agency. In short, whenever possible, and not actively prevented, administrative expenses can increase sharply for all participating agencies.

In summary, the experience of the six Texas cities suggests that solutions to the problem of devising an efficient way to provide transportation services to the handicapped depend on a careful analysis of the abilities and capabilities of existing transportation providers in the community; a clear understanding of the trade-offs between quality, control, and cost; and some hard decisions about what level of service a community and its E&H citizens expect and are willing to pay for.

ACKNOWLEDGMENT

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Comparison of Findings from Projects That Employ User-Side Subsidies for Taxi and Bus Travel

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Experiments with user-side subsidies began about four years ago. The Urban Mass Transportation Administration Service and Methods Demonstration program has funded a series of projects and monitored others already in operation to determine the workability of user-sider subsidies in different settings as they are applied to different forms of public transportation. Results from 13 applications of user-side subsidies as a means of improving the mobility of transit-dependent persons are presented. Examples of public and private providers, paratransit and fixed-route services, small to medium-sized cities, and limited (target market) eligibility, including a variety of subsidy levels, payment mechanisms, and fare policies, are discussed and examined. Generalizations are made, where possible, about administrative policies, fare-discount strategies, and project impacts.

There has been a great deal of interest in the concept of user-side subsidies since the early experiments began about four years ago. The Urban Mass Transportation Administration (UMTA) Service and Methods Demonstration (SMD) program has funded a series of projects (1,2) aimed at determining the workability of user-side subsidies in different settings and as applied to different forms of public transportation. In the meantime, there has been a growing number of locally initiated user-subsidized services; some of these have been monitored by the SMD program (3,4). Given the substantial amount of accumulated experience and the high level of current interest on the part of the planners, cross comparisons of existing results were made in an effort to develop transferable findings that will be useful in planning other projects.

Subsidies for public transportation have traditionally been provider-side subsidies made available directly to the transportation provider as compensation for offering certain specified services at fares that do not generate sufficient total revenues to cover the cost of providing the service. The user-side subsidy offers an alternative method of subsidizing transportation services (5,6). In this method, a provider accepts tickets or vouchers (or any mechanism used to provide evidence of trips delivered) from users and redeems them from the subsidizing agency for a value established in advance. This value usually represents the difference between the fare paid by the rider and the total cost of the trip. However, it may also be applied in such a way as to permit subsidization of the difference between a discounted fare and the full fare in cases in which a transit operator receives a provider subsidy as well.

This paper presents results from 13 applications of user-side subsidies, in most cases as a means of improving the mobility of transit-dependent persons. Examples of public and private providers, paratransit and fixed-route services, small to medium-sized cities, and limited (target market) eligibility and subsidization of all trips, including a variety of subsidy levels, payment mechanisms, and fare policies, are examined and discussed. Where possible, generalizations are made about administrative policies, fare-discount strategies, and project impacts.

The analysis of the available data from these projects has focused primarily on six areas:

1. Characteristics of the market segments that elect to participate and the penetration of the eligible market,
2. Trip-making frequency and mode share of project trips,
3. Findings related to trade-offs among alternative administrative policies,
4. Costs of user-side subsidy projects,
5. Benefits to project users, and
6. Impacts of user-side subsidies on taxi operators.

VARIATIONS IN THE DESIGN OF PROJECT STUDIES

Table 1 contains a summary of the basic features of each of the four on-going demonstration projects in Danville, Illinois; Montgomery, Alabama; Kinston, North Carolina; and Lawrence, Massachusetts. A user-side subsidy demonstration project in 1978 in Milton Township, a suburb of Chicago, is also included.

In addition to the above demonstration projects, the SMD program monitored locally initiated user-side subsidy programs in Kansas City (4), the San Francisco Bay area (3), Los Angeles, and the state of West Virginia (7). Summary information on

Table 1. Summary of user-side subsidy projects.

Item	SMD Demonstration Projects					Non-SMD Projects			
	Danville	Montgomery	Kinston	Lawrence	Milton	Kansas City	San Francisco Bay Area[a]	Los Angeles Harbor Area	West Virginia TRIP
Date project began operation	12/75	8/77	9/77	7/78	8/78	5/77	1974-76	9/78	6/74
Population	42 600	133 400	22 300	66 900	61 600	500 000	NA	120 000	1 810 000
Area (miles^2)	12.9	46.4	6.1	6.8	36	NA	NA	23	24 181
Population density (persons/mile^2)	3300	2900	3800	9800	1955	1600	NA	5217	75
Population over 65 (%)	13	9.3	9.8	14.9	6.2	12	NA	NA	NA
Total eligible population	7500	18 600	2860	12 500	6500	75 000	1250-21 000	NA	122 000
Project modes	Taxi (1975-78), bus (1978)	Taxi, bus	Taxi	Taxi, bus	Taxi	Taxi, agency vans[b]	Taxi	Taxi	Taxi, bus
Number of taxi companies in service area	2	16	10	10	NA	NA	NA	NA	NA
Number of participating taxi firms	2	3	8	8	2	2	-	1	NA
Number of participating taxi vehicles	24	47	33	63	14	90	-	35	NA
Project taxi coverage (vehicles/mile^2)	2.0	1.0	5.5	9.3	0.4	0.3[c]	1-2	0.66	NA
Taxi fare structure	Zone	Zone[d]	Zone	Zone	NA	Zone[d]	Meter	Meter	Meter
Shared-ride service available	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Taxi subsidy mechanism	Vouchers	Vouchers	Tickets	Tickets	Tickets	Tickets	Scrip, tickets, vouchers	Tickets	Tickets
Fare discount (%)	50[e]	50	50	50	NA	75	50-100	>90	88
Avg user fare ($)	0.62	1.30	0.76	0.75	0.50[f]	0.50	0.0-0.63	0.15[f]	0.38[g]
Monthly travel limit (total undiscounted fares, $)	20	30	25	20	None	NA	NA	None	8
Avg vehicle trip length (miles)	2.0	2.5[c]	1.3	2.0	2.0	NA	1.7-5.4	1.7	NA
Fixed-route transit									
Standard fare ($)	40	0.30, 0.15[h]	-	0.15	-	-	-	-	NA
Project fare/trip ($)	20	0.15, 0.0[h]	-	0.01	-	-	-	-	NA
Results									
Persons registered	3500	5500	700	3200	-	10 710	140-2000	NA	NA
Percentage of eligibles registered	47	30	25	26	-	14	4-32	NA	NA
Project taxi ridership (monthly)	4500[i]	3290[j]	3200[j]	7000[j]	NA	10 000	413-1650	3500	NA
Project transit ridership (monthly)	10 660[k]	21 100[j]	-	15 000[j]	-	-	-	-	NA

Note: NA = data not available.
[a]Six programs in six regions of San Francisco; range of values for the programs is shown.
[b]Eight agency vans; three city-owned vans.
[c]Estimated.
[d]Zone fares for project trips only.
[e]Fare discount was 73 percent during first year of project.
[f]Flat fare.
[g]Estimated average total fare is $3.00.
[h]Peak and off-peak fares, respectively.
[i]Ridership level after introduction of bus service.
[j]Average over a stable six-month period 1978-1979.
[k]Handicapped and elderly ridership only; transit discounts are also available to youth (under 18 years of age).

these projects is also included in Table 1.

Although the user-side subsidy was originally tested by the SMD program as a means of providing low-cost taxi service for transportation-handicapped persons, the concept has since been applied to fixed-route transit service and is being tested in a variety of contexts. Because the subsidy is offered only for trips delivered, it offers the potential for selectively subsidizing different markets and even varying the fare discount for each eligible target market. For instance, in Danville, taxi service for eligible (registered) transportation-handicapped persons was discounted about 75 percent for the first year (December 1975 to December 1976) and 50 percent for the remainder of the taxi portion of the demonstration (January 1977 to June 1978), while bus service, which began in December 1977, was discounted 50 percent for all persons over 65 or under 18 years of age. Persons eligible to receive discounted service on both modes could make travel choices depending on the accessibility of each mode to their destination, the desired level of service, and the cost differential involved.

In most cases, user-side subsidies are being applied to existing transportation systems. An administrative staff is required to register eligible persons, issue identification or some proof of eligibility, redeem tickets or vouchers submitted by the provider, conduct marketing and promotional activities, and perform other necessary management and accounting functions. The agency that administers the program and subsidizes providers is usually part of the local government and is not directly involved with the provision of service or a part of the institutional structure of any single transit authority. This gives it the flexibility to select existing public and private providers, negotiate service agreements, and even encourage new services by offering a guaranteed minimum total subsidy or by producing evidence of an untapped demand.

With this flexibility, it is possible to coordinate among a mix of potential carriers, including social service agencies, nonprofit providers, and taxi operators. The Share-A-Fare transportation brokerage project in Kansas City (4) co-

ordinates travel for elderly and handicapped citizens by enlisting providers, scheduling trips, and administering user-side subsidies. The transportation suppliers include two taxi companies, three social service agencies that have vehicles, an ambulette service, and three city-owned and city-operated vans. Agency clients can travel in taxis or a lift-equipped van (either a city or ambulette vehicle). Taxi and agency carriers are reimbursed on the basis of a fixed cost per trip, and users pay a 50-cent flat fare. Subsidy funds come from revenues generated by a 0.5 percent city sales tax allocated to public transportation purposes.

FARE POLICIES AND PAYMENT MECHANISMS

User-side subsidy projects have used either tickets or vouchers as instruments for fare and subsidy transactions. In voucher use, the rider presents an identification card at the time of the trip, and the driver completes a standard form with the user's name, information about the trip, and the total fare. Then the user signs the voucher and pays his or her share of the fare, and the voucher is subsequently submitted to the project for reimbursement of the difference between the user's share and the total fare. The essential difference between tickets and vouchers is that tickets are purchased in advance and the user pays a discounted fraction of their face value. No cash transaction is required at the time of the trip, since tickets are accepted at their face value for the full fare and redeemed at a later date by the provider.

The decision as to whether to use tickets or vouchers would seem to depend on the application. Tickets require less processing at the time of the trip and hence are being used for the public bus services to minimize the time the driver spends in fare-collection activities. Other advantages of tickets are that (a) when tickets are purchased in advance, the city benefits from a cash flow that represents the total discounted value of unredeemed tickets; (b) the number of discount trips taken by an individual can be limited by the number of tickets sold to him or her during a given time period; and (c) the redemption process is straightforward and permits prompt reimbursement. These advantages must be weighed against the necessity of establishing a ticket-distribution system (through one or more outlets) and the potential for misuse and fraud that result from the transferability of tickets. This latter problem is minimized if an identification card must be shown when tickets are used.

Vouchers are a somewhat more complex mechanism in terms of administrative requirements. Drivers must fill them out and have them signed by the passenger, and mistakes are not infrequent. Vouchers must be checked and verified by the project staff, resulting in delayed reimbursement, which was a major factor in the decision of some taxi drivers in Montgomery to withdraw from the project.

These disadvantages of the voucher mechanisms are offset to a degree by the following: (a) no ticket sales and distribution systems are required, (b) vouchers permit third-party billing to agencies that sponsor client travel, and (c) trip information available from vouchers is useful for project monitoring and agency accounting.

The potential for fraud, misuse, or overuse (users who exceed their monthly budget) has been noted in connection with user-side subsidies. So far, there is no evidence of widespread misuse of tickets by ineligible persons; however, the budgets have not been strictly enforced in cases where registered taxi users have exceeded their monthly limit for essential travel purposes. Apparently, fraud, misuse, and overuse do not constitute a major problem if proper monitoring procedures are followed and measures are taken to counteract any unacceptable practice when it occurs.

TAXI SERVICE POLICIES

Shared-ride policies generally permit a taxi operator to collect one fare for each passenger, regardless of whether the riders are part of a group traveling to the same destination or have different origins and/or destinations. This is difficult to implement in cities that have meter-based rather than zone-fare policies. Changes in city ordinances were introduced in Kinston and Lawrence that allowed shared riding for all taxi trips, project or otherwise. Montgomery has decided to revise its taxi ordinances to permit shared riding. (This seems to be an important impact of user-side subsidy projects.) Consequently, all of the sites studied that permit shared riding have zone-fare structures, except for the Los Angeles Harbor Area project. In Los Angeles, successive riders in a shared-ride trip do not get charged for the "flag drop"; however, the meter cost of deviations necessitated by pickups and drop-offs is included in their fare.

Group riding is a different policy than shared-ride taxi service. If two to five people are traveling to the same destination, under a group-ride policy they would all be allowed to travel for one fare. This provides an incentive for the riders to travel together, thus increasing the efficiency of subsidized service. It is employed where meter fares are used and shared riding would necessitate a complicated method of determining each individual's portion of the total meter fare. No more dispatching effort is required than if a person were traveling alone, and the taxi operator is only reimbursed for one trip (in most cases). This policy has been adopted in all projects that do not employ shared riding, e.g., San Francisco Bay Area programs and the Transportation Remuneration and Incentive Program (TRIP) in West Virginia.

USER-SIDE SUBSIDIES FOR FIXED-ROUTE TRANSIT

Three SMD projects are testing the potential of user-side subsidies for fixed-route transit. In Montgomery and Lawrence, project subsidies are available for trips taken by taxi or on the public transit system. Danville, which pioneered the user-side subsidies for taxis, has replaced the Reduced Taxi Rate (RTR) program with a demonstration of fixed-route bus service. It began in December 1977, six months before termination of the RTR program.

Danville had no public transit; the city decided to employ the user-side subsidies as a means of compensating a private carrier for all trips provided and thus test the market for fixed-route transit without purchasing vehicles and operating a transit system. The transit provider operates under a renewable contract with the city. The city sells books of 40-cent tickets to the general public and half-fare tickets to the elderly, handicapped, and young. Tickets are sold in a number of banks and stores in Danville. Every week the tickets collected are redeemed by the transit operator for a value specified by the contract. Passenger who do not have tickets pay a cash fare of 50 cents for which the provider receives a match to cover the remainder of the specified cost of a trip.

In contrast to Danville, user-side subsidies for the public transit system in Lawrence and Montgomery are limited to registered elderly and handicapped persons. The fixed-route transit system is publicly

operated in Montgomery and privately owned and operated in Lawrence; both systems receive provider-side subsidies to cover operating deficits. Tickets are issued to project participants and redeemed by the transit operator for the face value, which is the standard fare charged to elderly and handicapped persons. In essence, the city is subsidizing project riders for the fare they would have paid without the project.

PROJECT DEMAND

Registration

Project registration is usually required before eligible persons can begin to take trips at a discounted fare. The percentage of the estimated eligible market that has registered is 47 percent in Danville and 25-30 percent for the other three demonstration sites. For the nondemonstration projects, registration rates vary widely, from 4 to 32 percent; most programs experience a 15-30 percent penetration of the eligible market.

A comparison of socioeconomic characteristics of registrants in general reveals that they are predominantly over 65 years of age, unemployed, have very low incomes, and live in households that do not own automobiles. Only 10-18 percent of the registrants are under 65 years of age, and 5-10 percent work full or part time. The size of the nonelderly handicapped, elderly handicapped, and able-bodied elderly segments of the registered population are also similar across projects. About 30-50 percent of registrants require some form of mobility aid (crutches, cane, walker, or wheelchair) to get around.

Eligible persons who do not register seem to be more self-sufficient; they have higher incomes and acceptable transportation alternatives. In this respect, there is a distinct difference between registered and nonregistered eligible persons. These differences are an important indication that the subsidies are being used by those who need them most.

Frequency of Taxi Use

Trip rates reported here for different projects represent frequency of use by registrants who make one or more trips per month. This group will be referred to as project users, or simply users, in the discussion of trip making that follows. A comparison of trip rates of all registrants is less enlightening, because the varying proportion of nonusers at the different sites tends to mask variations in trip rates among users.

A frequency distribution of project taxi trips per month shows that about 66, 40, and 85 percent of registrants in Danville, Kinston, and Montgomery, respectively, do not use taxis during a given month. The registered nonuser segment in Danville and Kinston is composed primarily of persons who already have adequate alternatives and who registered in order to have transportation on occasions when their usual modes are unavailable. The much lower percentage of registered persons taking project trips in Montgomery probably reflects lower taxi coverage there.

The demographic profiles of Danville and Kinston registrants who travel by project mode during a month are similar to those of persons who do not. However, project trip frequency (in trips per month) for those who do use the service is clearly related to age and health. Trip rates decrease with age; handicapped but ambulatory persons 45 years and under averaged almost twice as many project trips per month as those between 45 and 65 years of age.

The mean trip rates for those who use the project at least once in a month are 5.5, 5.1, and 7.9 for Danville, Montgomery, and Kinston, respectively. (These rates represent conditions before Danville public bus service was introduced in December 1977 and after user-side subsidies were applied to the Montgomery public transit system in November 1978.) About 25-30 percent of users in Danville and Montgomery took more than 5 trips/month, and the fraction who reach or exceed their monthly limit (which corresponds to about 12-14 trips) is usually less than 10 percent. The higher rate of project trip making in Kinston compared with Danville and Montgomery may reflect better taxi availability and coverage and a more taxi-dependent market. Kinston has no public transit, and automobile availability is much lower than in Danville and Montgomery; less than 10 percent of Kinston registrants have ready access to a car.

Total vehicular trip-making rates reported for elderly and handicapped persons range from one to two one-way trips per day. Total project trip frequencies discussed above indicate that most users are relying on the project mode for less than one-fifth of all their trips, in spite of the general shortage of alternative modes reported in the registration interviews. The small percentage of registrants who take more than a few trips per month indicates that, for most participants, the projects provide a backup mode of transportation. However, there is a small group of registrants at each site that relies heavily on the system.

Fare Elasticity of Demand for Project Taxi Trips

Judging from the predominantly low income of project registrants, cost per trip should be an important factor in the decision as to which mode to use. This sensitivity to cost is expressed as fare elasticity of demand. An opportunity to measure this elasticity occurred in Danville (8) when the fare discount was reduced from an average of 73 to 51 percent, coincident with a general taxi fare increase of 12 percent. Project demand dropped substantially, and the resulting average fare increase of about 100 percent caused a 28 percent decrease in use. The aggregate price elasticity of demand was therefore -0.28, which is in the range of the demand elasticity exhibited for the transit industry in general (-0.2 to -0.4). The gradual climb in project ridership during the year that followed the fare increase is attributable to continued growth in the population of registrants, which buffered the long-term aggregate impact of the price change.

Although the average taxi fare currently paid by users of demonstration project service falls within a fairly narrow range ($0.70-$1.25/trip), an example of the influence of much lower fare levels on taxi use is available from the Los Angeles Harbor Area project. The user fare is only $0.15, regardless of trip length, up to a meter fare of $3.00 (riders pay the excess meter fare above $3.00, which corresponds to about a 2.5-mile trip length). In a sample month, 507 persons who took project trips averaged 8.2 trips each, which is only slightly higher than the average rate for Kinston users. However, this trip frequency might be greater without a $3.00 limit on the subsidy per trip. Only 20 percent of all trips in one month were greater than 2.5 miles, and 11 percent were greater than 3 miles.

Mode Share of Project Taxi and Bus Trips

Fixed-route bus service was introduced in Danville

seven months before the RTR program ended. Since both modes were available, the user could trade off cost and level of service in deciding which mode to use. Fixed-route buses cost $0.20/trip and operated at 30- and 60-min headways. Immediate-request door-to-door travel by RTR taxis costs an average of $0.62/person trip.

Total ridership on the Danville fixed-route transit system has grown from 450 passengers/day at the start to a current level of around 950. Trips by riders eligible for half-fare tickets (youth, elderly, and handicapped) constitute about 69 percent of the total trips. Demand from this market has steadily increased, while full-fare ridership has stabilized at about 300/day.

An analysis of mode shifts and the overall impact of the Runaround (fixed-route system) on RTR demand during the seven-month period when both modes were available (9) has revealed a number of interesting findings:

1. Total RTR demand decreased by more than 30 percent as a result of the bus service.
2. Most of the registered people who began riding buses continued to ride taxis as well. Very few, if any, switched all trips from RTR to the Runaround.
3. Two-thirds of RTR riders did not use the bus because of their health, age, or inaccessibility to bus routes. Only 12 percent of RTR trips surveyed would have been made by bus if there were no taxi discount--some riders would have had to find another way to travel or else forgo the trip. About one-half reported they would still take a cab at full fare.
4. After the RTR program was discontinued, bus ridership by persons eligible for RTR continued to increase but at about the same rate as before the termination of taxi discounts.
5. Attitudes regarding the choice between Runaround and RTR indicated that the cost, general convenience, distance to the bus route, and the physical condition of the traveler were more important determinants of mode choice than the difference in level of service (wait time and travel time) between the two modes.

Demand for the bus trips grew steadily in Lawrence and Montgomery during the first year of the discounts. Project registrants in Montgomery account for more than twice the number of bus trips that were taken by the total handicapped and elderly population before the project. Records of ticket sales will provide a means of linking registrant's identification numbers with serial numbers of tickets, thus permitting analysis of bus trip rates, mode shares of bus and taxi use by market segment, and disaggregate modeling of bus and taxi demand.

Registrants averaged 4.7 and 4.3 bus trips/month in Lawrence and Montgomery, respectively (registration is not required to ride buses in Danville, and the number of persons taking half-fare trips is unknown). A frequency distribution of project bus trips in Lawrence for the month of January 1979 indicates that users took a mean of 9.3 trips and a median value of 5 trips. During that month, about 44 percent of all registrants took bus trips.

When both taxi and bus discounts were available in Danville, the ratio of project bus trips to taxi trips was 2.4. This ratio was about 2.1 for Lawrence and 7.0 for Montgomery. The much higher ratio of bus to taxi trips in Montgomery reflects the higher average cost of taxi trips and the limited project taxi coverage. These aggregate ratios should not be taken as an indicator of mode choice, however, since some registrants may use one mode almost exclusively.

The introduction of discounts for bus service in Montgomery did not precipitate a decrease in project taxi ridership; in fact, monthly taxi ridership grew from 2600 to 3200 over the six-month period that followed initiation of the bus discounts. An important distinction to make in comparing this experience with Danville, where taxi demand decreased, is that there was already bus service in Montgomery and the project discount only reduced the cost of transit trips, whereas in Danville a new public transit mode was introduced.

PROJECT COSTS

For user-side subsidy projects, the total cost to the public includes subsidies paid to the provider plus the cost of administering the program. There are two categories of administrative costs: (a) initial planning and implementation and (b) monthly management and administration. Monthly costs can be further broken down into direct costs, which are related to voucher or ticket processing; registration and reimbursement; and indirect expenses for marketing, coordinating, and project management.

Cost breakdowns were analyzed for taxi service in Kinston, Montgomery, and Danville. The total annual project cost for Danville was $76 000, representing a total of 74 520 trips delivered. This cost is based on the average monthly ridership during a stable period prior to introduction of the bus service. For Kinston and Montgomery, total annual costs of $52 600 and $77 400, respectively, were projected from the monthly ridership levels.

Monthly administrative costs do not increase in direct proportion to ridership, at least up to the capacity of the administrative staff to process additional vouchers or tickets. Hence, as ridership increases, monthly administrative costs are spread over more trips. Project start-up costs, which include system design, initial planning and registration, advertising, and office supplies, were $14 000 in Danville and $2914 in Kinston. Start-up cost is not included in the total annual cost or cost per trip.

Danville was the first user-side subsidy demonstration project; consequently, a major portion of the start-up cost was spent on the design and development of administrative mechanisms and policies. The difference between Danville and Kinston project start-up costs implies a similar savings for other cities that are able to use this experience and adopt the administrative systems already in use.

The administrative costs per trip for Kinston and Montgomery, $0.61 and $0.67, respectively, are much higher than that for Danville ($0.24/trip). A large part of this difference is explained by the higher ridership in Danville. The total annual administrative costs are $18 000, $23 400, and $26 400 for Danville, Kinston, and Montgomery, respectively. Inflation undoubtedly accounts for some of the difference, since the Danville data reflect conditions over two years prior to the period in which costs for Kinston and Montgomery were examined. Furthermore, the fact that the Danville taxi program was dealing primarily with only one taxi company must have greatly reduced the time required for reimbursements, coordinating policies with drivers and owners, etc. (Three firms participated, but one went out of business early in the demonstration, and another provided less than 5 percent of all trips.)

A comparison of direct costs for Kinston (tickets) and Montgomery (vouchers) reveals that Montgomery's cost is about $600/month higher. Part

of the difference stems from the time required for certification and registration; these activities account for 25 percent of the direct costs in the Montgomery project, which has more than seven times as many registrants as Kinston. It appears that direct costs are otherwise fairly comparable (monthly ridership is about equal), suggesting that the cost of ticket sales was offset by voucher processing costs. Therefore, the main determinant of potential cost advantages of tickets over vouchers depends on the labor required for ticket sales. In a city as large as Montgomery this could be much more costly than in Kinston, unless ticket sales were centralized or tickets were sold by employees of stores, banks, or other outlets.

Administrative costs stabilized early in the Kinston project but have been decreasing steadily in Montgomery as a result of improvements in procedures and the implementation of a computerized voucher and bus-ticket processing system. Costs associated with distributing bus tickets, processing them, and reimbursing the transit operator amount to only $0.02/bus trip or about 19 percent of the total administrative costs of the bus and taxi program. This does not, however, reflect marketing and promotion of the bus discounts or costs associated with registering persons who are only using the bus service (registration has increased more than 20 percent since the introduction of discounts for bus service). Nevertheless, it is evident that providing subsidies for bus travel involves a marginal increase of perhaps 20-25 percent in the administrative cost of operating a taxi discount program.

FACTORS THAT INFLUENCE COST

At fare levels and trip distances similar to those of Danville and Kinston, a user-side subsidy program that delivers 100 000 taxi trips/year would cost the city about $1.00/trip (including administrative costs). This compares favorably with the cost of publicly provided demand-responsive services in similar-sized cities. User and project costs per trip will generally increase with city size because cities that have larger areas and populations also have higher average trip lengths and, very possibly, higher labor rates. For instance, in Montgomery, which has an area four times that of Danville, the average fare is about $2.60, reflecting a 25 percent greater average trip length and a 30 percent higher cost per mile for taxi service.

With user-side subsidies, the inherent flexibility of taxi supply can be exploited. This is a distinct cost advantage with respect to alternatives that involve a fixed capacity, such as a publicly operated fleet of minibuses or a contract with a private operator to provide a fixed or guaranteed minimum number of vehicle hours of service. Since demand varies over a day and total demand is difficult to estimate a priori, the per-trip reimbursement approach protects the program from insufficient or excess capacity that could result from purchase of a given number of vehicle hours per day.

BENEFITS TO PROJECT USERS

It has already been shown that the regular users of discount taxi services are the more transit-dependent (and economically disadvantaged) segment of the eligible market. When the cost of taxi travel is reduced, people who have to rely on taxis because of the lack of other suitable alternatives can take more trips or can spend a smaller portion of their income on transportation.

The analysis of project trip-making rates discussed above reveals that most project registrants benefitted primarily from a reduction in their expenditures for bus and taxi travel. There has not been an overall increase in the frequency of taxi trips or a greater reliance on taxis, except where the fare reduction was sufficient to make the cost of taxi travel comparable to that of bus or private automobile. Where this is the case, the most prominent change in travel behavior has been a mode shift from walk to taxi for short trips.

Bus ridership has increased as a result of the program discounts of about $0.15/trip, although data are not yet available to determine whether this increase is primarily a result of more bus users, increased reliance on buses, or a combination of both.

A 50 percent reduction in taxi fares is certainly a help for people on limited incomes. However, at user round-trip fares of $1.00-$2.50, cost is still a significant constraint on the extent to which these projects can enable increases in trip making that lead to improved health, quality of life, etc. At mean taxi trip frequencies of 5-8 trips/month, demonstration project users are saving between $4.00 and $6.00/month. Apparently, the cost of taking more taxi trips, even at a 50 percent discount, has deterred most participants from approaching their monthly maximum taxi budget, which corresponds to 12-18 trips, based on the average fare per trip and maximum dollar amount of accumulated fares.

Other findings about benefits to project users are qualitative in nature and come primarily from surveys of users who were asked questions about whether and how the project affected their travel habits. In Danville, follow-up surveys of registrants were conducted to investigate impacts of the taxi discount project on travel behavior (1); 41 percent claimed they traveled more often because of the project, 43 percent said they were able to take trips they could not take before, 58 percent said they were less dependent on others for transportation, and 30 percent reported that they were able to take more trips during a particular part of the day.

A survey of users of TRIP tickets in West Virginia (7) revealed that taxis have become the primary mode for 45 percent of users, compared with 20 percent before the program. Buses (tickets can be used for buses or taxis) continued to be the primary mode for about 35 percent of TRIP users. About 87 percent of participants in the TRIP program claimed that their mobility had increased. When asked what additional trips were being taken, the purposes most frequently mentioned were visits to a doctor's office or clinic, shopping, and visits with family and friends.

IMPACTS ON TAXI OPERATORS

It has been postulated that competition among providers for project trips will stimulate better service. However, this assumes that providers have an incentive to increase their share of the project-based demand. Any such interest on the part of taxi operators would depend on the economics of serving project trips, that is, whether project trips increase total revenues, permit more efficient utilization of vehicles and drivers by spreading the demand over the day, or are at least as profitable as other business.

Impact on Taxi Revenues

Whether taxi revenues have increased as a result of the demand created by project discounts is difficult to establish in most projects because of the lack of reliable taxi operating data and the tendency of exogenous factors that affect supply and demand to

mask the impact of project trips on total taxi revenues. Nevertheless, some project data and estimates based on observed changes in travel behavior merit discussion here. Taxi ridership data from Danville indicate that the maximum increase in taxi demand, attributable to the subsidized taxi service (at a time when the fare discount was 73 percent) was about 4000 trips/month, representing about a 15 percent increase from preproject conditions (1). This growth, which was not sustained after the discount was reduced to 50 percent, reflects increased use of taxis and new customers who were not riding taxis before the project.

The impact of increases in demand by the target market depends, of course, on the share of the total taxi business represented by these users. Trips made by elderly and handicapped persons account for about 10 percent of the ridership of the operators in Lawrence and Montgomery that are serving the bulk of the project trips. Project demand constituted 24 percent of all trips in Danville, where only one provider was involved, although three firms participated, as noted above. Increases in taxi demand generated by project discounts will, therefore, have less of an impact in Lawrence and Montgomery than in Danville.

Relative Profitability of Project Trips

Of comparable importance to the question of whether total taxi demand increased as a result of project subsidies is whether project trips are as profitable as nonproject trips. In other words, is the revenue per taxi mile greater than, the same as, or less than it would be for regular service? The characteristics of project trips may differ in such a way as to affect labor and vehicle productivities. For instance, operators assert that shorter trips are less economical because of increased deadheading and dispatching costs. If the fare structure is the same for project and nonproject trips, then such factors as the average trip length, extent of shared riding, and dwell time will affect the efficiency and hence the relative profitability of the project service on a per-trip basis.

An analysis of waybill data from a sample of cabs in the Los Angeles Harbor Area project (10) supports the contention that shorter trips are less efficient. The ratio of paid to total miles, which is a measure of operating efficiency, increases with average trip length for both exclusive and shared-ride trips. Because the 15-cent flat-fare policy in the Los Angeles Harbor Area project is low enough to enable people to shift a portion of their walk trips to taxi, project passenger trip lengths average 1.5 miles compared with an average of 2.3 miles for nonproject trips. As a result, the shorter project trips appear to generate less revenue per taxicab mile.

Another factor that influences the profitability of project trips is the extent of shared riding. If more shared riding takes place, the revenue per revenue mile and the ratio of revenue miles to total miles will increase.

Since project riders in Los Angeles cannot share a cab with nonproject persons (presumably because of different fare policies), the extent of shared riding is constrained. Only about 16 percent of subsidized trips were shared, compared with an average of 29 percent of all taxi trips before the project. In Danville, 36 percent of all project trips were shared with another trip (project or nonproject), compared with 28 percent of all nonproject trips. Project trip lengths in Danville were only about 15 percent shorter because the zone-fare policy results in a minimum fare of at least $0.38, even for very short trips. Hence, the greater extent of shared riding for project trips offset the reduced efficiency of slightly shorter trip lengths, and the revenue per total cab mile was about equal for project and nonproject trips.

Another factor that can affect the extent of shared riding in both project and nonproject trips is the taxi supply. Dispatchers are unlikely to schedule shared rides if there is an excess supply and other cabs in the vicinity are vacant. This has been reported by the project administrator in Kinston to be the explanation for the low incidence of shared riding. An on-board taxi survey there revealed that only 13 percent of project users (and about the same proportion of nonproject trips sampled) were part of a shared-ride trip.

In sum, project fare levels that encourage the use of taxis for very short trips will result in a lower ratio of paid miles to total miles and require more dispatching time in relation to fewer, longer trips. Similarly, policies that limit the potential for shared riding, especially those that prohibit sharing among project and nonproject trips, will further constrain the revenue per taxicab mile.

If project trips are generally less profitable than other trips, taxi operators will be reluctant to serve project users at times when the demand approaches fleet capacity, which will result in a decreased level of service compared with nonproject trips.

A positive impact of project trips on the economics of taxi operations is the potential for spreading the demand more uniformly over the day. If project trips occur during periods of low total demand, the excess taxi capacity can be utilized and, since nonproject trips are not forgone, the operator may be less concerned about the relative profitability of subsidized trips. Some taxi operators, e.g., Kansas City and the San Francisco Bay Area, have reported that this has occurred (3,4). However, for the three cities (Kinston, Lawrence, and Montgomery) for which data exist to permit a comparison of demand profiles over the day between target and nontarget riders, Lawrence is the only site where the target population is making significantly fewer trips during the peak period than other taxi riders.

Attitudes of Taxi Operators Regarding User-Side Subsidies

Taxi operators' attitudes toward user-side subsidies are reflected in their willingness to participate in the program. For all demonstration projects except Montgomery, most or all of the local taxi firms elected to serve project users. In Montgomery, only 3 of the 16 local taxi companies are participating; 2 firms withdrew from the project during the first year. Reasons given for not participating include (a) the complexity of the grid-fare structure (Montgomery is the only demonstration city where the nonproject fares are based on meters and mileage; all other sites have zone-fare structures for all taxi trips), (b) time required for preparing and submitting vouchers, (c) delays in reimbursement of vouchers submitted, and (d) the burden of increased paperwork.

In the other three demonstration sites, more than 80 percent of the taxi firms have become project providers, and there are no instances of providers in these cities dropping out of the program (except for reasons independent of the project). In both Kinston and Danville, participating taxi operators

have generally favorable attitudes toward the project.

Providers in West Virginia have had a strong positive attitude toward TRIP, although none of them believed that TRIP revenues would ever be sufficient to propel the industry into long-term financial stability. More than 97 percent of providers (taxi and bus) surveyed are participating, and the only common complaint of taxi operators has to do with delays in reimbursement (7).

CONCLUSIONS

The following conclusions can be drawn from the findings discussed here about the transferability of user-side subsidies and specific issues relevant to other applications:

1. The user-side subsidy is a workable means of providing transportation for a selected market that involves public and/or private providers. It is easy to administer and does not require the purchase and operation of vehicles.
2. Project registrants are distinguished by lower income and lower automobile availability than in the target market as a whole.
3. Where taxi supply is adequate, more than 40 percent of all registrants take at least 1 project trip per month by taxi. The mean project trip rate for users at sites studied has been between 4 and 8 trips/month and tends to remain stable, with only slight fluctuations over time. Handicapped non-elderly persons are the most frequent users, averaging 6-12 project trips/month.
4. The aggregate price elasticity of demand for taxi trips is in the range of price elasticity values reported for the transit industry.
5. User-side subsidies for taxi travel are a cost-effective alternative to publicly operated demand-responsive service.
6. There is no evidence as yet to indicate that competition among providers will tend to improve service quality; however, it is preferable to involve as many providers as possible to ensure adequate coverage and a stable supply of taxis for project trips.
7. Taxi operators may have reservations about participating and require some assurance that reimbursement delays will not be intolerable. Small taxi firms are less likely to be willing to participate, because of the burden of increased paperwork.
8. Project fare levels that encourage the use of taxis for very short trips will reduce the ratio of paid miles to total miles and require more dispatching time for fewer, longer trips.
9. The compatibility of project and nonproject fare structures is essential to maximize the extent of shared riding.
10. Implementation of user-side subsidies for taxi service with meter-based fare structures is more complicated, especially if shared riding is permitted. However, introducing zone fares for project trips only is not an attractive solution from the point of view of taxi operators. There are two potential problems: (a) the complexity of having different fare structures for project and nonproject trips and (b) the likelihood that drivers will assert that zone fares for some trips are less than meter fares.
11. Fraud and abuse do not constitute a major problem when appropriate administrative procedures are followed to monitor users and providers.
12. Providing subsidies for bus and taxi modes extends the penetration of the target population, primarily because able-bodied elderly persons who rarely travel by taxi will continue to choose the bus.
13. More than twice as many bus trips as taxi trips are taken by project registrants if user-side subsidies are available for both modes. However, conventional buses are not an acceptable alternative for many people who use taxis, even at much lower fare levels.

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