vehicles are accommodated during periods of peak flow when lower speeds are acceptable." AASHO, *A Policy on Arterial Highways in Urban Areas*, Washington, D.C., 1957, p. 120. (There is no indication what the meanings of the terms "feasible," "desired," "wasteful" and "acceptable" are.)

[7] Coverdale and Colpitts, *Report on Traffic on the Existing San Francisco Bay Crossings and the Proposed Potrero Point-Alameda Crossing, Sierra Point-Roberts Landing Crossing, San Francisco-Marin Crossing*, New York, September 1962, pp. 13–14.

vehicles. A more even distribution of the traffic over the hours of the day and a flattening of the peaks would also increase the capacity estimates. Two frequently found definitions are "practical capacity" (under which drivers experience no "unreasonable" delay, hazard or freedom to maneuver) and "possible capacity" (maximum traffic volume observed).

The bridge load factor (defined as the ratio of mean hourly traffic to maximum hourly traffic) runs around 33 per cent. This indicates a very poor utilization of facilities compared with the power system which has a load factor of 75 to 80 per cent.

Average and standard deviations were found to be 1,100 and 1,500 vehicles per hour, resulting in relative dispersions of 65 to 87 per cent when compared with mean hourly traffic flows of 2,200 to 2,500 vehicles per hour. This shows the erratic character of bridge traffic as between times of day. The same measures show that electric energy demand is a great deal more stable.

Results were also obtained for bus passengers and for heavy truck traffic on the transbay routes. The number of bus passengers is particularly susceptible to high fluctuations. Load factors of less than 10 per cent, utilization factors of 90 to 96 per cent (taking capacity as the maximum number of hourly passengers recorded since April 1959), and relative dispersions of over 200 per cent were recorded for an October day in 1961. Heavy truck utilization of the Bay Bridge was not analyzed in the same manner, but work done by Carll and Homburger indicates that truckers try to avoid peak hours. The truck peak occurs immediately after the auto peak in both directions; trucks account for less than 10 per cent of the total traffic during the auto peak.

A summary comparison of findings on electric power and bridge traffic performance will be of interest:

	Load Factor (per cent)	Utilization Factor (per cent)	Relative Dispersion (per cent)
Winter Demand, 1961			
Bridge westbound	33	93	74
Bridge eastbound	32	98	71
Electricity	73	86	24
Summer Demand, 1961			
Bridge westbound	37	90	66
Bridge eastbound	35	93	65
Electricity	82	97	19

The poor load factors of the Bay Bridge and the erratic fluctuations of traffic on it are noteworthy. It must be mentioned, though, that the electric power figures, which were compiled for the Pacific Gas and Electric system, may look unduly favorable. Regional power demands, for example during the summer for air conditioning and water pumping in the agricultural San Joaquin Valley, or during the winter in the industrial-residential Bay Area, may show much more extreme peaks.

POSSIBLE SOLUTIONS TO URBAN PEAK PROBLEMS

The foregoing demonstrates that peak phenomena can be subjected to quantitative, statistical research. The studies can readily be extended to other technologies, for example to telephone, teletype, and data transmission networks; air transport; and gas and water supply systems. Leads and lags in peak patterns could be investigated; in the morning there are probably successive "waves" of peak uses to be observed on the airport access road, at the aircraft gate positions, the terminal building, runways, and in the air. Long-range trends can be examined and forecasts of peak behavior can be attempted: Are peaks getting "worse"? To what extent are they being suppressed? Supposing capacity had to be provided, what would unsuppressed peaks be like on urban freeways?

It is certainly possible to measure and predict the "lifebeat of the metropolis" in various ways. But the really challenging task is to devise rational, economically efficient ways of dealing with peak phenomena. Some tentative suggestions can be put forward.

1. *Peak pricing*. There has been considerable economic discussion on how to charge peak users. As is to be expected, the conclusions suggest that those who demand high-cost peak facilities, should pay more than off-peak customers. One would like to suggest that rather different questions ought also to be considered. First, urban dwellers do not become peak users for their own amusement, especially not the hapless commuters. Millions of urban workers are virtually compelled to be at a certain place at a certain time for reasons which are inherent in the general rhythm of urban life and the functioning of the urban economy. High peak-use charges may simply impose penalties on a particularly vulnerable segment of the population. At the same time, appropriate pricing regimes would discourage nonessential peak traffic and shift it into off-peak hours. Better utilization of transport facilities would be the desirable result.

2. *Planning peak service facilities*. We must ask how the capacities of the peak facilities are determined in the first place. Are some—for

example, freeways—deliberately built to less than absolute peak demands? If so, why? What is the economic rationale of the rule of thumb in highway engineering to cater to the thirtieth highest hourly traffic volume in a year, rather than to provide some other level of service? Why are other technologies geared to handle extreme peak loads? These and related questions probe into the fundamentals of long-range investment decisions under oscillating demand conditions. Pricing, by contrast, pertains more to short-range actions once the plant scale has been determined. In military terminology, we may say that investment is economic strategy and pricing represents economic tactics. The relation of both to peak problems is a most promising research area.

3. *The space and time economies of the metropolis.* We know absolutely nothing about the precise economies that are obtained by assembling people, messages, and objects in time and space (the executive, his secretary, the mail, and telephone calls are all brought together at the office at 9 o'clock in the morning). Conversely, we know nothing about the diseconomies of shifting these components of economic activity out of phase. Big cities, especially London and New York, have for years experimented with staggered working hours in the central business district. What have been the trade-offs between diminished business efficiency and enhanced urban transport performance?

4. *Encouragement of transport services with good peak performance.* In some respects private passenger cars are rather poor vehicles for carrying people in and out of central areas during peak hours. No other medium requires as much precious urban space per passenger for movement and storage; speed and safety performance is disappointing for highly peaked mass movements; nonmarket costs (air pollution) are high. Figure 1 provides a dramatic illustration of how much more efficient buses are for the purpose. It would be interesting to calculate how many millions of dollars in bridge investment would be necessary if the transbay buses were replaced by automobiles and the same peak-hour performance had to be maintained. Other transport means yet to be introduced or invented may be superior still to buses. It should be the prime function of urban transport investment analysis to ferret out and encourage these alternatives.

5. *Making peak transport demand unnecessary.* What is the possibility of rearranging urban land-use patterns in such a way as to cut down on peak movements? Are there substitutes to be found outside the transportation industry for physical movements of people? Could

message transmissions (telephone, videophone, closed television circuits) replace face-to-face meetings? Could the business executive of tomorrow operate out of his suburban home with the aid of exotic communications devices?

II. *Investment Analyses for Urban Transportation*

It is not possible within the context of this paper to develop a complete analytical framework for urban transportation planning. The excellent review of study methods by Richard M. Zettel and Richard R. Carll should be consulted.[8] Urban transportation economics proper can conveniently be seen as part of public enterprise economics; this broader field has attracted increasing attention recently and some of the works will be of interest.[9] We will discuss items of special interest only here.

TERMINOLOGY

Urban transportation, and in fact the whole field of public enterprise economics, is burdened by confusing terminology. Agreement on clear definitions of the things to be analyzed would alone be a step forward.

First, this writer wishes to express dissatisfaction with the term "benefit-cost analysis," which is quite commonly used. It can be traced back to the *Flood Control Act of 1936* which interpreted project feasibility to mean that "the benefits, to whomsoever they may accrue, are in excess of the estimated costs." Since then, four distinct aspects have become associated with benefit-cost comparisons.

1. All benefits, no matter how widely dispersed throughout the economy, must be credited to the project.

A wide analytical viewpoint is certainly desirable. In urban transportation studies, the point of reference should be set at the level of the metropolitan economy. But the analysis must not be restricted to the measurement of favorable effects only. All costs, regardless of how remote their incidence is, ought to be traced as well. Many so-called highway benefit studies credit land value increases to adjacent road development, forgetting the corresponding relative decreases in property values elsewhere. Other undesirable consequences, such as smog, accidents, noise, and scenic blight, are also often overlooked. There

[8] Zettel and Carll, *Summary Review*.

[9] Tillo E. Kuhn, *Public Enterprise Economics and Transport Problems*, Berkeley, 1962. (In the Appendix of this book there is a "Summary Comparison of Analytical Procedures and Criteria Proposed in Prominent Public Enterprise Documents.")

has further been a tendency to double count highway benefits which were simply transfers from one party to another.[10]

2. All benefits and costs of a project, whether they can be expressed in money terms or not, must be considered in the analyses.

Again there is agreement that all relevant evidence, whether it fits into the economist's special domain or not, ought to be studied. However, a clear distinction should be made between market and nonmarket values. The latter, while largely falling outside pure economics, must not be neglected in favor of the former. It is also misleading, arbitrarily, to convert nonmarket effects—highway accident deaths, time savings, comfort—into dollars and cents, as has been done in many highway benefit studies.

3. Benefit-cost studies provide scientific guidance for user charging and, hence, for resource allocation in transportation.

Neither of these laudable objectives has been achieved by benefit-cost studies to date. In the literature there is widespread confusion about the adherence of transport pricing to the minimum boundary condition (cost of providing the service), or to the maximum one (benefit, value, or utility derived from use), or to some intermediate position. The *Final Report of the Highway Cost Allocation Study*, for example, blindly averages conflicting results of unrelated cost and benefit formulae, some of them of questionable validity. The *Final Report* as much as admits that five years of research were in vain by inviting the policy makers to take their pick among the results:

> Although it is believed that the use of these findings will assist in developing a reasonable allocation of Federal-aid highway costs among those who occasion them and reap their benefits, the fact that they were achieved by a mediation between differing results emphasizes the truth that in the field of cost allocation indisputable accuracy of findings is not possible. The report concludes that definitive answers to questions of cost allocation between users and non-users cannot be reached solely through analysis. These answers are ultimately matters of policy.[11]

[10] The Final Report of the so-called Section 210 Study states, in one of its better passages, "The benefits of highway improvement, spread out like ripples from a stone dropped in a stream, and in some respects are as elusive as quicksilver. . . . Only by an elaborate input-output analysis, on an interregional and interindustry basis, for which techniques are not now available, would it [be] possible to make any sort of approximation of the totality of nonuser benefits that will be brought about by the . . . program." U.S. Congress, *Final Report of the Highway Cost Allocation Study*, House Document No. 54, Washington, D.C., 1961, p. 31.

[11] *Ibid.*, p. 4. The *Final Report* offers to the policy makers the following "range of required payments based on study findings" for a diesel tractor-semitrailer and full trailer combination: low—$273.26 per annum; high—$3,553.20 (Table I-3, p. 17). The suggested payment ranges for other vehicle types are less extreme. But of whct possible policy use can findings of this sort be? It should be noted that their spurious accuracy extends to single cents.

On the second point, there is no guarantee at all that a meticulous transport pricing regime will automatically bring about the right investment decisions for the future. Pricing, as evidence of current consumers' acceptance of the service under the usual monopoly conditions, provides partial guidance only for planning; it becomes rather irrelevant when the investments under consideration mature five or ten years from now.

Public transport enterprises are further in the strange position that the customers (highway or rapid transit users) are also, as citizens and voters, the shareholders. Users pay for services consumed, but simultaneously they also put up capital investment funds. For example, motorists constantly invest gasoline taxes in the Interstate Highway System. It is often glibly assumed that urban transport investments which are "financially feasible" are also economically justified and socially desirable. But the availability of funds, especially under the present complex structure of intergovernmental aids and grants, is no reliable guide to planning decisions in the urban sphere. If coordinated urban transport planning is to be taken seriously, it will require coordinated physical, economic, financial, and fiscal planning. These phases cannot be separately pursued.

4. The only correct public investment planning tool is the benefit-cost ratio.

This notion must be rejected. There are other decision-making criteria which will perform much more satisfactorily. Benefit-cost ratios have a number of fundamental defects, and often rather suspect procedures have been used to arrive at them. In particular, the treatment of the time dimension has often been incorrect, interest has been neglected, time spans have been set unrealistically long, no diligent search for alternative solutions has been carried out.

In view of the checkered history and doubtful scientific reputation of some benefit-cost studies, it may be desirable to banish this expression from the urban transportation scene. Intellectually, future analyses should be firmly anchored to the economic theory of investment. The term "investment analyses for urban transportation" may therefore be appropriate. There is no reason for continuing to regard benefit-cost studies as a separate body of analytical techniques in economics.

The rest of the terminology also needs weeding out. The current literature offers a jungle of project effects which are supposed to be analyzed: pecuniary and nonpecuniary, internal and external, private and social, nontransfer and transfer, on-site and off-site, direct and indirect, market and extra-market, economic and noneconomic, measurable and nonmeasurable, monetary and nonmonetary, tangible and intangible, direct and spill-over, individual and collective, primary and secondary.

It is suggested that a simple three-tier classification of effects is all that is needed:

1. Costs (all undesirable effects of actions; inputs; sacrifices) vs. gains (desirable effects; outputs; rewards). In private enterprise investment analysis these terms would correspond to cash costs and cash revenues. In urban transportation studies a much broader interpretation is necessary.

2. Market vs. nonmarket costs and gains. This is a simple distinction between effects which are satisfactorily expressed by market prices according to the economist's rule book, and those which are not.

3. Internal vs. external costs and gains. This distinction arises entirely from the viewpoint adopted for the analysis: external effects are ignored, internal ones are considered. A public viewpoint compels study of all costs and gains within the area of jurisdiction—there are no external effects by definition.

Suppose the viewpoint is that of the San Francisco Bay Area metropolitan region, and a scenic parkway is under study. The additional tourist trade this facility generates would be an internal market gain to the metropolitan economy; its contribution to urban aesthetics, an internal nonmarket gain; the fatal accidents attributable to it, internal nonmarket costs; and the losses sustained by the hotel trade in Los Angeles, external market costs.

In this way, rather complex repercussions can be arranged systematically, precluding double counting, omissions, and confusion.

PROJECT SELECTION CRITERIA

The urban transportation analyst will be confronted by projects with diverse cost and gain patterns extending over time. It is generally agreed that discounting to present values is a convenient method for reducing these complex time profiles into flat images as it were. The standard discounting formulae are well known and need not be repeated here. Applying them, we obtain the present values of a series of gains, V, and of a series of costs, C, when both are discounted at a rate r over the functionally useful life of the project.

The most basic project selection test then is: accept projects if $V \geqq C$, reject if $V < C$. There is a mild controversy over the choice of the discount rate. Some claim that r should be determined within the project planning process itself; for example, it might be the internal rate of return of the very last (marginal) project that can still be fitted into the program. Others, this writer included, suggest than an externally derived market rate of interest or social rate of time preference is appropriate. But otherwise there is unanimity that the basic accept-reject test is sound. Even the benefit-cost ratio proponents are accommodated. Their fundamental selection rule is: Carry out all projects which have a benefit-cost ratio of at least unity, reject all those with a lesser ratio. That is to say, accept projects if $V/C \geqq 1$, reject if $V/C < 1$. The two tests amount to exactly the same thing, of course.

Suppose a whole program consisting of a number of projects has to be chosen. What is the correct decision-making criterion? Some, the author among them, say that for the program as a whole maximization of $V - C$, or maximization of the present value of net gains, yields the best results. Others say that the project with the highest V/C ratio deserves first consideration, the one with the next highest ratio should come second, and so on, until the program is complete.

On reflection it becomes apparent that both procedures lead to identical results if there are no other constraints. When all projects with $V/C \geqq 1$ are included in the program, the program as a whole will also show maximum $V - C$. Consequently, the involved process of arranging projects on a list by degrees of preference is really quite redundant.

Frequently, mutually exclusive alternatives have to be compared in transportation investment planning. Different designs or locations are technically possible, but one and only one solution is to be carried out. How should the best project be selected?

Here again, some advocate maximization of $V - C$, others maximization of V/C, as the correct selection criterion. We can demonstrate the virtues of both of these by working through an example contained in the AASHO report on *Road User Benefit Cost Analyses for Highway Improvements*.[12] This manual, despite numerous theoretical and practical shortcomings, still has a considerable following among members of the highway profession.

We need not examine the rationale of AASHO's gain and cost figures since we are only interested in the method of project choice. As shown in Table 1, alternate plan 1 (the existing condition) means doing nothing at all: annual highway costs would stay at \$19,800 and annual road user costs (defined as the costs of operating motor vehicles) at \$411,600. Alternate plans 2 to 6 represent various highway improvement projects,

[12] American Association of State Highway Officials, *Road User Benefit Analyses for Highway Improvements*, Washington, D.C., 1960. (1952 report without basic change except for use of 1959 unit costs.)

TABLE 1

AASHO METHOD OF PROJECT SELECTION

Alternate Plan	Total Annual Cost (dollars): Highway	Total Annual Cost (dollars): Road User	First Benefit Ratio: Differences in Costs from Alternate 1 (dollars): Highway (C)	First Benefit Ratio: Differences in Costs from Alternate 1 (dollars): Road User (V)	First Benefit Ratio: Calculated Benefit Ratio (V/C)	Second Benefit Ratio: Differences in Costs from Alternate 2 (dollars): Highway (C)	Second Benefit Ratio: Differences in Costs from Alternate 2 (dollars): Road User (V)	Second Benefit Ratio: Calculated Benefit Ratio (V/C)
1 (basic)	19,800	411,600	--	--	--			
2	22,200	356,700	2,400	54,900	22.8	--	--	--
3	23,100	354,800	3,300	56,800	17.2	900	1,900	2.10
4	25,000	336,200	5,200	75,400	14.5	2,800	20,500	7.30
5	29,200	352,100	9,400	59,500	6.3	7,000	4,600	0.66
6	29,700	352,600	9,900	59,000	6.0	7,500	4,100	0.55

Source: American Association of State Highway Officials. *Road User Benefit Analyses for Highway Improvements.* Washington, D.C., 1960, pp. 151-152.

each resulting in its particular set of highway and road user costs. Only one plan can be carried out. Which one should it be?

AASHO correctly compares the additional road improvement costs (C in our terminology) with the savings in vehicle costs (V). But use of the benefit-cost ratio as a selection criterion leads to complex calculations. In the first round, alternate plans, 2, 3, and 4 "all show justification of a high order," but plan 2, with the highest V/C ratio of 22.8, would seem to be the most preferred. However, when plan 2 is put in as the basic condition, "the extra costs of plans 3 and 4 show justification, the latter to a high extent." Hence, AASHO concludes, alternate plan 4, which emerges with a high V/C ratio of 7.3 in the second round, should be selected. Plan 3 is inferior to 4, and plans 5 and 6 can be rejected outright as they show benefit-cost ratios of <1 in the second round.

Applying our selection criterion of maximum $V - C$ to AASHO's basic data, we get exactly the same result with much less trouble:

Alternate Plan	*Gains* V	*Costs* C	*Net Gains* $V - C$
2	$54,900	$2,400	$52,500
3	56,800	3,300	53,500
4	75,400	5,200	70,200
5	59,500	9,400	50,100
6	59,000	9,900	49,100

As can be seen, alternate plan 4 maximizes $V - C$ and should be chosen.

It is possible to apply another variation of the $V - C$ maximization criterion to the AASHO data and still arrive at the same conclusion. According to the AASHO publication, the value to the community at large of accommodating a certain volume of highway traffic may be called V. The exact magnitude, in dollars and cents, of performing this function is not given by AASHO. However, it appears that V stays the same no matter which alternate highway improvement plan is adopted. Highways and motor vehicles can then be regarded as two factors of production which have to be combined in certain proportions to yield the desired highway transportation services. Highway costs, C_h, must be added to motor vehicle costs, C_m, to arrive at total costs of highway transportation, C. Alternate plans 1 to 6, therefore, represent different admixtures of the two factors of production, each with its particular magnitude of C.

Alternate Plan	Highway Costs C_h	Motor Vehicle Costs C_m	Total Highway Transportation Costs $C = C_h + C_m$
1	\$19,800	\$411,600	\$434,400
2	22,200	356,700	378,900
3	23,100	354,800	377,900
4	25,000	336,200	361,200
5	29,200	352,100	381,300
6	29,700	352,600	382,300

With V fixed, the problem becomes one of straightforward cost minimization. Alternate plan 4, which results in the lowest combination of highway and vehicle costs, is obviously the best solution.

Either way, then, maximization of $V - C$ provides us with a simple, effective, and unambiguous criterion for correct project choice. The AASHO method, on the other hand, necessitates calculations of first, second, and possibly further benefit-cost ratios. There is no virtue in using this approach for choices among mutually exclusive alternatives.

Benefit-cost ratios have the further drawback that elaborate accounting rules must be followed in listing effects as gains or costs, otherwise distorted ratios are obtained. This is a serious handicap in highway analyses where the effects of positive costs (highway expenditures) may be conceived either as positive gains (user benefits) or as negative costs (savings in motor vehicle costs), as we have seen in Table 1. Following the maximization of $V - C$ rule, these bookkeeping details are of no significance and a correct answer is obtained every time.[13]

RANKING AND BUDGET CONSTRAINTS

The controversial concepts of "project ranking" or "project priorities" need to be examined carefully. Suppose, once again, that a whole program of several projects has to be submitted for approval to a top decision-making body, for example, to Congress, to a budget committee, or to a planning authority. We must assume that the proposed projects have already passed the $V \geqq C$ test. Ideally, all of them should therefore be endorsed immediately. Any deletions or delays would

[13] Benefit-cost ratios also perform badly when there are complementary and competitive relationships among projects. These are quite common in the urban transport sphere; for example, the cross effects which freeways, feeder roads, subways, parking garages, and bus lines exercise upon each other. Such network or systems phenomena are discussed in detail in Tillo E. Kuhn, *Public Enterprise*, pp. 92–100, 116–123, 187.

mean loss of net gains. But the decision-makers, for reasons of their own, wish to trim the whole program down. It is therefore necessary, so writers on the subject claim, to arrange the projects on a priority basis in order of descending benefit-cost ratios. The decision-makers would then be able to first eliminate projects at the bottom of the list, gradually working their way to higher benefit-cost ratios until they have cut the program to the desired size.

This whole process, as described, is a little baffling. Basically, we are really concerned with a simple "accept or reject" choice: projects can only be either definitely "in" or definitely "out" of the program. Yet ranking implies that there are shades of being "in" or "out," subtle degrees of being accepted or rejected. If the ranking problem is stated in this way, it doesn't make sense. Additional circumstances have to be brought in to make it realistic.

1. Ranking over time. Most appealing is to regard ranking as an ordering in time; that is, once a priority list exists, project 1 would be done first, project 2 a little later, and so on. For example, construction companies might not have the capacity to cope with numerous projects all at once. Or if they expanded their capacity, there might be a danger of "feast and famine" cycles in construction activity. The decision-makers, with revenues coming in gradually throughout the year, may also prefer a more balanced pattern of project expenditures for financial reasons.

How can ranking over time be handled analytically? This is really a mathematical exercise in testing how much we gain and lose by shifting the starting dates of various projects backward and forward in time. Suppose there are twelve projects which all show $V \geqq C$, and each costs $1 million. The decision-makers have approved a total annual program of $12 million, with one project starting every month. Here the correct method would be to try to maximize $V - C$ for the program as a whole under these particular conditions. A trial-and-error approach is needed, if the cost and gain profiles of the individual projects are irregular.

Is it possible to use a V/C ranking if both gains and costs are expressed in present values? If the gain and cost profiles of the various projects have the same basic pattern, such ratios can be employed for determining priorities over time: the highest V/C ratio project should come first, and so on. It should be noted that in many cases net gains will grow at faster compound interest rates than the rate assumed for discounting purposes. When this occurs, the growth rate of the numerator will be larger than that of the discounting term in the denominator. Hence, such projects would show larger V/C ratios as they are postponed over time. However, maximization of $V - C$ would still be a less ambiguous project selection tool under the circumstances.

2. Budget constraint. Of importance also is the notion, frequently encountered in the water resource economics literature, that the decision-makers arrive at varying budget limits by some magical processes which are quite unrelated to the sizes and merits of the programs submitted by the analysts. Hence, lists of ranked projects must be made available, so that appropriate cut-off points satisfying the budget limits can be determined.

Once more, this procedure does not seem satisfactory. If there is an arbitrary budget limit—arbitrary in the sense that it was not arrived at with the aid of analysis—then in effect we are confronted with a constrained C. If so, then the V's for the program as a whole should be maximized in relation to the given C. If the budgeting process is fickle and there are several possible constrained C's, alternative programs must be worked out for each one of them, still following the criterion of maximizing $V - C$. The correct method under the circumstances is to compose the different programs with the aid of various discount rates: a high rate would ration out many projects and would therefore result in a conservative program; a low rate would have the opposite effect.

The most disturbing feature of arbitrary budget setting is this: it seems to treat the specified sum of C as practically costless—the money is earmarked and must be spent no matter how big or small the V's obtained; but any amount of proposed expenditure that exceeds the specified budget becomes infinitely costly no matter how large the potential additional V's may be. In other words, a completely arbitrary step function for the cost of money prevails, with the C constraint suddenly rising from zero to infinity. But in good budget planning there should really be gradually increasing penalties on larger programs. Such a smooth rationing effect can best be achieved by upward adjustment in the discount rate, for example from 4 to 5 to 6 per cent. This would be comparable to the rising interest costs faced by private enterprises in the money market, when larger and larger loans are sought.

It is suggested, in conclusion, that the ranking and budget constraint problems in urban transportation can be tackled intelligently. First, budgets ought to be based on well-prepared investment analyses; there is something wrong with the institutional arrangements if budgets are simply imposed arbitrarily. Second, if arbitrary budget limits are nevertheless a fact of life, then the program size should be fitted to the constrained C by varying the discount rate; if there is great disparity between the resulting discount rate and, say, the market interest rate in the private sector, this will at least be a signal to the decision-makers that there is something wrong with their budget constraint. Third, ranking over time can be determined by analytically postponing or advancing individual projects; maximization of $V - C$ for the program as a whole is the correct criterion.

OTHER CONSTRAINTS AND CRITERIA

Frequently distinctions are made in urban transportation planning between capital costs (K) and operating costs (O), where total cost $C = K + O$. Institutionally, different constraints are placed upon K and O and this greatly distorts the investment process. Sometimes K is subjected to budget scrutiny and rigorous analysis, but O is unconstrained because it is assumed that future project operating costs can be met from future project revenues. Consequently there is great incentive to substitute O for K. Projects with low capital intensity will be promoted, or planners will try to pass off capital costs as operating ones; because of the nebulous nature of everyday cost definitions this is not too difficult. Alternatively, funds for K may come from low-interest, low-risk, general revenue bonds, whereas O has to be found from possibly meager operating revenues. Here substitutions of K for O are advantageous. Either way, whenever costs are loaded onto an artificially low-risk, low-interest, source of finance, the economic balance is disturbed.

Other distortions occur when "foreign aid" [14] from outside the region enters into urban transport investment considerations. Usually federal or state aid is limited to capital investment items. Hence there is great pressure to favor highly capital intensive projects. In effect, massive monuments to the future in steel and concrete will be built with outside funds, even when less durable investments might be economically more appropriate.

The common practice of federal and state governments to offer liberal financial aid for urban freeways, especially those which form part of the interstate or state highway network, but not for other transportation technologies, has had particularly powerful effects. In California at the present time as much as 100 per cent of the costs of urban freeways designated for the Interstate Highway System are

[14] This somewhat unorthodox term is explained in *ibid.*, pp. 55–57, 200–202.

borne by the senior governments and over 90 per cent of the construction costs by the federal government; the remainder, plus all operating expenses, by the State of California. This formula applies, for example, to the controversial $180 million, 7.1 mile Western Freeway in San Francisco, which has been proposed by the State but has not been accepted locally. From the point of view of the local authorities, this project would be a gift from the authorities in Washington, D.C. and Sacramento, were it not for losses of tax revenues from freeway land, destruction of community and aesthetic values, and so on.

Under these peculiar institutional circumstances[15] it is small wonder that urban freeways have been sprouting in the big cities all over the United States and a near miracle that local governments show any interest at all in alternative solutions, especially rapid transit, which are not eligible for the same massive "foreign aid" support. The economist can only strongly urge that senior governments adopt a policy of complete technological neutrality and offer urban *transportation* aid with no strings attached. Otherwise urban transport investment analyses, complete with benefit-cost studies and the rest, are a waste of time.

INVESTMENT APPROACHES TO URBAN PEAK PROBLEMS

This becomes an exercise in contrasting economic costs and gains. Two basic lines of attack are possible. First, it may be possible to quantify, in market terms, the gains (V) associated with different levels

[15] Richard M. Zettel describes the situation very well: ". . . in this nation we have never met fiscal problems of the lesser units of government through *unconditional* revenue-sharing or grant-in-aid arrangements—whereby the recipients would be permitted to allocate funds among their several functions and activities as their legislative bodies saw fit. Instead, the grantor seeks to establish an 'interest' in a particular function or activity as justification for the grant; and it then sets conditions upon use of the grant so that its 'interest' will be furthered. . . . these conditions conspire to shift fiscal responsibility upward. And the manner in which this fiscal responsibility is exercised tends to remove critical decisions on some governmental activities to a seat rather far removed from the scene of the problems. The grants take on the nature of 'foreign aid,' to be used or to be lost to the community. But the community must abide by the conditions. It may think its school problem more critical than its highway problem, but the highway grant will be spent for highways—along with local resources if matching is required. And if grants are available for highways but not for transit, then highway construction tends to become the financially feasible 'solution' to the transportation problem even though the community might prefer to experiment with transit. And since the way is closed to shifting funds, the dismaying alternative is to seek new grants for new purposes—grants for education in addition to highway grants; specific grants for transit as a follow-up to specific grants for highways." Richard M. Zettel, "Public Finance Policy and Urban Transport," paper presented at the annual meeting of the American Society of Civil Engineers, Detroit, 1962.

of peak performance; for example, for unsuppressed peak service (the highest V), for a slightly flattened peak (a somewhat lower V) and a severely curtailed peak demand (the lowest V). This measurement of the V's is highly problematic, but ingenious researchers may be able to accomplish it. For example, the uninhibited V would express what commuters *would be prepared to pay* if they were conveyed to their destinations with speed and comfort. Or it might be the total market gains accruing to the metropolitan economy from such a superb service. The suppressed V's would then reflect the reduced cash returns from commuters and/or the lowered efficiency of the metro economy. Given the different transport cost estimates (C) which correspond with the various V's (high C would go with high V, low with low), then the correct selection criterion would again be maximization of $V - C$.

A more promising approach, in the writer's view, would be to regard the peak V as largely nonmeasurable in market terms. The community, or its representatives, should then clearly specify the desired level of peak-hour service for everybody in the community. Exact standards should be set for door-to-door speed, safety, performance, avoidance of air pollution, external design, etc. The specifications must stress that urban transportation be seen as a *system* and be designed from beginning to end. This system must include both private and public instrumentalities, of course, as well as *all* functional components (feeders, vehicle storage, terminals, transfer facilities, etc.). In view of the backward technological performance of contemporary urban transport media, it would be a very good idea if the community transport goals were set rather high. Designers, inventors, systems analysts, and producers would rise to this challenge, just as they have risen to the challenge to get a man safely to the moon and back. There is no reason to be timid in our demands for better urban transport service.

Once the various qualities of peak-hour service have been specified by collective value judgment, the economist can help to select appropriate design configurations which will minimize C. Various other economic problems—time paths of accomplishment, trade-offs, supply and demand trends over time—can also be explored with profit by the analyst.

PREPONDERANCE OF NONMARKET VALUES

A problem that occurs over and over again in the public sector is the preponderance of nonmarket values and especially nonmarket gains. The reasons are familiar and need not be repeated here. It must be conceded that the intrusion of nonmarket values severely limits the scope of economic analysis.[16] The various gain and cost items cannot be aggregated into common money terms. Furthermore, since the relative market and nonmarket contents of costs and gains will likely differ, the two series cannot jointly be subjected to the traditional revenue-cost comparisons and calculations.

Under these circumstances, how can economists still contribute to better decisions? Fortunately, the costs of typical urban transport projects consists almost entirely of market items: the dollar outlays on men, machines, and materials necessary to build and operate these facilities. If there are distortions in the price signals generated in the market for transportation supplies, they can be corrected. Furthermore, if pure nonmarket costs are caused by specific projects, they can be entered as negative nonmarket gains if desired. For example, the smog from a freeway or the noise nuisance from an elevated rail line are just as much detractions from existing amenities as they are positive community costs. If we follow the criterion of maximizing $V - C$, it does not matter in which account they end up.

It is then necessary that the urban community or its representatives specify precisely the level of V for the transportation service. Since V will be composed of a number of desirable attributes which cannot be reduced to the common denominator of money, it is essential that they all be spelled out in detail. The specifications for a comprehensive urban passenger transportation system might for example be:

1. Under projected land-use conditions, the system must be capable of conveying peak-hour commuters in less than, say, 30 minutes from door to door (or in a larger metropolis, perhaps 60 per cent of peak-hour commuters in less than 30 minutes, 40 per cent in 30 to 60 minutes).

2. The system must adhere to certain stated standards of passenger comfort and convenience (rates of acceleration and deceleration, seat availability, air conditioning, etc.).

[16] Lloyd Rodwin argues that there is a gulf between traditional economics and physical (city and regional) planning: "This role [of metropolitan planning] cannot be played by the price system. The difficulties are already manifest in the widespread concern with urban maladjustments. We know the market for urban land and improvements is characterized by imperfect knowledge, sluggish or inflexible adjustments to price signals, and significant discrepancies between public and private costs. We know, too, that many of the basic decisions on urban development are not, and for some practical purposes cannot, be made by the market mechanism. They involve public policy on the character of land use control systems and decisions on public investment of capital for urban overhead." Lloyd Rodwin, "Metropolitan Policy for Developing Areas," *Regional Economic Planning: Techniques for Less Developed Areas*, Paris, 1961, pp. 221–232.

3. The fatal accident rate attributable to the system itself must not exceed 0.1 per 100 million passenger miles (or some other figure).

4. The system must not exceed stated air pollution tolerances.

5. Large portions of right-of-way must be underground, as shown on a detailed land-use map.

6. The external design of the facilities must be of high aesthetic quality and must have the approval of the civic art commission.

7. Flexibility of routing is an important quality of service aspect. The number of origin-and-destination pairs that can be served, as well as the number of nodes and interchange points, are significant and should be specified.

Given these and many additional performance standards that can be thought up, the economist can then help to choose among various means to achieve these ends. The following aspects lend themselves particularly to economic analysis:

1. Minimization of C in relation to the given V (or various dimensions of V).

2. Research on the increases or decreases of the various components of V which would result from moving the value of C up and down.

3. Study of the time paths for achieving the specified goals: over-all progress of the program; priorities for completing geographic segments of the system and for reaching different functional objectives.

4. Exploration of possible trade-offs between different goals, gains and costs. For example, more safety vs. less speed; higher aesthetic quality vs. higher cost; great portions underground vs. less passenger comfort; more air pollution vs. less cost.

5. Exploration of different technical-economic mixes on the supply sides: desirable degrees of capital intensity and combinations of factors of production.

6. Design of performance criteria, checks on operational efficiency.

7. Continued surveillance of community preferences over time; consumers' acceptance of system.

Even though the goals and performance standards of the urban transportation system will have to be determined largely by collective value judgments, the economic analyst is not likely to run out of work in this sphere.

III. *Goals, Choices and Investment Analysis*

Clear identification of goals emerges as the most important first step in any urban transportation plan. Once the ends are stated, means can be sought to achieve them. Up to the present, major metropolitan transportation studies have spent little time defining ends before rushing into the phases of data collection, field surveys, and computer programs.[17] In addition, present conditions and attitudes surely are of only limited use in determining a more desirable future.

Apparently these are general shortcomings of all urban planning. Davidoff and Reiner make the point in an important article on planning philosophy.

> In each plan, the importance of placing value formulation first cannot be overstated, though there is great reluctance in urban planning to start with a search for ends. Even where goal selection is placed first, there is a tendency to underplay this and return to familiar territory—"survey and analysis." We do not understand the logic that supports ventures in research before the objectives of research have been defined. Such emphasis on research is premised on an ill-founded belief that knowledge of facts will give rise to appropriate goals or value judgments. Facts by themselves will not suggest what would be good or what should be preferred.[18]

Because value formulation is necessary in urban decision-making, planning is sometimes identified with arbitrary, undemocratic processes, manipulated by a few who impose their own preferences on the rest of the community. If this occurs, then it is, of course, not good planning. Ideally, planning should make possible more choice and particularly more intelligent choice than would otherwise be possible. It is meant to free the community from the tryanny of poor, short-sighted, selfish, and ill-informed decisions. As Davidoff and Reiner go on to say, "Values are inescapable elements of any rational decision-making process or any exercise of choice. Since choice permeates the whole planning sequence, a clear notion of ends pursued lies at the heart of the planner's task and the definition of these ends thus must be given primacy in the planning process." There is no reason why decisions on values cannot be decentralized, by putting alternatives before the voters, by informing and educating the citizens, by enlisting

[17] Regarding the need for metropolitan transportation studies, Zettel and Carll state, ". . . the review failed to turn up any extensive analysis of the urban transport problem that the studies were to investigate and help solve. The study prospectuses usually plunge directly into the technical details of fact gathering and data analysis, without attempting to define the problems on hand" (*Summary Review*, p. 20). Practically all of the studies surveyed state "preparation of a transport plan," or "formulation of a highway plan" as their basic objectives, without alluding to the higher-level community objectives that these technical efforts are supposed to serve (*ibid.*, pp. 25–26).

[18] Paul Davidoff and Thomas A. Reiner, "A Choice Theory of Planning," *Journal of the American Institute of Planners*, No. 2, May 1962, p. 111.

their advice. The purely technical decisions for implementation can then more safely be centralized.

Urban transportation planning and investment analysis must consequently be regarded primarily as a vehicle for community choices: preferences must be explored, options must be suggested, different solutions—even utopian ones—must be pursued. The difficulties are staggering, for when people decide upon one comprehensive transport system for their city rather than another one, they significantly affect the urban way of life. Furthermore, their decisions will typically not bring results this year or next, but five, ten, or twenty years from now. Quite a different generation of urban dwellers may feel the full effects.

In essence, the greater the number of alternatives considered and the more futuristic the outlook, the more powerful transport planning and analysis will be. Alas, there is as yet little evidence that this general philosophy prevails in contemporary urban transportation policy and practice.

COMMENT

BRITTON HARRIS, University of Pennsylvania

I am basically most sympathetic with Kuhn's effort as an economist to come to grips with the nature of the city and the challenges offered to economic analysis by urban problems. I perhaps disagree implicitly with his method of slicing the problem, and, as a planner speaking to economists, I shall try to suggest some of the ways in which Kuhn's discussion of applications seem to me to fail to mesh with his attempted capsulization of first principles.

The urban metropolitan scene offers half a dozen features which are somewhat intractable under conventional economic analysis.

First, it is pervaded by externalities, with individual actions having many ramifying effects upon other entities.

Second, many investments, especially in the public sector, are "lumpy." Associated with this discontinuity of investment decisions are substantial economies and diseconomies of scale.

Third, the long life of investments in land improvements introduces rigidities into the market for capital services. Under conditions of growth, an investment can be optimal for only a narrow point in time, yet once committed, it is not readily transferable.

Fourth, the great strategic importance of public investments spotlights the fact that no market exists for the services of many of these investments, and this lack of a market complicates investment decisions. Kuhn and Vickrey suggest different approaches by a cost-benefit analysis and user charges to create a pseudo-market or an actual market for certain services.

The fifth difficulty centers on the problem of identifying an optimum. Owing to the wide range of public investment channels and of public influences on private investment and behavior, many distinct combinations of factors are possible, and these may be widely separated in what might be called a "policy space." As in the economics of the farm or the industrial producer, marginal analysis can lead only to a local optimum. It cannot identify possible structurally different recombinations of factors which may result in a higher optimum.

The sixth problem arises when, as a result of a combination of difficulties four and five above, specific individual policies are pursued and judged independently of their combined effects and possible substitutes. This type of judgment, it may readily be seen, leads to suboptimization, wherein one program may tend to run away with the pattern of metropolitan development. The danger of suboptimization is particularly serious where one policy operates in a market or pseudo-market (cost-benefit) framework while its complementary or competing policies do not. Examples of suboptimization may be found in highway policy, federal mortgage insurance policy, urban renewal, and central business district planning.

Reply by Tillo E. Kuhn

Harris offers some interesting and penetrating comments. He lists several features of urban investment decisions which are, he says, "somewhat intractable under conventional economic analysis." Although he seeks to leave the matter of degree in doubt, he conveys the impression that the pitfalls are fatal to applications of economic principles.

I am more sanguine than Harris about the potential contributions of economics. In essence my position is that if conventional economic analysis—whatever that means—is largely useless in the urban sphere, let us by all means develop unconventional economic analysis for the purpose. Otherwise "economics will fade out of this sphere by default," as I pointed out in an earlier version of my paper.

To take his easier, more technical points first, that there are externalities—lumpiness in investment and time rigidities in the capital market—is, I feel, fully recognized in my paper and elsewhere. Quite satisfactory methods to tackle these difficulties are available.

His more substantial arguments are directed against the decision standards of "suboptimization" or the "local optimum." It is difficult to define an optimum where a market mechanism does not exist, as is often the case with urban services. To act in a pseudo-market context, therefore, can be dangerous, as indeed might be an indiscriminate use of tolls such as Vickrey proposes. In a particularly perceptive passage, Harris warns against the dangers of suboptimization when one program—highways, urban renewal, mortgage insurance, and so on—runs away with metropolitan development, because it is not based to the same extent upon a market or pseudo-market framework as other programs.

I agree with Harris that proper markets for urban services do not exist. Of course, if market mechanisms conforming to the economist's rule book can be found or created, all the better. But professional economists should be on guard against the vested intellectual interests they have in the notion of the market, and all the formidable methodological apparatus it gave rise to. Simple scientific honesty compels us to state nonmarket items in other quantitative or qualitative terms. The frequently observed attempts to heroically translate all manner of effects of public action into dollars and cents are to be depreciated.

Now to the core problem of suboptimization in urban decision-making. Urban objectives have several dimensions—cultural, political, ethical, aesthetic, economic. To pursue only one dimension would indeed lead to a suboptimum from the total point of view. Likewise, once the multidimensional structure of public goals has been correctly identified, various discrete bundles of means are available. Harris uses the suggestive idea of the "policy space" within which we must move—not marginally, but by recombinations of policy sets.

In urban research, as in the social sciences generally, the need to handle multidimensional problems, the irrelevance of simple dichotomies, the absence of continuously variable relationships, create tough methodological problems. How to reconcile the different objectives? How to move up to a "higher optimum," when this is a surface rather than a point? How to select the best policy bundle? It will certainly be desirable to enlist the support of all relevant expertise, including that in economics, for the purpose. Conscientious tracing of causes and effects of various policies will be helpful. Identification of policy trade-offs—more urban mobility may detract from social, cultural, aesthetic desiderata, for example—will be highly illuminating.

In all this the scope for economic decisions, I believe, can best be delineated by the distinction between ends and means to achieve ends.

Our urban goals are predominantly noneconomic. My good friend Dick Carll would argue that they may not even be rational. We should always allow for the intuitive, the romantic, the lyric, otherwise urban life will be empty. But in the choice of human means we should endeavor to be rational.

Consequently transportation planning in urban areas ought to be pursued in this fashion: let a community pattern be set up as an end; then let us devise the optimum transport system to serve it, as a means; and then let us finally submit, for community decision-making, the question of whether the transport requirement is unreasonable for meeting the general community objectives.

This still begs the question how the multidimensional community goals should be determined. Here we get into the old hassle between "predictive" and "prescriptive" uses of economic analysis. In another article by Harris, his attitude is made clear. Speaking of "process-oriented" analysis, he describes a society of individuals, each attempting to optimize the current situation, all interacting, and all subject to resource scarcity. Given these restraints, we can analytically describe what their behavior will be. We can alter the restraints and describe a different pattern of behavior. Models based upon hypothesis about how individuals optimize their economic welfare can add to our predictive abilities.

"When we are using a model for predictive purposes," Harris continues, "normative considerations may enter in the following way: we may assume, for better or worse reasons, that we can specify a manner in which people *ought* to behave under given circumstances, which will coincide with the way they actually will behave. We impute to them an optimizing behavior which will reproduce their actual behavior." In other words, those analysts who are perceptive of values, as well as of facts, will be better prophets. But Harris hastens to add that he is not defining *standards*. The assumed behavior, he points out, need not "coincide with any normative moral code, nor need it lead to the fulfillment of any normative goals. It would thus appear unwise to equate optimizing behavior with rationality, with socially ethical behavior, or with any socially optimum results."

This may explain why Harris balks at the idea of applying economic principles for decision-making in urban public enterprises. He would probably not argue long against using economic welfare theory in private enterprise, where the behavior of persons is defined by hedonistic motives and constrained by market conditions. But in public enterprise, behavior is not compelled by impersonal forces: it is consciously directed in a particular course which reflects public choice. Applying economic principles, we are not describing a behavioral process, we are discussing *guidelines for policy.*

However, among scientifically minded people there is felt a growing need to describe public decision-making as a process of collective behavior, to outline the sequence of choices. This was the purpose of Davidoff and Reiner, and they find that the identification and formulation of values, goals, and objectives enters at every stage of the process. They feel that the planner should not only be responsible for furnishing information (including predictions about the consequences of certain decisions), but also for the evaluation of alternative choices, the suggestion of the *best* choice, the testing of values, and the identification of goals. This describes very well, in my opinion, what economists and urban transport experts in their own professional spheres also ought to do. We must, in Mumford's words, not only inform, but "educate the attitude" of decision makers.