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INTRODUCTION AND SUMMARY OF RESULTS

IN PASSENGER TRANSPORTATION, the consumer desires the greatest possible speed and comfort, as well as other factors, at the lowest possible price, and the history of the industry is one of progressive improvements in these relationships. This book considers consumer preferences as they are influenced by the relationship of speed (or time) and price. The latest manifestations of technological improvements in regard to time are the proposed 300 mile-per-hour trains, the 1,800 mph supersonic transport planes (SST), the short-take-off and -landing planes (STOL), and the vertical-take-off and -landing planes (VTOL). Since the social benefit of these innovations as well as their profitability depends, in part at least, on the value placed by the community on time saving, a study of consumer attitudes toward time in relation to cost should be useful.

Until quite recently, economic literature had little to say about the value of time saving innovations to the individual consumer or to the community as a whole. Social welfare problems relating to the supply of transportation services (e.g., the effect of regulation) drew the focus of attention away from the *demand* factors. Regulators were given only meager information on the travelers' sensitivity to changes in the trip's price, a crucial variable in any pricing policy.[1] In none of the studies did traveling time play any role.

[1] Richard Caves mentions only two studies made prior to 1962 relating to the demand elasticity in his *Air Transport and Its Regulators,* Cambridge, Massachusetts, 1962, pp. 31–54.

In the sixties there has been an awakening of interest in the demand for transportation resulting from the fast expansion of the air industry and increased pressure on the federal government to coordinate the transportation market. The increasing number of studies in this field has brought to the fore the effect of traveling time on consumer preference for modes of travel. However, most of these studies lack an explicit theoretical exposition; time is usually treated as a variable affecting tastes.

These studies discuss time in relation to utility and comfort. The utility a traveler derives from a trip is directly related to the amount of traveling time involved and the discomfort of traveling increases with traveling time. Therefore, this approach holds, differences in traveling time by different modes of transportation serving the same route are reflected in the differences in the utilities these modes yield. The train is usually faster than the automotive modes (bus and private car), and air is usually faster than ground transportation. Hence, the observed shift of travelers from bus to train to air as their incomes rise is interpreted as analogous to a shift to better housing, better food, etc. Since differences in traveling time between the various modes increase with the distance of the trip, as do the differences in utilities, the air carriers' superiority increases with distance and makes them the dominant mode of transportation for long-range trips.

This explanation, which ties the choice of a mode of travel to the amount of discomfort involved in traveling, may have a certain intuitive appeal but is lacking in analytical power. Its major handicap is reliance on a cardinal concept of utility, i.e., on the notion that utility is a measurable entity. This explanation assumes that one can compare the utilities derived by different individuals from different commodities. It can be used, therefore, as an operative tool of analysis only if the utilities derived from trips by different modes of transportation are measurable. For only if the relationship between traveling time and utility can be defined in quantitative terms can one predict the effect of a reduction in traveling time on the demand for travel.

A more promising approach treats elapsed time as one of the factors affecting the price of a trip, rather than its utility. Time is a scarce resource and, as such, commands a positive price. This fact has been long recognized by economists concerned with problems of production.

It was suggested recently that the same approach applies to problems of consumption.[2] Consumption, according to this argument, involves the combination of goods purchased in the market and the time provided by the consumer. The price of any consumption activity depends on the price of the goods involved and the value the consumer places on his time. A trip from New York to Boston by plane involves a monetary cost of $16 and 3 hours of traveling.[3] The cost of the trip to a passenger who assigns to his time a value of $5 an hour adds up, therefore, to $31.

The value placed on time increases with the household's income. This relationship is reflected both in differences in the consumption patterns of households with different incomes, and in the ratio of time to market goods used by each for its consumption activities. The higher the consumer's price of time, the smaller his tendency to use time-intensive activities, i.e., activities that contain a large time component. For example, if the trip from New York to Boston by bus involves a monetary cost of $8 and 5 hours of traveling, a traveler whose price of time is $3 an hour will go by bus (the total costs being $23 by bus vs. $25 by air) while a traveler whose price of time is $5 an hour will find it cheaper to use the faster (less time-intensive) mode, namely air (the costs being $31 for air vs. $33 for bus).

The time intensity of a trip (i.e., the part that time constitutes in the total cost of the trip) depends, among other things, on the distance traveled. Both differences in fare and in time elapsed between air and ground transportation increase with distance. However, the time differential increases faster than the fare differential resulting in an increased tendency to shift to a faster mode as the distance increases. For example, a bus trip from New York to Chicago involves a monetary cost of $28 and 17 hours of traveling, while the same trip by air costs $49 but lasts only 5 hours. A traveler whose price of time is $3 an hour who, as has been shown, found it cheaper to go to Boston by bus, prefers to go to Chicago by air (the cost being $64 for air vs. $79 for bus).

[2] See Gary S. Becker's "A Theory of the Allocation of Time," *Economic Journal*, September 1965, and Jacob Mincer's "Market Prices, Opportunity Costs, and Income Effects" in *Measurement in Economics: Studies in Mathematical Economics and Econometrics in Memory of Yehuda Grunfeld*, C. F. Christ, ed., Stanford, California, 1963.

[3] In this study, travel time is that necessary to go from one central urban area to the other.

The competition between private and public modes of transportation is dominated by the insensitivity of the monetary costs of a trip by private car to changes in the number of the people going on the trip. Thus, if the money cost of traveling by car from New York to Boston is $14 and the elapsed time 5 hours, an individual whose price of time is $5 an hour will prefer air to car when he is traveling alone (the total costs being $31 and $39, respectively), but if he is accompanied by another two people with the same price of time he will use his car rather than go by air (the costs being $89 and $93, respectively).

The price of time of children is relatively low and, thus, the inclusion of children in the party may weigh heavily in favor of the car. For example, two persons going to Boston whose price of time is $5 an hour may use air transportation rather than their private car (the cost of the former being $62 vs. $64 for the latter). On the other hand, if one of this party is a child whose price of time is zero, the party will go by car (the cost being $39) rather than air ($47).

The price of time becomes, therefore, a crucial determinant of the choice of mode. A theory that regards time as one of the factors determining the price of the trip provides us with a strong tool for the analysis of existing traffic patterns. However, to make this tool an instrument for the prediction of future demand one has to specify the exact form of the relationship between the price of time and income. Economic theory states only that this price is an increasing function of income. It does not indicate, however, whether the value of time changes at a faster or a slower rate than the traveler's earnings, whether it depends on the amount of time involved, or whether it is affected by the mode used. The estimation of the exact relationship is an empirical problem.

Scarcity of data confined the empirical work to one case study—passenger demand for air transportation. Interview data were used to estimate separately business travelers' and personal travelers' price of time and demand for air trips. Assuming that the price of time is proportional to hourly earnings and independent of the time and mode of travel, it was found that business travelers value their time at about their hourly earnings. In other words, employers tend to view traveling time as working time lost and, hence, assign to their employees' time a value that equals the foregone output.

One would expect the same relationship between the price of time

and hourly earnings to apply to personal travel, if the traveler is free to change his working time at will. But usually this is not the case. In the short run at least, such an employee is bound by some institutional arrangement: number of daily working hours, number of days worked per week, etc. When traveling for personal purposes, therefore, he may not assign to his time a value that equals his hourly take-home pay. Unfortunately, we cannot determine the exact nature of this relationship; the data do not show any systematic relationship between the imputed value of time and hourly earnings or annual income.

Both estimates of the relationship between the price of time and hourly earnings have to be approached with care. For one, these estimates are subject to random sampling errors, thus also admitting some alternative interpretations. Moreover, our estimates may depend on the assumption that the value travelers place on their time is proportional to their hourly earnings. The verification of this assumption calls for additional investigation.

A by-product of the evaluation of the price of time is the estimate of the demand function for air travel. Income has been found to be the major variable determining demand. The household's number of trips is very sensitive to changes in its income. One would expect an increase in income to lead to a greater proportionate expansion in air travel, since income elasticities are significantly greater than one.

A major policy problem is whether a fare cut would result in an increase or a decrease in air-carriers' revenues; in other words, whether a reduction in fares would lead to a greater or a smaller proportional increase in air travel. In this study, the price of the trip is defined as a combination of both money and time costs. The effect of a price change on the demand for trips is examined but there is no attempt to isolate the effect of changes in the pecuniary component (i.e., fares) on this demand. Still, the study provides some indirect answers to this highly disputed question.

It is found that any price reduction would lead to a smaller proportional increase of both personal and business travel. In other words, the price elasticities of both the demand for personal air travel and the demand for business air travel are smaller than one (however, the difference in the latter case is not statistically significant). Since any cut in fares leads to a smaller proportional reduction of total price, these

results support the notion that a reduction of fares would be accompanied by a fall in air-carriers' revenues.

Finally, it is argued that business air travelers are more sensitive to changes in income and price than personal travelers. Both income and price elasticities of business travelers exceed, in their absolute value, those of personal travelers. This result may seem somewhat puzzling when viewed against the background of the air-carriers' promotion policies (e.g., excursion fares, family plans, etc.), which seem to be aimed primarily at the personal traveler.

Hypothetical illustrations related to the supersonic transport plane and to the high speed train demonstrate that the value travelers place on their time is crucial in determining the future modal split. Admittedly, the estimates provided in this study can be regarded only as preliminary evidence that must be substantiated by future research. A major handicap in this is the scarcity of data.

The transition period from piston to jet passenger planes furnished an ideal testing ground for our theory. Given information on motives and socioeconomic characteristics of passengers on both the slower and faster equipment one would have been able to derive some more reliable estimates of the price of time. This opportunity has been missed. Fortunately, economists may have a second chance. The introduction of faster planes and trains should yield almost perfect conditions for a controlled experiment to answer the elusive question of how people value their time. It is of utmost importance that this opportunity should not be missed.

Chapter 2 opens the study with a short discussion of the factors determining the price of time. Chapter 3 analyzes the variables shaping the demand for trips and the modal split. Noting the limitations of the theory attributing this choice to the discomfort of travel, Chapter 4 shows that the theory of the allocation of time goes a long way in explaining the structure of the transportation market. A discussion of the statistical method and the nature of the data prepares the stage for estimation of the demand for air transportation and the price of time in Chapter 5. Chapter 6 closes the report with some applications of our model to some current problems—the supersonic passenger plane and the fast trains.