7. User-side subsidies attract those individuals who are most transit dependent and most in need of the subsidized services. Eligible individuals with other means of transportation take few, if any, subsidized trips.

8. The principal benefits that accrue to subsidized users are a decrease in their travel costs for those trips that would otherwise have been made at full fare and a change from less-attractive travel modes such as fixed-route transit or walking.

9. Private transportation providers are generally supportive of user-side subsidy programs and are willing to absorb small administrative costs in return for the expectation of increased business.

10. There is some evidence that user-side subsidies stimulate competition among private transportation providers and serve as catalysts for innovation within the industry.

However, the most attractive feature of a user-side subsidy by far is its inherent efficiency. A user-side subsidy enables the subsidizing agency to target its program at those groups who are deemed to be most in need without having to extend benefits to other less needy individuals. Moreover, a user-side subsidy can be implemented with minimal interference in the operations and pricing structure of the local transportation industry. It therefore enables the subsidizing agency to utilize the efficiencies and productivities inherent in a competitive, free-market economy to obtain high-quality transportation service at the lowest cost. This combination of targeted benefits and competitive pricing minimizes waste and allows the subsidizing agency to allocate a greater proportion of its budget to direct subsidy benefits.

From a federal policymaking perspective, user-side subsidies seem to offer an efficient way of providing low-cost transportation services to those who really need them without the burden of substantial government intervention in private enterprise operations. Moreover, their ability to separate income transfer payments from transportation operating costs could ultimately lead to more efficient allocation of federal, state, and local transportation funds. Social service agencies, for example, could extricate themselves from providing separate transportation services for their clients by sponsoring user-side subsidies on existing public and private transportation services. Public transportation would also benefit from widespread adoption of user-side subsidies. With the burden of providing low-cost transportation services to the transit-dependent borne by user-side subsidies, public transit operators could set fares to be more representative of actual operating costs and thereby reduce their operating deficits. Overall transportation subsidies should decrease under such a scenario, since only a subset of the total transit would be eligible for the user-side subsidies.

The application of user-side subsidies to fixed-route public transit services has already been successfully demonstrated in three SMD sites--Danville, Montgomery, and Lawrence. In each of these sites, the subsidized target group consisted primarily of the elderly and the handicapped. In future evaluation efforts, the SMD Program plans to investigate the feasibility of employing user-side subsidies for low-income transit users to offset the adverse effects of a systemwide fare increase.

ACKNOWLEDGMENT

Much of the data on which this paper is based came from detailed evaluations of UMTA SMD projects and locally initiated user-side subsidy programs that were studied by the SMD Program. I would like to thank the following individuals for their contributions of both data and valuable insight concerning user-side subsidies: David Koffman of Crain and Associates; Michael Nelson and Mary Lovely of Charles River Associates, Inc.; and Lawrence Bruno, of UMTA's Office of Service and Methods Demonstrations.

Economies of Scale in Transportation for the Elderly and the Handicapped

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The costs of 36 transportation services for the elderly and the handicapped were analyzed to determine whether there are economies of scale in the provision of special transportation. A U-shaped cost curve was found for unit costs as ridership is increased by increasing the service area. In the case of increasing ridership by increasing the number of trips within a fixed service area, there are decreasing costs per passenger trip and a U-shaped curve for costs per passenger mile. However, because small agencies receive more unpriced resources in the form of shared overhead and volunteer labor and because of increased management costs and quality of services, coordinated or consolidated services may not lead to lower unit cost.

The number of programs that provide transportation to the elderly and the handicapped either as a primary function or as a support function for an organization with another purpose has grown significantly. As a result, several agencies often provide similar transportation services to a similar or to the same client group within the same service area. Many (1-3) have raised questions about the efficiency of this duplication of service and have suggested that such services should be coordinated or consolidated in order to save money or to produce more service for the same money. This recommendation is based on an underlying assumption that there are economies of scale in provision of special transportation. This paper presents the findings of a study undertaken for the Urban Mass Transportation Administration to test this hypothesis (4).

Increases in the scale of operation as measured by ridership can occur in two separate ways: by increasing the number of riders within a given area (for instance, by broadening the criteria for use of the system) or by increasing the service area of the system. Therefore the hypothesis of economies of scale was separated into two questions:

1. Do unit costs (i.e., costs per passenger trip or passenger mile) decrease with increases in ridership that are due to increasing the number of riders or special groups served within an area?
2. Do unit costs decrease with increases in ridership that are due to increasing the service area?

To answer these questions, we collected and analyzed the costs of 36 special transportation services in northeastern Illinois.

In our search of previous literature, we located only one study that dealt with the question of economies of scale for special transportation services. A 1977 article by Kidder and others (5) found economies of scale for a sample of 18 special service systems. By using regression analysis to develop a logarithmic cost model, they found that "a preliminary fitting of cost per passenger kilometer to number of passenger kilometers produced by the systems shows a nonlinear, negative slope relation that 'bottoms out'" (5, p. 37). In addition, Kidder and others mentioned two other findings of interest in light of our own study. They observed that the data did not exhibit "the expected upturn in the average cost curve at the higher operational scale" (5, p. 37). They attributed this to the ability of the larger systems to convert to fixed-route service. They also noted that two of the systems, the costs of which differed significantly from predicted costs (in opposite directions), received a high proportion of operating funds from government subsidy, suggesting to them that there is a causal link between receiving government subsidies and unit costs.

Our study differs from that by Kidder and others in that, in addition to size, we included other variables that affect costs (e.g., mode of service and percentage of passengers in wheelchairs). Our findings differed in that our models do not indicate that unit costs bottom out, but on other points we did come to similar conclusions, as will be pointed out in the following sections.

METHODOLOGY AND SAMPLE DESCRIPTION

In order to study the relation of size to unit costs, we gathered data by sending questionnaires to 429 special service providers in the Chicago metropolitan area. Based on their ability to provide detailed cost information, 36 agencies were chosen from the respondents for in-depth interviews. Information on costs, services-in-kind received by the agencies, ridership, and characteristics of their service, service area, and clients was gathered from the questionnaires and interviews.

Because many of the directors of the transportation services did not recognize all the costs attributable to the transportation service, costs had to be imputed in many cases. Imputed costs were of two types: those that the agencies did not keep records of but did attribute to the transportation function (e.g., vehicle maintenance costs) and those that the agency did not attribute to the transportation function (e.g., a staff person's time when that person's primary function was not related to transportation).

Two sets of costs were calculated from this information. The first set, financial costs, represents the actual money paid by the agency and subsidizing agencies for transportation. These costs include drivers' wages, fuel, maintenance, vehicle insurance, vehicle depreciation, the salaries of administrative and clerical staff whose primary job concerns the transportation service, and building cost or rent for space primarily devoted to the transportation service. Salaries and rent for space not primarily devoted to transportation were not included because the agency would probably have paid these even if transportation were not provided. In all cases, vehicle depreciation was included even if some other agency had paid part or all of the purchase price because in effect this is the same as if the other agency had provided an operating subsidy.

We called the second set of costs opportunity costs. These include all the above financial costs plus salaries for that portion of the time spent in the transportation service by anyone not previously included, rent for that portion of space partly devoted to transportation for any space not previously included, and an imputed wage for volunteer drivers. (Wages were imputed at $3.50/h, the lowest wage for any of the paid drivers, because the volunteers generally had little or no training or previous experience.) Although no additional monetary expenses were incurred by these three items, they represent resources that could be used for other purposes if the transportation service were not provided. Thus, opportunity cost represents the total resources expended for the transportation service, whereas financial cost represents the marginal monetary cost of the service.

It might be argued that opportunity costs are not a useful measure because special service agencies are constrained by actual monetary costs. However, comments made during interviews suggest that opportunity costs are meaningful to the agencies although the directors of the agencies do not articulate these costs in monetary terms. For instance, several directors mentioned the "headaches" involved with transportation provision. We suggest that those headaches actually represent a reduction in the quality or quantity of the agencies' primary output (e.g., therapy or meals). Further, one director of an agency that had changed from the provision of transportation to the purchase of transportation included in the benefits of the change the ability to absorb the loss of one staff person, although she never attributed the person to the provision of transportation or to the cost of providing transportation. This suggests that opportunity costs might actually be greater than we estimated. As for volunteers, if they were not used for driving, they could be used for some other purpose. (This is not to say that agencies should not use free services or share overhead when the opportunity is available. In fact, many small agencies could not provide transportation other than by taking advantage of these opportunities.)

Of the 36 agencies in the sample, 24 were operated by local governments, 7 by social service agencies, 3 by charitable institutions, and 2 by private companies. In all cases, the agency or company had another function besides providing special transportation services, although for the two private companies, the additional function was transportation related. Twenty-nine of the agencies provide service that is largely (more than 30 percent) demand responsive. Most of these require a 24-h reservation. The seven non-demand-responsive agencies provide primarily fixed-route or subscription service. Fifteen agencies provide service to the wheelchair user, although wheelchair passengers make up more than 5 percent of the ridership for only eight of the agencies. Thirty-three of the 36 agencies receive some government assistance. None of the agencies cover full expenses by fares. In fact, 20 charge no fares at all. Four agencies contract with another organization to provide service (except for the screening of clients), and an additional six agencies lease vehicles from another organization.

Three agencies use volunteer drivers. Two of these operate on the basis of a volunteer being assigned to one trip. In this case, the volunteer will make a pickup at the passenger's home, take the passenger to his or her destination, in many cases wait, and then take the passenger home. Several of the agencies provide transportation to the general public, although their prime objective is to serve a particular group.

In order to discover the effects of size and other parameters on unit costs, financial and opportunity costs were analyzed by using two methods. First, the average costs of different types of agencies were compared. Second, cost models were developed by using regression analysis. The findings of those two methods are presented in the next two sections.

COMPARISON OF COSTS

In order to compare the effects of size and other variables on the costs of special service transportation, the sample was subdivided into different sizes or types of agencies, and the means of operating statistics and financial and opportunity costs were calculated for each agency type. Table 1 presents these means.

Cost efficiency is a result of two operating characteristics: low operating costs and high productivity. Thus an agency with low costs per hour or per mile can be cost inefficient if it also has low vehicle productivity. Therefore, three measures are important: productivity, operating cost (cost per service hour or per vehicle mile), and unit cost (cost per passenger trip or per passenger mile). This distinction can clearly be seen when the sample is divided into agencies that primarily provide demand-responsive service and agencies that primarily provide other types of service (subscription and fixed-route). Demand-responsive services have significantly lower costs per service hour and vehicle mile. This may be partly because they use smaller vehicles. However, because their vehicle productivities are lower (a third of that of the other services), their costs per passenger trip and per passenger mile are higher.

This division also bears out the finding of Kidder and others (5) that larger agencies provide fixed-route services. The mean ridership of the agencies in our sample that provide primarily demand-responsive service was 18 000 trips/year, whereas the mean ridership of the other agencies was 82 000 trips/year. This raises an important question that we could not answer from our study. As ridership increases, do agencies tend to change from demand-responsive to subscription and fixed-route service? If this is true, it may imply that larger agencies are achieving cost efficiencies by limiting service to recurring trips or trips along major routes. Although this type of service generally allows for higher vehicle productivity than individually scheduled, many-to-many trips, it excludes clients with less easily scheduled travel needs. On the other hand, the correlation between large riderships and subscription and fixed-route service may occur because these types of services do not survive at low riderships.

The second division of the sample was based on whether the agency provided service for wheelchair passengers. The mean cost per service hour was higher for those agencies that provide this service, perhaps partly because the vehicles are equipped with lifts. Although the drivers may have more training, they receive approximately the same wages. However, the cost per vehicle mile is lower for agencies that provide wheelchair service. This implies that the vehicles have a higher rate of miles per service hour (this is not necessarily the same as speed because the vehicle may not actually be in use during a service hour). The fact that the wheelchair services have lower vehicle productivities and provide longer average trips may account for the higher miles per service hour. We hypothesize that the wheelchair-bound passengers take longer trips because they take fewer shopping and social trips due to physical barriers at those sites. The remaining trips, medical/therapy and work, tend to be longer (6). The cost per passenger trip is higher for wheelchair service, whereas the cost per passenger mile is lower; this is a result of the longer average trip distances.

The ratio of opportunity cost to financial cost for agencies that provide wheelchair service is much lower than that for the agencies that do not provide the service. This is partly because they do not use volunteers; the additional work required to handle wheelchairs and the requirements of the frequently more severe disabilities of wheelchair passengers probably discourage both potential volunteers from offering their services and agencies from using less professional drivers.

The third subdivision of the agencies was according to whether the transportation service was operated by a government agency. We found that government agencies have lower operating costs per service hour, partly because the special transportation operations of government agencies frequently share vehicle maintenance facilities and insurance coverage with other local government fleets. Average maintenance costs and insurance costs for government agencies are, respectively, \$0.61 and \$0.37 per service hour, whereas for nongovernment agencies they are \$1.31 and \$1.17. In addition, the government agencies are less likely to provide more expensive service for wheelchair-bound passengers. Interestingly, administrative costs are virtually the same for the two types of agencies (\$2.43 per service hour for government and \$2.45 for nongovernment). However, the cost per vehicle mile for government agencies is higher, which implies that these agencies use their vehicles for relatively few miles per service hour. The cost per passenger trip for government agencies is lower, whereas the cost per passenger mile is higher. This reflects the fact that the average trip distance is half that of nongovernment agencies, which may be because the service areas of government agencies are smaller (the largest is 6x6 miles) than those of nongovernment agencies.

The ratio of opportunity cost to financial cost for the government agencies is much lower than that for the nongovernment agencies. This is partly because the nongovernment agencies are more likely to use volunteer drivers. The nongovernment agencies appear to use their "free" drivers inefficiently; their average driver cost per service hour is \$5.70 even though they pay wages averaging \$4.18/h (including imputed wages for volunteer drivers). This helps account for the difference in opportunity costs per service hour for government and nongovernment agencies.

Finally, the agencies were divided into small, medium, and large based on their annual ridership. The ratio of opportunity costs to financial costs is 1.4 for the smallest agencies, whereas it is 1.1 for medium and large agencies, which indicates that the small agencies receive more shared overhead and/or volunteer labor. Thus, although financial costs per service hour are lowest for the small firms, their opportunity costs per service hour are highest. The small agencies' cost per vehicle mile is also high-

Table 1. Service characteristics and costs of sample.

Sample Division	N	Avg Trip Distance (miles)	Productivity (passenger trips/ vehicle hour)	Financial Costs ($)				Opportunity Costs ($)				Opportunity to Financial Costs Ratio
				Per Service Hour	Per Vehicle Mile	Per Passenger Trip	Per Passenger Mile	Per Service Hour	Per Vehicle Mile	Per Passenger Trip	Per Passenger Mile	
Overall	36	4.3	4.6	10.80	1.16	2.78	0.80	13.05	1.40	3.51	1.00	1.3
Demand-responsive mode	29	3.6	3.9	10.33	1.10	3.01	0.86	12.49	1.31	3.82	1.07	1.3
Other mode	7	7.2	7.6	12.74	1.39	1.85	0.55	15.37	1.74	2.24	0.70	1.2
Provides wheelchair service												
Yes	15	5.1	4.3	11.35	1.06	3.08	0.78	13.23	1.24	3.55	0.90	1.2
No	21	3.7	4.8	10.40	1.24	2.57	0.82	12.93	1.52	3.48	1.07	1.4
Government agency												
Yes	24	3.3	4.8	10.34	1.29	2.57	0.88	12.28	1.56	3.04	1.04	1.2
No	12	6.7	4.3	11.72	0.88	3.21	0.61	14.61	1.05	4.44	0.90	1.5
Size of ridership												
<20 000	23	4.4	4.3	10.38	1.22	2.69	0.79	13.29	1.53	3.69	1.05	1.4
>20 000 and <50 000	7	3.6	4.0	11.51	1.00	3.68	0.93	12.60	1.10	3.96	1.02	1.1
>50 000	6	4.6	6.8	11.57	1.55	2.06	0.67	12.68	1.28	2.29	0.77	1.1

est for financial as well as for opportunity costs. Given that their productivity and average trip distance are about the same as those of the overall sample, it seems they are not using the vehicles as much as they could. However, the medium-sized agencies have very low productivities and short trip distances. As a result, they have the highest cost per passenger trip even though their operating costs are low. The large agencies have the lowest unit costs (both per passenger trip and per passenger mile) for both financial and opportunity costs although their operating costs are in the medium range. This is due to their high productivities.

To summarize, the smallest agencies have low financial costs per service hour because they take advantage of free services. Because they have medium productivities they take advantage of these low financial operating costs to achieve low unit financial costs. However, in terms of opportunity costs, they have high operating costs and therefore relatively high unit opportunity costs, possibly because they use these free services inefficiently.

The large agencies have relatively high financial operating costs because they receive few free services. Their opportunity operating costs are in fact slightly below average. Because they have a high productivity rate, they actually have the lowest unit opportunity costs.

The medium-sized agencies have medium to low operating costs but very low productivities. As a result, their unit costs are high. It appears that the large agencies are the most efficient; however, it should be remembered that the large agencies are more likely to provide fixed-route or subscription service.

It should be noted that productivities vary more between agencies than operating costs (i.e., cost per service hour or per vehicle mile). This implies that there is more potential for decreasing unit costs (i.e., cost per passenger trip or per passenger mile) by increasing productivities than by decreasing operating costs. Increasing rider density (trips per square mile of service area) is more likely to increase productivity (trips per vehicle hour) than increasing service area. Therefore, it appears that increasing rider density will have a greater effect on lowering unit costs.

RELATION OF UNIT COSTS TO SIZE

The agencies and the type of service that they provide differ from one another in many ways that may affect unit costs. In order to isolate the effects of size, the effects of other types of differences must be taken into account. We attempted to do this by developing cost models by using regression analysis.

For financial costs, however, we did not find statistically significant models of unit financial costs that included any measure of size. This appears to indicate that there are constant returns to scale for financial costs. Figure 1, which shows financial cost per passenger trip plotted against total annual ridership, seems to confirm this. The plot shows that there is great variation in unit costs for the smallest agencies. Some of this variation is probably due to the higher amount of shared overhead and volunteer labor that the small agencies are more likely to receive. Also, when total transportation costs are low, the agencies may not control them as closely, which may add to the variation for small agencies.

The cost models fitted for opportunity costs are presented in Table 2. The model of cost per passenger trip explains 88 percent of the variation in the data and has an F-value of 14.30, which is significant at the 1 percent level. The t-values indicate that the intercept is not significant and the coefficient for revenue from government subsidy is significant at the 10 percent level. All the other coefficients are significant at the 5 percent level. The model for cost per passenger mile explains 82 percent of the variation in the sample and has an F-value of 10.37. The intercept and coefficient of rider density are significant at the 10 percent level. All the other coefficients are significant at the 5 percent level.

The effect of increasing the service area when rider density is constant is shown in Figure 2. It can be seen that there are economies of scale as the service area is increased to an optimal size and diseconomies above that size. For opportunity cost per passenger trip, the most efficient size of service area (i.e., the one with lowest unit cost) appears to be in the range of 300-500 $miles^2$ (see Figure 2a) regardless of the rider density. However, for opportunity cost per passenger mile, the most efficient size of service area depends on the rider density as shown in Figure 2b. This may reflect the relationship between service area and average trip distance. When rider density is high, service may be more efficiently provided if trip distances are kept short (which is an inherent result of small service areas). It should be mentioned that there were no agencies in the sample with service areas in the range between 350 and 750 $miles^2$ and only a few larger than 750 $miles^2$. In fact, the majority of service areas (25 out of

Figure 1. Financial costs per passenger trip versus annual ridership.

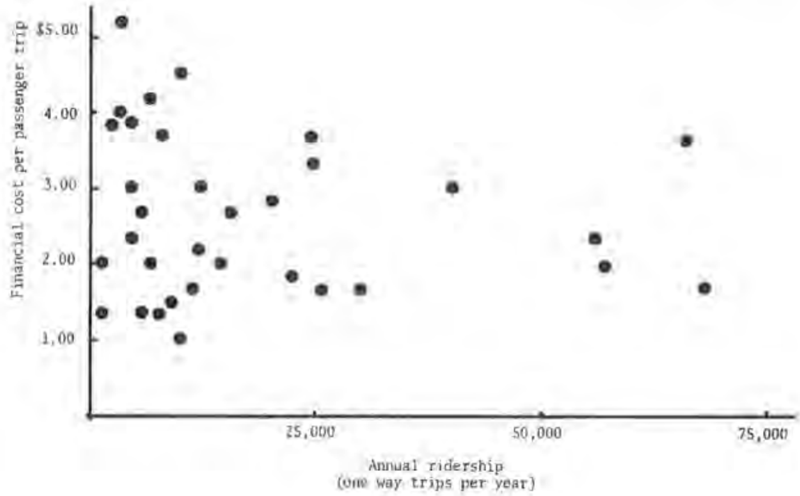


Table 2. Models of opportunity cost for special services for elderly and handicapped.

Independent Variable	Dependent Variable: Cost per Passenger Trip	t-Value	Cost per Passenger Mile	t-Value
Intercept	−0.0398	0.02[a]	−0.8157	1.86[b]
Measure of output				
Service area (100 miles²)	−2.4512	4.69	−0.3812	2.44
(Service area)²	+0.2849	4.82	+0.0439	2.70
Rider density (10 000 trips/mile²)	−1.0593	2.25	−0.3744	1.95[b]
Passenger miles (10 000 trip miles)			+0.0052	2.22
1/passenger miles			+0.3655	
Quality of output				
Avg trip distance (miles)	+1.0837	3.21		
(Avg trip distance)²	−0.0869	3.57		
1/avg trip distance			+1.0451	5.56
Mode (d) (1 = demand responsive)			+0.9131	5.03
Proportion wheelchair	+3.7931	2.26		
Input price				
Driver wages ($/h)	+0.8642	2.60	+0.2823	3.47
Organizational factors				
Government agency (d) (1 = government agency)	−2.5758	3.11	−0.3973	2.91
Proportion government subsidy	+1.6710	1.76[b]		
Individual volunteers (d)	+3.0020	2.35		
Environmental factors				
Proportion older than 65 (%)	−0.1827	2.96	−0.0350	2.30
R^2	0.88		0.82	
F-value	14.30		10.37	

Note: (d) indicates dummy variable. Unless otherwise indicated, the t-value is significant at the 5 percent level.
[a]t-Value is not significant.
[b]t-Value is significant at the 10 percent level.

36) are 36 miles² or less. Thus, this sample provides evidence for a U-shaped curve, but it may not be accurate as to the size of service area at which costs begin to rise or how low they are at the optimum size.

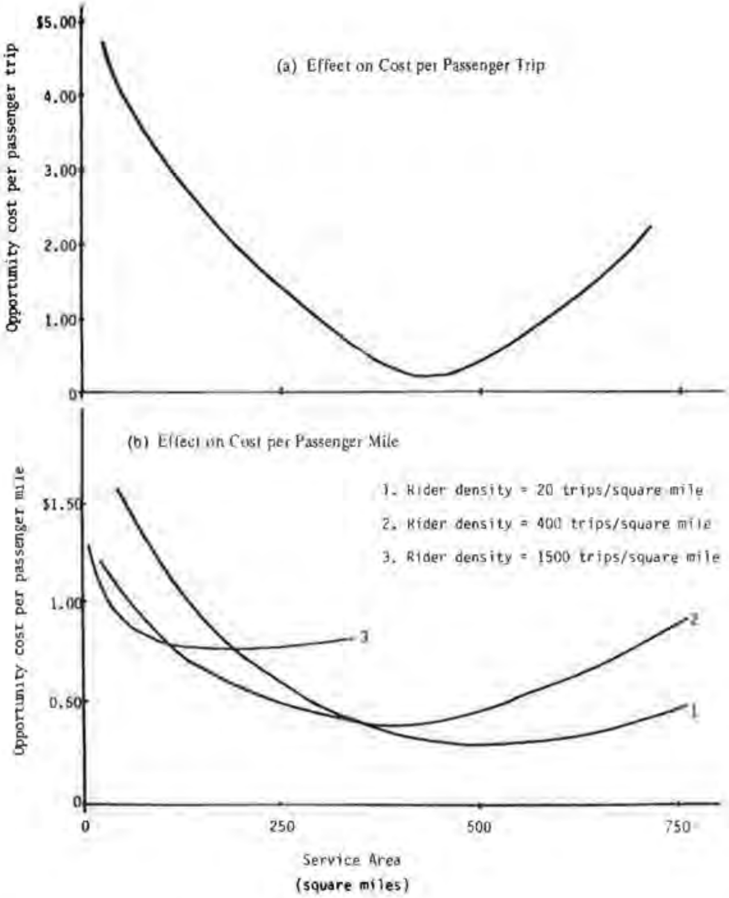
The effects of increasing rider density on opportunity unit costs are shown in Figure 3. The effect on cost per passenger trip is constant decreases in cost with increasing scale. For cost per passenger mile, the effect depends on the size of the service area. Agencies with very small service areas experience economies of scale for all ranges of rider density in the sample. Agencies with medium or large service areas, however, have U-shaped cost curves with respect to costs per passenger mile.

In summary, it appears that agencies with very small service areas and low rider densities are inefficient. They probably could reduce unit costs by expanding ridership either by increasing rider density (e.g., broadening criteria for service) or by increasing service area. Agencies with large service areas appear to operate more efficiently with low rider densities. Thus, large service areas may be efficient in low-density or rural areas (where they are probably necessary if enough destinations are included to be useful to the passengers) but less efficient in dense, urban areas. Obviously, these implications need to be tested further. If the actual causes of the relationships were further understood, it might be possible to overcome the apparent inefficiencies of certain combinations of sizes of service areas and rider densities by transferring management or operating techniques.

FINAL REMARKS

Although our research indicates that there are economies of scale when total resources are considered, there are problems with recommending the coordination or consolidation of special transportation services in order to take advantage of the potentially greater efficiency of a larger ridership. One difficulty concerns the use of unpriced resources (i.e., shared overhead and volunteer labor) under a new organizational arrangement. A

Figure 2. Effect of service area on unit opportunity cost.



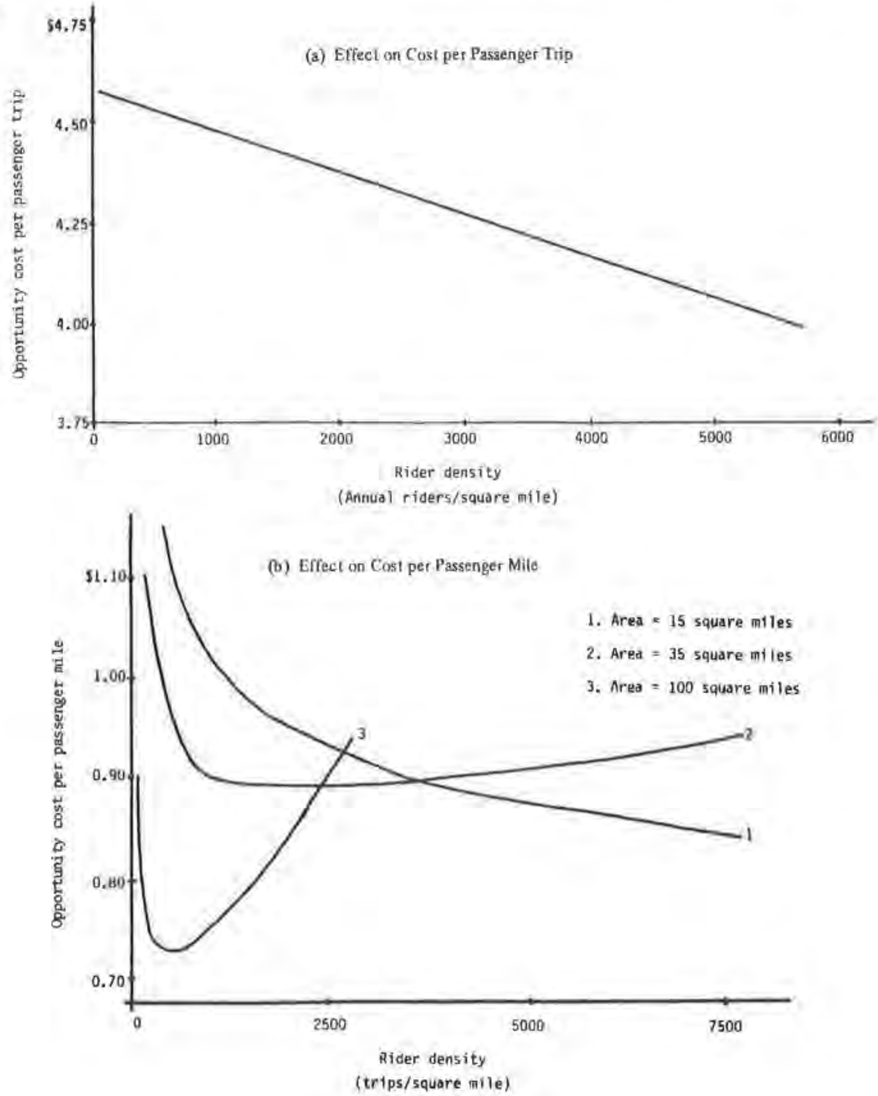
second is based on empirical evidence concerning the actual unit costs of consolidated and coordinated services.

Our study of economies of scale indicates that from the point of view of actual money paid (by the provider and by other organizations that subsidize the provider) for special transportation services, returns to scale seem to be constant. In other words, there is no optimal size for special transportation services. On the other hand, from the point of view of total resources used, there are economies of scale. Special transportation services with small service areas and/or low rider densities are inefficient. (Agencies with very large service areas are also inefficient.) Thus agencies with very small riderships would apparently operate more efficiently if they enlarged their ridership or if they coordinated or consolidated their transportation services with other agencies. But this is true only if the unpriced resources (i.e., shared overhead and volunteer labor) are effectively used in some other capacity after coordination or consolidation. Given the tight budget constraints of most agencies providing special transportation, it seems likely that any shared overhead released by a reorganization of transportation services will be put to good use. Although there are relatively few agencies that use volunteer drivers, the effect of volunteers in reducing financial cost is much greater. Further, these agencies may not find other uses for the volunteers and, if they do, the volunteers may not offer their time for the new job. Although most providers seem to prefer not using volunteer drivers (because they are less reliable, do not have special training, and increase problems with insurance), agencies with tight budgets may have no choice other than to continue to use volunteers or to discontinue the provision of transportation.

The coefficients of the other variables in the opportunity cost models are for the most part as expected. Cost per trip increases with average trip distance up to distances of about 6 miles. For trips longer than 6 miles, the cost begins to fall off because the longer trips are usually provided by subscription and fixed-route service at higher vehicle productivities. The cost per passenger mile falls off and gradually flattens out as trips get longer. The models indicate (as Table 2 also did) that providing demand-responsive service is more expensive per passenger mile and providing wheelchair service is more expensive per passenger trip. Unit costs go up as driver wages go up, which is expected. Unit costs go down as the percentage of the population of the service area that is 65 or older increases. Since many of the agencies serve the elderly, increases in elderly population mean that trip origins are closer together, thus decreasing the time and mileage spent in deviating to pick up passengers.

If the agency assigns voluntary drivers to individual trips, the opportunity cost per trip is considerably higher. This appears to be an inefficient use of labor; however, it may be that the drivers would not volunteer if they were assigned to drive a van picking up several passengers for a set period of time. As the agencies that assign volunteers to individual trips usually provide trips with few other alternatives (e.g., they cross jurisdictional boundaries), they may be filling a rather special role in transportation for the elderly and the handicapped.

Figure 3. Effect of rider density on unit opportunity cost.



Finally, if the transportation is provided by a government agency, the unit costs are lower, as was also shown in Table 1 and discussed in the last section. However, the opportunity cost per passenger trip increases 1.7 cents for every 1 percent of operating revenue provided by government subsidy. Two possible causes for this relationship are the costs of accountability (e.g., more record keeping) and the inefficient use of resources that the agencies perceive as free (i.e., the subsidies). The nature of the relationship among government operation, government subsidy, and cost requires further investigation.

The second problem with increasing efficiency through consolidation is that empirical evidence indicates that the unit costs of agencies providing consolidated transportation are actually higher than the opportunity costs of uncoordinated special transportation services. [This evidence comes from research we are currently engaged in as well as previous research by others (7).] These increased unit costs are undoubtedly due partly to the increased management necessary to coordinate services for several agencies that have differing requirements. Probably more importantly, however, these transportation-only agencies increase costs in attempting to improve the quality of their product. Our research indicates that they do provide a higher quality of transportation; for instance, vehicles are maintained better and drivers have more training.

This poses a difficult choice for those interested in special transportation. Ideally, special transportation services should be consolidated so that the transportation is efficient and of high quality. However, this apparently will result in higher costs in a period when funds are getting scarcer.

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Two Options for Travel Needs of Mentally Retarded: Implications for Productivity and Cost-Effectiveness

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The mentally retarded have a growing effective demand for transportation because of progressive deinstitutionalization. Simultaneously, local transit operators have a renewed obligation to implement special efforts that meet the travel needs of the retarded. This paper examines two options that would comply with the interim directives pertaining to Section 504 of the Rehabilitation Act of 1973. First, mobility training for independent travel on fixed-route systems is a very cost-effective option of interest to both line-haul operators and social service agencies who must purchase transportation for the mentally retarded. Furthermore, independent travel ability greatly enlarges employment, recreational, and locational opportunities for the mentally retarded individual. The second option is extending paratransit services to the mentally retarded. Client mixing and time sharing of the mentally retarded with other patrons, especially the elderly, can be both practicable and desirable. Incorporated paratransit services for the mentally retarded are practicable because of the complementary travel-demand patterns of the elderly and the retarded. Combined services are desirable because the mentally retarded can form a ridership core that is efficient and remunerative to serve. Problems can and do arise, occasionally because of client misbehavior, more often because of inadequate planning by transit operators. Nonetheless, incorporating the mentally retarded onto paratransit systems already serving the elderly or devising a system for the retarded can significantly raise the productivity of special transit systems.

The mentally retarded make up a significant fraction of the nominally handicapped. In the United States they represent 3 percent of the national population, or approximately 6.1 million individuals. The majority of retarded persons--between 75 and 90 percent--can, with special assistance, be expected to function independently in community life(1).

Unfortunately, the mentally retarded have been uniformly overlooked by federal transportation policymakers, despite their sizable numbers, their special transportation needs, and, most importantly, their qualification as a distinct transportation-handicapped population under relevant federal legislation (2). The most widely used estimate of the national population of the elderly and physically transportation handicapped is 7.4 million (3). However, the mentally retarded are not included in this count (unless they are also physically handicapped). This omission is rather astonishing: The addition of the 6.1 million mentally retarded persons to the 7.4 million elderly and physically disabled would exceed the initial estimate of the travel handicapped by 82 percent. It suggests that there is really a total of 13.5 million transportation-handicapped individuals in this country.

This is a particularly appropriate time to examine the transportation needs of the mentally retarded and the major options available to meet those needs. First, U.S. transit operators have just received new interim directives from the U.S. Department of Transportation (DOT) concerning their obligations to the physically and mentally handicapped. Because of these new policy directives, many local transit operators are struggling to define and develop new transportation services.

Second, this is an opportune moment to examine the special transportation problems of the mentally retarded because of the increasing emphasis in the social service delivery system on the deinstitutionalization of the mentally retarded. As more of these citizens are returned to the community or are placed there directly, their effective demand for transportation services will increase.

Third, some agencies and institutions dealing with the mentally retarded have not recognized the potential effectiveness of several transportation options in meeting the needs of the mentally retarded. In particular, these agencies have been slow to perceive the value and success of training the mentally retarded to use conventional fixed-route transit.

CHOOSING MOST COST-EFFECTIVE OF TWO MAJOR TRANSPORTATION OPTIONS

This paper will focus on two separate methods of meeting the transportation needs of the mentally retarded: mobility training and the provision of separate special paratransit services. The paper will suggest how these two options can and should be viewed by agencies in three different positions:

1. Local communities and transit operators endeavoring to devise the most appropriate or cost-effective method of serving different types of handicapped people,
2. Current special efforts or community paratransit systems trying to increase the usefulness and productivity of their services, and
3. Agencies responsible for the mentally retarded who are struggling to provide these citizens with a productive and meaningful life.