Consideration of Special User Groups in Regular Transit Operation and Finance

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Information from the Urban Mass Transportation Act Section 15 Reporting System and the Bureau of the Census was used as the data base for characterizing and evaluating regular transit services and funding for special user groups of the young, the elderly, the poor, minorities, and the carless. For the selected 101 urbanized areas, 32 relevant variables that reflect four distinct sets, transit resources per capita, transit services per capita, transit consumption per capita, and attributes of special user groups, were identified. After the variables accuracy and variability were assessed, correlation analysis revealed that transit resources per capita, transit services per capita, and transit consumption per capita are only 12 percent positively correlated with special user group attributes. For expedient assessment of attributes of special user groups in urban areas, a composite measure that reflects the overall status of the population of the young, the elderly, the poor, minorities, and the carless was developed. Transit resources per capita, transit services per capita, and transit consumption per capita were found to be either negatively correlated or not significantly correlated with the composite measure. The results of correlation analyses revealed that transit funding and operations do not appear to create more egalitarian distribution of income and mobility. Such findings have not been previously addressed in transit literature. The composite measure is suggested for use as an index for planning for the use of transit funding and operations in addressing social equity issues.

Inadequacy of transportation services represents a serious constraint on the physical and emotional well-being of certain groups of urban residents. The carless, the poor, the handicapped, the elderly, minorities, and the young suffer serious disadvantages from not being adequately served by the vast automobile-based transportation systems throughout the United States. Many studies have concluded that these groups of urban residents have, vis-à-vis society, certain general disadvantages in mobility and accessibility, which make them of special concern, in an equity sense, in the provision of public transit services (*1–8*). Provision of special services is often perceived as the only solution when the majority of the population of these groups is able to use regular transit services (*9, 10*).

In recent years studies of the public transportation of special user groups have been numerous (*11*). These studies have focused mostly on special services for the elderly and the handicapped and have covered only a limited geographic region. A number of other studies have focused on transit performance and subsidies (*11, 12*). A review of the literature, however, revealed that evaluation of regular transit operations and funding in terms of special user groups has hardly ever been addressed (*5, 13–16*). Justification of subsidies based on the concept of social equity comprises an indispensable objective of public financial support for transit. Taxes are levied to support transit operations and services for those who cannot pay their full cost and do not have access to alternative means of transportation. The present study is an attempt to characterize and evaluate regular transit services and funding in relation to special user groups of the young, the elderly, the poor, minorities, and the carless. The objective of the research reported herein was to determine whether regular transit operations and subsidies are indeed consistent with the needs of special user groups throughout the United States.

Although there is considerable discussion about the uniqueness of both transit systems and their markets, a macroscopic nationwide study such as this is useful for incorporating information about the population of special user groups in transit decision making. By characterizing the status of regular transit systems in relation to the young, the elderly, the poor, minorities, and the carless, transit decision makers can improve their policies, with a sense of equity, for meeting the mobility and accessibility needs of these groups of citizens. Funding and planning agencies could incorporate this information in resource allocations to provide more equal opportunities in community transportation.

DATA BASE

The nationwide scope and limited resources of this study required the use of centralized data sources. The only reasonable source of transit operational and financial data was the Urban Mass Transportation Act Section 15 Reporting System. Annual data, as reported for the fiscal year between July 1, 1979, and June 30, 1980, were used (*17*). Data that define attributes of the young, the elderly, the poor, minorities, and the carless were extracted from 1980 Bureau of the Census data bases. Lack of appropriate centralized sources of data on the handicapped population at the urbanized-area level prevented the inclusion of this special user group in the study. Furthermore, lack of centralized and appropriate sources of data on special services for the handicapped prevented incorporation of this component of service in this study. Special services are often provided for the handicapped, and exclusion of information on the handicapped and special services for them is more justifiable than is inclusion of only one type of these data. Special service supply and demand relative to the handicapped are therefore viewed as attributes of an exclusive mode that constitutes a separate dimension of the problem and are not discussed herein.

Census data are reported both for various levels of govern-

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mental jurisdiction and for various geographic levels. Section 15 data, on the other hand, are reported only by transit operators. Merging of data from these two sources required a common geographic base. The urbanized areas used by the Bureau of the Census were adopted as a feasible alternative that was most nearly representative of the idealized transit-serviceable urban areas for the young, the elderly, the poor, minorities, and the carless. When necessary, transit data from multiple operators in a given urbanized area were aggregated. Of the 366 urbanized areas in 1980, only 101 were included in this study. The remainder were excluded either because they were not served by transit or because transit and census data had not been adequately reported for the time period of interest.

CHARACTERIZATION OF TRANSIT SYSTEMS

Relevant transit system attributes consisted of variables that reflect their financial and operating status and special user groups of the young, the elderly, the poor, minorities, and the carless. The identified variables consisted of four distinct sets: transit resources per capita, transit services per capita, transit consumption per capita, and the attributes of the special user groups. Transit resources generally include labor, capital, and operating monies. Transit services include major characteristics such as vehicle miles, vehicle hours, and passenger capacity miles. Transit consumption reflects utilization of the transit services and includes attributes such as passengers and passenger miles. The transit special user groups of this study consisted of the young, the elderly, the poor, minorities, and the carless. Lack of centralized sources of data on the handicapped resulted in their exclusion from the study. The carless population is often identified by measuring car availability through either household ownership or other sources of availability outside the household. Persons per automobile and automobiles per household were selected as measures reflecting carlessness. As persons per automobile increase, and as automobiles per household decrease, there will be an increase in carlessness. The young are often considered to be the portion of the population below the age for driver licensing; this includes, also, children who are automobile-ride dependent on adults. Percentage of population younger than 18 years, percentage of population in school, and percentage of population younger than 5 years were selected as reflective of this portion of the population. The elderly are often identified as those who have problems caring for themselves, whose life cycle has changed, or who have retired from full-time employment. As in most other studies, the last definition, percentage of those 65 years of age or older was used as the statistic reflecting the percentage of elderly. Although there is not a universal consensus about the definition of the poor as related to transportation, those whose financial condition does not permit use of an automobile have often been classified as the poor. As the percentage of the population with income lower than $5,000 increases, and as the percentage of the population with income greater than $10,000 increases, the population of the poor will decrease. These four attributes were selected as statistics reflecting the poverty level. The percentage of nonwhite population was used to reflect minorities.

ANALYSIS

In the course of this study, 20 financial and operational variables and 12 special user group variables were selected.

Simple statistical analysis of the 32 selected variables was performed with the Condescriptive Program of SPSS (*18*), which served both to characterize the variables and to allow an assessment of their accuracy and adjustment, if required. Table 1 gives a summary of the dispersion within each of the four distinct sets. Overall, the variables were found to vary widely among the 101 urbanized areas.

The Pearson Correlation Analysis Program of SPSS (*18*) revealed that many pairs of the special user group attributes are highly correlated, which suggests that the number of variables could be significantly reduced and their statistical dependency could be rectified. Factor analysis is a useful statistical procedure in such a task. The Factor Analysis Program of SPSS (*18*) was used with varimax rotation and a minimum Eigenvalue of one. The results of factor analysis showed that three dimensions combined to account for 70 percent of the variance.

In factor analysis, variables that have similar patterns of variance are grouped together into statistically independent factor dimensions. Results may be used in either of two ways. First, one or more variables within each factor group, generally the most significant as indicated by a large factor loading, can be selected to represent the dimension of that group and the others are then discarded. In the second approach, a new variable is created to represent each of the factor groups, and an index (factor score) is computed as a measure of that variable. Although the factor scores do serve to adequately represent the factor dimensions, their meanings are not always intuitively obvious and their interpretations are often difficult. Thus the first approach was adopted. Table 2 gives the varimax rotated factor matrix. Where possible, variables most closely related to each factor have been listed first and loadings of less than 0.4 have been omitted for clarity.

Factor 1 was interpreted as a poverty index, and the percentage of families in the low-income group was selected to represent this factor. Factor 2 was interpreted as a youthfulness index, and the percentage of the population younger than 18 years was selected to represent this factor. The percentage of the population older than 65 years of age was also selected because it not only reflects Factor 2 with a very large negative loading but it also identifies the elderly group. Factor 3 was interpreted as an automobile availability index, and persons per automobile was selected to represent this factor. The percentage of the nonwhite population also was selected because it identifies minorities. In this way, five reasonably statistically independent attributes were selected to present the special user groups of the poor, the young, the elderly, minorities, and the carless.

To develop an understanding of possible relationships of transit operations and financial status with attributes of special user groups, a pairwise correlation analysis was performed. The results of Pearson Correlation Analysis Program of SPSS (*18*) are given in Table 3. As the data in the table indicate, many pairs of variables are not significantly correlated. Seventy-five percent of the significantly correlated variables show negative correlation. When transit resources per capita, transit services

TABLE 1 DISTRIBUTIONAL CHARACTERISTICS OF SELECTED VARIABLES

Variable	Mean	Standard Deviation	Coefficient of Variation	Dimension
Transit resources per capita				
Operating expense per capita	17.61	16.18	91.91	$/person
Revenue per capita	18.43	16.78	91.07	$/person
Passenger revenue per capita	5.36	5.30	99.01	$/person
Local operating assistance per capita	3.84	5.93	154.51	$/person
State operating assistance per capita	2.22	3.72	167.57	$/person
Federal operating assistance per capita	4.50	3.15	70.00	$/person
Total operating assistance per capita	10.56	9.49	89.87	$/person
Local capital assistance per capita	1.76	4.03	228.98	$/person
State capital assistance per capita	0.78	1.24	158.97	$/person
Federal capital assistance per capita	8.24	13.04	158.25	$/person
Total capital assistance per capita	10.78	16.45	152.60	$/person
Revenue vehicles per capita	0.31	0.17	55.41	Vehicles/1,000 persons
Transit employees per capita	0.65	0.43	66.09	Employees/1,000 persons
Operators per capita	0.42	0.25	59.37	Operators/1,000 persons
Transit services per capita				
Passenger capacity miles per capita	540.11	508.90	94.22	Passenger mi/person
Revenue vehicle miles per capita	8.44	4.97	58.91	Vehicle mi/person
Revenue vehicle hours per capita	0.64	0.37	57.08	Vehicle hr/person
Transitway length per capita	1.35	1.58	117.43	Miles/1,000 persons
Transit consumption per capita				
Passengers per capita	23.34	25.29	108.35	Passengers/person
Passenger miles per capita	83.03	104.53	125.89	Passenger mi/person
Attributes of special user groups				
Persons per automobile	2.09	.38	18.15	Persons/automobile
Automobiles per household	1.38	.21	15.48	Automobile/household
Percentage of families in low-income group	7.60	2.74	36.09	%
Percentage of families with income less than $5,000	6.68	1.86	27.92	%
Median family income	21,017.18	2,793.69	13.29	$/year
Percentage of families with income greater than $10,000	75.85	12.97	17.10	%
Percentage of population younger than 5 years	7.09	1.14	16.10	%
Percentage of population younger than 18 years	27.04	2.94	10.88	%
Percentage of population in school	21.50	2.07	9.64	%
Percentage of population older than 65 years	11.26	3.12	27.72	%
Percentage of nonwhite population	16.70	11.41	68.30	%

per capita, and transit consumption per capita are significantly correlated with the variables that reflect the young, the elderly, and the poor, the correlation coefficients are all negative. Proponents of operating subsidies argue that subsidies create a more egalitarian distribution of income and mobility. The negative correlations of operating assistance per capita of Table 3 suggest the inconsistency of funding distribution in enhancing equity. For the selected urbanized areas, the correlation analysis revealed that the federal operating assistance per capita decreases with increases in the percentage of the population younger than 18 years, the percentage of the population older than 65 years, and the percentage of families in the low-income group. This suggests that there is more federal operating assistance per capita for the more affluent urbanized areas. This conclusion probably explains why in Table 3 most of the transit service per capita variables are negatively correlated with special user group variables when there is no significant correlation among service utilization, passenger miles per passenger capacity mile, and special user group variables. Transit subsidies and operations generally showed less inconsistency (i.e., negative correlation) with respect to minority and carless variables. The exception was transitway length, which is negatively correlated with percentage of nonwhite population.

The results of correlation analysis showed that 11.6 percent of the transit resources per capita variables, 10 percent of the transit services per capita variables, and 30 percent of the transit consumption per capita variables are positively correlated with special user group variables. In other words, 88 percent of entries of Table 3 exhibited either a negative or a nonsignificant correlation. This suggests that transit operation and funding decisions are not adequately reflecting the equity issue.

COMPOSITE MEASURE OF SPECIAL USER GROUPS

The attributes, selected using factor analysis, present a set of statistically independent dimensions of special user groups. In a given urban setting, one or more of these five attributes might well be above average and the other attributes might be below average, resulting in a unique condition. The statistical independency of the five attributes does not guarantee that they are mutually exclusive. Many studies have shown that there are population overlaps of special user groups such as the young and the carless; the elderly and the carless; and minorities, the

carless, and the poor. Nonetheless, it is apparent that the combination of the five attributes reflects the demand of special user groups, which should be of special concern in an equity sense to transit decision makers. Thus it was deemed useful to have a single composite measure for each urbanized area that would reflect the overall status of the special user groups. The composite measure can be used by transit planners and decision makers as a reference for developing more equitable decisions and policies pertaining to special user groups. As an index, it should be of special interest to funding agencies because total population is currently often used as the only measure for funding and resource allocation.

Because the five attributes have different dimensions, it is desirable to normalize them for purposes of comparison. The conventional technique for doing this is to compute standardized or Z-scores as follows:

$$Z_{ij} = (X_{ij} - \bar{X}_i)/S_i \qquad \begin{matrix} i = 1, \ldots, 5 \\ j = 1, \ldots, 101 \end{matrix} \qquad (1)$$

where X_{ij} is the actual value of special user groups i attribute for j urbanized area and $\bar{X}_i$ and S_i are the mean and standard deviation, respectively. The Z_{ij} -score thus represents the deviation from average value of the attribute i expressed in units of one standard deviation for urbanized area j. Next a composite measure was developed for each of 101 urbanized areas as follows:

$$SZ_j = \sum_{i=1}^{5} Z_{ij} \qquad j = 1, \ldots, 101 \qquad (2)$$

TABLE 2 VARIMAX ROTATED FACTOR MATRIX OF ATTRIBUTES OF SPECIAL USER GROUPS

Variable Description	Factor 1	Factor 2	Factor 3
Percentage of families with income lower than $5,000	.93		
Percentage of families with income greater than $10,000	−.88		
Percentage of families in low-income group[a]	.81		
Median family income	−.74		
Percentage of nonwhite population[a]	.43	.47	
Percentage of population younger than 18 years of age[a]		.90	
Percentage of population older than 65 years of age[a]		−.75	
Percentage of population younger than 5 years of age		.88	
Percentage of population enrolled in school		.61	
Persons per automobile[a]			−.88
Automobiles per household			.80

[a]Variables selected for further analysis.

where SZ_j is the sum of Z-scores of the five attributes for j urbanized area. Figure 1 shows the relative frequency histogram of SZ. The mean and standard deviation of SZ were found to be 0.0 and 2.31, respectively, with a maximum of 9.47 and a minimum of −5.56. Table 4 gives the values and ascending order of SZ of the 101 selected urbanized areas. The conclusions of this investigation revealed that there are considerable

TABLE 3 PEARSON CORRELATION OF TRANSIT RESOURCES, SERVICES, AND CONSUMPTION WITH ATTRIBUTES OF SPECIAL USER GROUPS

Variable (per capita)	Persons per Automobile	Population Younger than 18 Years (%)	Population Older than 65 Years (%)	Families in Low-Income Group (%)	Nonwhite Population (%)	Sum or Z-Score of Attributes of Special User Groups
Transit resources						
Operating expense	*	N	*	N	*	N
Revenue	*	N	N	N	P	N
Passenger revenue	*	N	*	N	P	*
Local operating assistance	*	N	N	*	P	*
State operating assistance	*	N	*	N	*	N
Federal operating assistance	*	*	*	N	*	N
Total operating assistance	*	N	N	N	P	*
Local capital assistance	P	*	*	*	*	*
State capital assistance	*	N	*	*	*	*
Federal capital assistance	*	*	*	*	*	*
Total capital assistance	P	*	*	*	*	*
Revenue vehicles	P	N	*	N	*	N
Transit employees	*	N	*	N	*	N
Operators	*	N	N	N	*	N
Transit services						
Passenger capacity miles	*	*	*	N	*	*
Revenue vehicle miles	*	N	N	N	*	N
Revenue vehicles hours	P	N	*	N	*	N
Transitway length	P	N	N	N	N	*
Transit consumption						
Passengers	*	N	*	N	P	*
Passenger miles	P	N	*	N	P	*

Note: * = not correlated at level of significance of 0.05, P = positively correlated at level of significance of 0.05, N = negatively correlated at level of significance of 0.05.

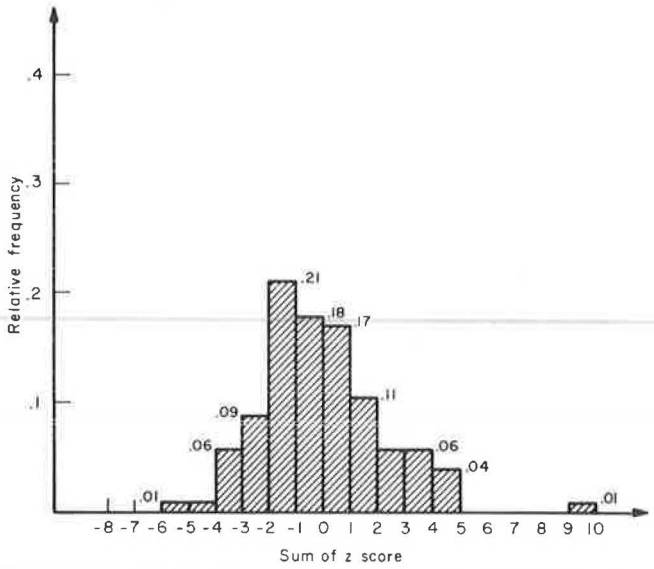

FIGURE 1 Relative frequency histogram of sum of Z-scores.

variation and major differences in the overall level of the special user group market from city to city. Urbanized areas with larger values of the composite measure are deemed to be of more concern to transit decision makers and funding agencies if egalitarian distribution of income and mobility is desirable.

To further investigate past transit decisions as they relate to the special user groups, the Scattergram Program of SPSS (*18*) was used both to show the graphic relationship and to compute Pearson correlation and simple linear regression for transit resources per capita, transit services per capita, and transit consumption per capita with the composite measure of special user groups. Surprisingly, all variables were either negatively correlated or not significantly correlated with the composite measure. The results of this analysis are summarized in the last column of Table 3. This outcome raised serious doubts about the consistency of past regular transit decisions in enhancing income and mobility equity for special user groups. Different types of capital and operating assistance were found to be either negatively or not significantly correlated with the composite measure. This may be of special interest to subsidizers of transit. Transit funding is a complicated issue, especially when funding is required from more than one political jurisdiction. Local and state assistance is based on decentralized decision-making processes that are in part political. Federal assistance is based on multiobjective decision-making processes that are subjects of much debate. Proponents of social equity objectives of transit argue that transit subsidies should create a more egalitarian distribution of income and mobility. The data in Table 3 indicate that federal operating assistance per capita is negatively correlated with the composite measure and that federal capital assistance per capita is not significantly correlated with the composite measure. Such findings, which have not been previously addressed in transit literature, are contrary to what proponents of social equity would desire.

CONCLUSIONS

Data from the Section 15 reporting system and the Bureau of the Census were used to characterize and evaluate regular transit operations and funding as they relate to special user groups of the young, the elderly, the poor, minorities, and the carless. Thirty-two variables that reflect transit resources per capita, transit services per capita, transit consumption per capita, and attributes of special user groups were identified. Nonetheless, more relevant data, which provide a breakdown of transit consumption by attributes of special user groups, are desirable. Information such as percentage of elderly passengers, young passengers, and carless passengers would complement the aggregate consumption variables to identify special user group utilization of transit services.

Correlation analysis showed that most of the variables of transit resources per capita, transit services per capita, and transit consumption per capita are either negatively correlated

TABLE 4 COMPOSITE MEASURE OF ATTRIBUTES OF SPECIAL USER GROUPS FOR 101 SELECTED URBANIZED AREAS

Area	Composite Measure	Area	Composite Measure	Area	Composite Measure	Area	Composite Measure	Area	Composite Measure
Madison, Wis.	−5.56	Boston, Mass.	−1.67	Indianapolis, Ind.	−0.83	Altoona, Pa.	0.45	Fresno, Calif.	1.92
Champaign, Ill.	−4.24	York, Pa.	−1.66	San Francisco, Calif.	−0.83	West Palm Beach, Fla.	0.52	Albuquerque, N.M.	1.94
Seattle, Wash.	−3.78	Detroit, Mich.	−1.55	Canton, Ohio	−0.75	Phoenix, Ariz.	0.59	Birmingham, Ala.	1.97
Binghamton, N.Y.	−3.54	Fort Wayne, Ind.	−1.54	Akron, Ohio	−0.71	Asheville, N.C.	0.63	Saginaw, Mich.	2.16
Minneapolis, Minn.	−3.35	Peoria, Ill.	−1.47	Lancaster, Pa.	−0.58	Waco, Tex.	0.70	Jacksonville, Fla.	2.29
Eugene, Oreg.	−3.33	Pittsfield, Mass.	−1.33	Knoxville, Tenn.	−0.56	Erie, Pa.	0.71	Pensacola, Fla.	2.51
Sioux Falls, S.Dak.	−3.10	Providence, R.I.	−1.29	Omaha, Nebr.	−0.55	Cleveland, Ohio	0.76	San Antonio, Tex.	2.66
Roanoke, Va.	−3.03	Bay City, Mich.	−1.25	Harrisburg, Pa.	−0.50	Pittsburgh, Pa.	0.82	Beaumont, Tex.	2.70
Kalamazoo, Mich.	−2.84	Green Bay, Wis.	−1.22	Sacramento, Calif.	−0.41	St. Petersburg, Fla.	0.84	Lake Charles, La.	2.72
Denver, Colo.	−2.82	Springfield, Mass.	−1.20	Decatur, Ill.	−0.19	Louisville, Ky.	0.85	Bakersfield, Calif.	3.04
San Jose, Calif.	−2.61	Rockford, Ill.	−1.18	Boise, Idaho	−0.16	St. Louis, Mo.	0.89	Topeka, Kans.	3.31
Cedar Rapids, Iowa	−2.53	Dayton, Ohio	−1.15	Los Angeles, Calif.	−0.11	Dubuque, Iowa	0.96	Augusta, Ga.	3.55
Santa Barbara, Calif.	−2.35	Lowell, Mass.	−1.13	San Diego, Calif.	−0.03	New Bedford, Mass.	1.13	Memphis, Tenn.	3.62
Manchester, N.H.	−2.21	Worcester, Mass.	−1.12	Duluth, Minn.	−0.03	Little Rock, Ark.	1.13	Montomery, Ala.	3.88
Albany, N.Y.	−2.16	Brockton, Mass.	−1.11	Sioux City, Iowa	−0.02	Baton Rouge, La.	1.21	Honolulu, Hawaii	3.98
Portland, Oreg.	−2.15	Richmond, Va.	−1.10	Pueblo, Colo.	0.17	Flint, Mich.	1.22	Stockton, Calif.	4.13
Springfield, Ill.	−2.04	Washington, D.C.	−1.06	Tacoma, Wash.	0.19	Tampa, Fla.	1.27	Johnstown, Pa.	4.25
Buffalo, N.Y.	−1.98	Charlotte, N.C.	−0.97	Milwaukee, Wis.	0.23	Tucson, Ariz.	1.55	New Orleans, La	4.50
Nashville, Tenn.	−1.96	Grand Rapids, Mich.	−0.92	Trenton, N.J.	0.25	Baltimore, Md.	1.55	Mobile, Ala.	4.94
Billings, Mont.	−1.84	Spokane, Wash.	−0.92	Atlanta, Ga.	0.32	Salt Lake City, Utah	1.83	Albany, Ga.	9.47
Tulsa, Okla.	−1.81								

or not significantly correlated with attributes of special user groups. The lack of positive correlation raised serious doubts about the efficacy of past transit decisions in enhancing equity. Federal operating subsidies, which have recently come under fire for reducing transit productivity, were found to be negatively correlated with the percentage of low-income families. This suggests that federal operating assistance is probably channeled more toward affluent communities.

For expedient assessment of attributes of special user groups, a composite measure that reflects the overall status of the population of the young, the elderly, the poor, minorities, and the carless was developed. The results of correlation analysis of the composite measure with transit resources per capita, transit services per capita, and transit consumption per capita confirmed that transit funding and operations do not appear to create a more egalitarian distribution of income and mobility. It is suggested that the composite measure be used as an index for developing transit policies that address social equity issues.

REFERENCES

1. T. C. Hood, T. L. Bell, and K. W. Heathington. Planning for the Transportation Disadvantaged: A Classification of User Groups. *Proc., International Conference on Transport for the Elderly and the Handicapped*, Transport and Road Research Laboratory, Crowthorne, Berkshire, England, July 1978.
2. C. McGuire. *Who are the Transportation Disadvantaged?* UMTA–CA–09–0042. Metropolitan Transportation Commission, U.S. Department of Housing and Urban Development, and U.S. Department of Transportation, April 1976.
3. D. McRae. *The Transportation Disadvantaged in Oregon.* Oregon Department of Transportation, Salem, April 1977.
4. National Council on the Aging. *The Project Find Report.* U.S. Office of Economic Opportunity, Washington, D.C., Jan. 1970.
5. R. E. Paaswell and W. W. Recker. Location of the Carless. In *Transportation Research Record 516*, TRB, National Research Council, Washington, D.C., 1974, pp. 11–21.
6. J. S. Revis, B. D. Revis, and J. S. Revis. *Transportation and the Disabled: An Overview of Problems and Prospects.* Final Report JSR–1. U.S. Department of Health, Education and Welfare, Oct. 1976.
7. *The Handicapped and Elderly Market for Urban Mass Transit.* Transportation System Center, U.S. Department of Transportation, Cambridge, Mass., 1973.
8. *The Comprehensive Service Needs of the Severely Disabled.* Urban Institute, Washington, D.C., 1975.
9. W. G. Barker, T. K. Ryden, and F. T. Watson. Transit Options for the Elderly and Handicapped. *Transit Journal*, Vol. 4, No. 2, April 1978, pp. 2–20.
10. H. P. Hass, R. Reames, N. Donley, and H. R. Potter. *Guidelines for Implementation: Addendum to Elderly and Handicapped Transportation Needs.* Monograph MO–09–0007. Springfield, Missouri, Zoning and Planning Commission; UMTA, U.S. Department of Transportation, March 1977.
11. *Urban Mass Transportation Abstracts Cumulative Bibliography 1974–1980.* Urban Mass Transportation Research Information Service, TRB, National Research Council, Washington, D.C., 2 Vols., April 1982.
12. W. Wallace and L. Gougis. *Transit Subsidy Allocation Techniques.* Office of Planning Assistance, UMTA, U.S. Department of Transportation, 1983.
13. A. Chatterjee and K. C. Sinha. Distribution of Benefits of Public Transit Projects. Proc. paper 11497. *Journal of Transportation Engineering*, ASCE, Vol. 101, No. TE3, 1975, pp. 505–519.
14. D. C. Hodge. *An Equity Evaluation Model for Urban Mass Transportation: An Assessment of the Spatial and Social Distributions of Benefit and Costs.* UMTA–PA–110010. Pennsylvania Transportation Institute, Pennsylvania State University, University Park, 1974.
15. R. E. Paaswell. Problems of the Carless in the United Kingdom and the United States. *Transportation*, Vol. 2, No. 4, Dec. 1973, pp. 351–373.
16. J. Roberts. Transport and Social Equity. *Built Environment*, Vol. 4, No. 2, 1975, pp. 95–98.
17. *National Urban Mass Transportation Statistics: Second Annual Report, Section 15 Reporting System.* UMTA–MA–06–0107–82–1. UMTA, U.S. Department of Transportation, June 1982.
18. N. Nie, D. H. Bent, and C. H. Hu. *Statistical Package for the Social Sciences, SPSS.* McGraw-Hill Book Co., Inc., New York, 1975.