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CONTENTS

FOREWORD

The papers in this RECORD deal with the problems of transportation for the poor and the disadvantaged, including those with an employment handicap because of the difficulty of transportation from home to work.

In the first paper, Falcocchio, Pignataro, and McShane discuss basic criteria that should be considered in planning transportation demonstration projects for home-to-work for the disadvantaged. The authors contend that one shortcoming in planning such projects has been the failure to identify the kinds of operational objectives for measuring success in achieving the desired goal of increasing employment opportunities. The second deficiency is the lack of analytical measures for relating transportation improvements to unemployment reduction. The paper describes an analytical technique for use in evaluating the effectiveness of proposed transportation improvements in lowering unemployment levels of the poor.

In his paper, Gurin finds that improvements in transportation services are necessary but by themselves not sufficient for reducing unemployment of the poor. The decentralized character of employment opportunities for the disadvantaged creates a situation that can only be served by a highly flexible transportation system such as automobiles or dial-a-bus. While federal programs have emphasized vehicle supply, they have not given sufficient attention to the unique nature of the transportation requirements and the non-vehicle factors that limit mobility and job capability of the disadvantaged.

In the third paper, Falcocchio, Pignataro, and McShane propose a way to measure the effect of transportation accessibility on inner-city unemployment. The paper presents evidence that transportation services to job sites influence the employment potential of the inner-city low-income worker. It presents an employment-accessibility model that permits quantification of the expected benefits in unemployment reduction by improving transportation accessibility.

The paper by Saltzman, Kidder, and Solomon deals with transportation problems of the disadvantaged in small towns. They examine the unsuccessful attempt of a group of transportation-disadvantaged citizens in Lumberton, North Carolina, to organize a bus company. The success of such an activity depends on sufficient funding to cover overhead and operating expenses, which would have to be underwritten by the city government.

CRITERIA FOR PLANNING A HOME-TO-WORK PUBLIC TRANSPORTATION DEMONSTRATION PROJECT FOR LOW-INCOME WORKERS: A CASE STUDY

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This paper discusses some basic criteria that should be considered when a home-to-work transportation demonstration project is planned. Particular attention is given to the concept of relating the level of investment that is required if the objectives of a demonstration project are to have at least a 0.5 probability of being detected. The results of a case study in a large urban area are discussed in detail.

•THE approach typically followed for improving the transportation accessibility of a low-income area consists of setting up new bus routes to connect low-income areas to employment concentrations not well served by the regularly scheduled transit system. These efforts have been largely inclusive (1, 2, 3, 4). Some bus routes were classified as successful and many others as failures. The common criterion used for evaluation was the ridership generated over an extended period of time (usually 1 year).

Two problems emerged from the analysis of these projects. One concerns planning and management deficiencies in properly identifying the relevant project variables; the other involves a technological deficiency. The nature of the first problem was the failure to identify the kind of operational objectives that would measure the degree of attainment of the project's goal, i.e., improving employment opportunities. The second problem dealt with the lack of an analytical measure that would relate a transportation improvement to an estimate of unemployment reduction. Because the costs associated with the implementation of a new transit system or improvement are very high, the inability to predict the expected impact of an improvement often resulted not only in the adoption of a poor plan but also in wasteful utilization of public funds.

It is the purpose of this paper to describe the results of recent efforts (5, 6) at the Polytechnic Institute of Brooklyn to develop an analytical technique that may be used to evaluate the effectiveness of proposed transportation improvements in lowering the unemployment levels of low-skilled workers.

THE NEED FOR NEW TRANSPORTATION PLANNING CRITERIA

Transportation networks cannot be viewed as mutually exclusive systems, performing independent tasks in the achievement of a primary objective of a national, regional, or local scope. Spillover effects are usually pervasive, and they can be simultaneously good and bad, depending on who is affected. The design and construction of the National System of Interstate and Defense Highways, which is almost completed, has had a tremendous influence on the physical character, economy, and social aspects of most urban areas of this nation. Although it has unquestionably been successful in the achievement of national and regional economic objectives, similar statements cannot be made when the social and physical planning objectives of local scope are considered.

The past practice of neglecting the local needs of the region's subareas has led to weak plans. For example, the problems of crime, unemployment, substandard housing, and discrimination, although not directly related to transportation, might be reduced or increased somewhat by the manner in which transportation developments are directed (1). Transportation facilities in urban areas, therefore, should be viewed also as a means of alleviating the many problems that create great concern to the public and its elected officials.

This emerging need for relating the goals associated with the solution of urban problems to the requirements of urban transportation systems is becoming the dominant issue for most transportation, land use, and city planners (8, 9, 10, 11). The federal government is beginning to respond to this need (12).

Much research, no doubt, is still needed to convert the goals related to such social problems into transportation system requirements. And when one talks of transportation as an improving factor, invariably the question arises: Who does it benefit, and is the amount of benefit received worth the cost to someone else?

The significance of the foregoing discussion as it relates to the topic of this paper is embodied in the question: Can transportation be used as an improving factor with regard to the reduction of unemployment among low-income workers? Recent research (5, 6) on this topic produced encouraging results for a large urban area [Central Brooklyn Model Cities Area: 400,000 population; 5 square miles; 40 percent of families with yearly incomes $4,000 or less] where the unemployment level of unskilled workers was found to be strongly correlated to the quality of public transportation access to places of employment.

The model relating unemployment to transportation quality is a regression equation of the form (see also Fig. 1)

$$Y = 186.25 - 31.65 \log_{10} X \qquad (1)$$

$$r = 0.93$$

$$S_{y.x} = 1.61 \text{ percent}$$

where

Y = the unemployment rate of unskilled non-hard-core workers in a residential zone, and

X = accessibility of a residential zone to places of employment.

Accessibility is defined as

$$X_i = \sum_{j=1}^{n} E_j / T_{ij}^{b}$$

where

E_j = number of unskilled jobs in zone j;

T_{ij} = travel time between residential zone i and employment zone j; and

b = an exponent empirically calibrated from current unskilled work trip distribution.

THE UTILITY OF THE MODEL

The results of the employment-accessibility analysis for the Central Brooklyn Model Cities area may be summarized as follows (6):

1. The model was intended for use in short-range planning projects.
2. Up to 11.5 percent of the non-hard-core unskilled unemployment in the CBMC area is attributable to lack of adequate transportation to job sites.
3. The unemployment reduction that can be expected in an area depends on the increase in accessibility programmed for the area and the level of existing transportation service found in the area.
4. The model's most desirable feature is that it permits more comprehensive cost-

Figure 1. The employment-accessibility model.

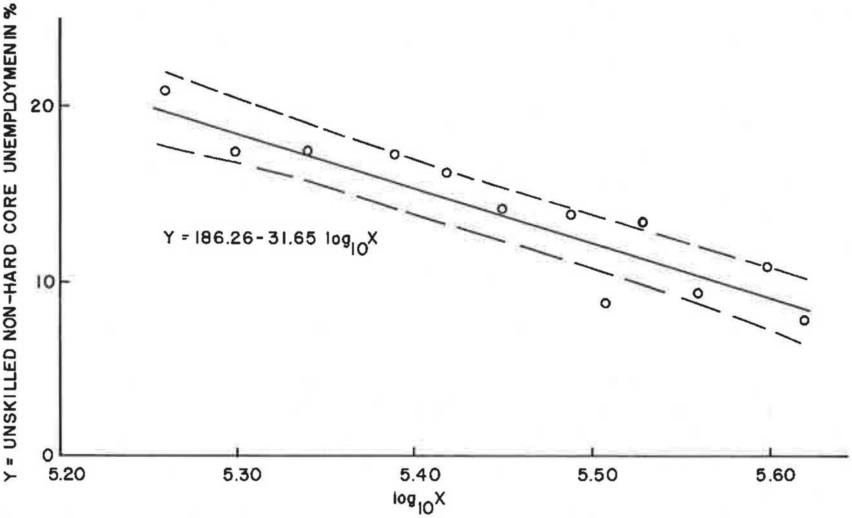


Figure 2. Low-skilled job concentrations in Brooklyn and Queens.

benefit analyses of improvements in transportation to job sites. This occurs because the model estimates the social benefits accruing as a result of increased employment. These benefits consist primarily of reducing the costs that society must bear to subsidize the income of the unemployed.

THE MODEL AS AN AID IN DECISION-MAKING

The work-trip mobility analysis contained in the CBMC study resulted in the identification of employment zones in need of improved transportation service. Twelve such zones were identified, and they are shown in Figure 2. These zones represent the principal industrial areas of Brooklyn and Queens.

Residential areas with poor transportation service to employment opportunities were also identified. These areas are located primarily within Brownsville, a community in the southwest portion of the study area. The employment zones of Figure 2 are within a 7.5-mile radius from Brownsville and contain over 40,000 low-skilled jobs.

Table 1 gives the employment zones, the number of low-skilled jobs located in each, their distance from Brownsville, and the travel time via existing transit.

As an illustrative example, three levels of transit improvement plans will be tested. Each of the three plans provides door-to-door service; they are referred to as the maximum, intermediate, and minimum plans.

The maximum plan is the most flexible of the three because it calls for the most individually exclusive service. The residential area is divided into three pickup zones, each with its own vehicles, and workers are then transported directly, without stopping en route, to the zone of employment common to all occupants of the vehicle. This plan allows for a total of 36 (3×12) mutually exclusive trip combinations.

The intermediate plan is similar to the maximum plan except that travel routes are established. This plan allows delaying a passenger destined to zone (n) because another passenger must be discharged in zone (n-1). The routes used in the intermediate plan are shown in Figure 3.

The minimum plan, just as the intermediate plan, also makes use of routes. This plan, however, considers the entire area as one pickup zone and further delays the passenger by forcing him to travel along while the driver completes the last pickup in an area.

Each of the three plans represents an improvement in travel time over the existing transit system. Of the three plans, the lowest travel time is achieved by the maximum plan and the highest by the minimum plan. Table 2 gives the travel times for each of the three plans and the existing conditions (the do-nothing alternative).

CHANGES IN UNEMPLOYMENT DUE TO CHANGES IN ACCESSIBILITY

The changes in unemployment for a given residential area can be determined by a change in any of the following conditions:

1. Transportation service to employment zones;
2. The number of jobs located in the employment zone; or
3. Both transportation service and jobs.

For the purposes of this paper, it is estimated that only a change in transportation service can be expected in the short run. If the jobs available in an area also were to change, however, it would be easy to incorporate this occurrence in the model.

The employment-accessibility model was described mathematically as

$$Y_i = 186.26 - 31.65 \log_{10} X_i$$

where

Y_i = the unemployment rate in a residential zone (in percent) and
X_i = the residential accessibility index of the residential zone
$= \sum E_j F_{ij}$.

Table 1. Distribution of low-skilled job concentrations in Brooklyn and Queens.

Area Identification	Identification of Employment Areas in Figure 2	Total Low-Skilled Jobs	Distance From Brownsville (airline miles)	Travel Time Via Existing Transit (minutes)
Brooklyn				
a. Gowanus, Red Hook,	1	1,630	4.8	44
Bush Terminal	2	3,159	5.7	50
	3	2,967	6.2	49
b. Navy Yard and	11	2,704	4.1	42
Greenpoint	12	5,669	5.0	47
c. Newtown Creek	10	3,960	2.7	48
Queens				
a. Ridgewood	5	441	2.5	43
b. Maspeth	7	1,809	4.2	55
c. Woodside	8	484	4.6	62
d. Long Island City	9	7,028	5.7	50
e. LaGuardia Airport	6	1,049	7.5	83
f. JFK Airport	4	4,605	6.8	62

Figure 3. Intermediate plan: door-to-door transit system.

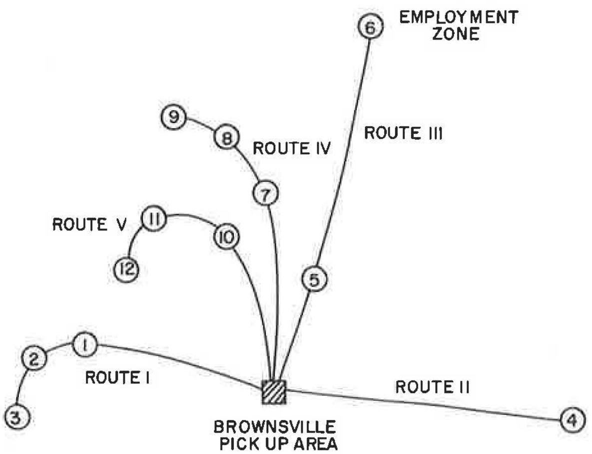


Table 2. Travel times (minutes) from Brownsville to employment zones.

	Zones of Employment											
Alternatives	1	2	3	4	5	6	7	8	9	10	11	12
Do-nothing plan	44	50	49	62	43	83	55	62	50	48	42	47
Maximum plan	30	34	23	30	20	49	31	35	36	23	25	28
Intermediate plan	30	39	45	30	20	54	31	40	45	23	35	43
Minimum plan	35	44	49	35	25	59	36	45	50	28	40	47

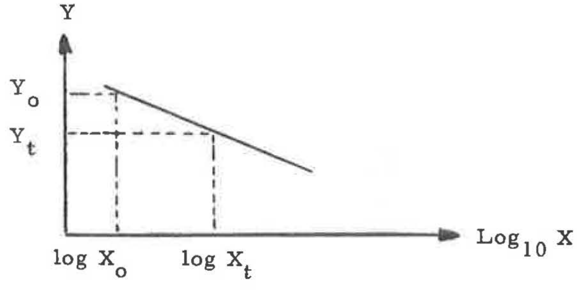
Table 3. Projected employment resulting from accessibility increases.

Alternatives	ΔY_A (percent)	Low-Skilled Labor Force	Number of Workers Who Will Become Employed
Maximum plan	1.58	10,255	162
Intermediate plan	0.95	10,255	97
Minimum plan	0.63	10,255	65

A change in unemployment from an initial condition, Y_{io}, to a new condition resulting from transportation improvements, Y_{it}, may be represented as

$$\Delta Y_i = Y_{io} - Y_{it} = 31.65\ (\log_{10} X_{it} - \log_{10} X_{io}) \tag{2}$$

This is illustrated in the following:



It is possible, therefore, to assess the impact of transportation improvements on the unemployment levels in Brownsville. Improvements in transportation service between parts of Brownsville and the job sites located in Brooklyn and Queens will mean reduced travel times (fares to remain unchanged). A lower travel time is in turn translated into a higher accessibility by the relationship

$$X_i = \sum E_j F_{ij}$$

where F_{ij} is a function of travel time.

The new accessibilities of each plan may be calculated from the following relationship:

$$X_{At} = X_{Ao} + \sum_{j=1}^{12} E_j (F_{Ajt} - F_{Ajo}) \tag{3}$$

where

X_{At} = new accessibility index for area A;
X_{Ao} = old accessibility index for area A;
j = an employment zone with improved transportation access;
F_{jt} = the travel time factor from area A to employment zone j resulting from the proposed transportation improvements; and
F_{Ajo} = old travel time factor from area A to employment zone j.

The new accessibilities resulting from the maximum, intermediate, and minimum plans are computed from Eq. 3:

$$X_{A(\text{maximum plan})} = 180{,}000 + 19{,}355 = 199{,}355$$

$$X_{A(\text{intermediate plan})} = 180{,}000 + 10{,}564 = 190{,}564$$

$$X_{A(\text{minimum plan})} = 180{,}000 + 5{,}918 = 185{,}918$$

Substituting these values into Eq. 1 yields the reduction in the unemployment rate caused by the increase in transportation accessibility. Thus the number of low-skilled workers who will become employed can be calculated. For each plan, this is summarized in Table 3.

Table 4. Origins and destinations of the newly employed: the maximum plan.

Brownsville Subareas of Origin	Employment Zones of Destination												
	1	2	3	4	5	6	7	8	9	10	11	12	Total
a	2	4	6	6	1	1	2	1	8	9	5	9	54
b	2	4	6	6	1	1	2	1	8	9	5	9	54
c	2	4	6	6	1	1	2	1	8	9	5	9	54
Total	6	12	18	18	3	3	6	3	24	27	15	27	162

Table 5. Origins and destinations of the newly employed: the intermediate plan.

Brownsville Subareas of Origin	Employment Zones of Destination					
	Route I 1-2-3	Route II 4	Route III 5-6	Route IV 7-8-9	Route V 10-11-12	Total
a	7	5	2	6	13	33
b	6	5	2	6	13	32
c	6	5	2	6	13	32
Total	19	15	6	18	39	97

Table 6. Origins and destinations of the newly employed: the minimum plan.

Brownsville Subareas of Origin	Employment Zones of Destination					
	Route I 1-2-3	Route II 4	Route III 5-6	Route IV 7-8-9	Route V 10-11-12	Total
a, b, c (combined)	13	10	3	14	26	66

Table 7. Existing work trips between Brownsville and employment zones.

Employment Zones	No. of Brownsville Workers Currently Employed	Employment Zones	No. of Brownsville Workers Currently Employed
1	18	7	6
2	34	8	—
3	23	9	16
4	18	10	45
5	4	11	21
6	7	12	20
		Total	212

Table 8. Total demand on the maximum plan: existing travel added to forecast trips.

Brownsville Subareas of Origin	Employment Zones of Destination											
	1	2	3	4	5	6	7	8	9	10	11	12
a	8	15	14	12	2	3	4	1	13	24	12	16
b	8	15	14	12	2	3	4	1	13	24	12	16
c	8	15	14	12	2	3	4	1	13	24	12	16
Total	24	45	42	36	6	9	12	3	39	72	36	48
Type of vehicle	Van	Van	Van	Van	Auto	Auto	Auto	Auto	Van	Mini-bus	Van	Mini-bus

Cost-Effectiveness

These results indicate that, although the number of workers who will become employed is significant, especially for the maximum plan, the effectiveness of a door-to-door transit system is minimal in lowering the unemployment rate in the area.

Whether or not it is justifiable to implement any of the alternative plans, however, depends on their cost and the benefits they provide. Although the cost of each alternative plan can be readily estimated, the benefits brought about by these plans are difficult to estimate precisely. For this purpose, it is assumed that the income earned by a low-skilled worker can be interpreted as the social benefits accruing to society for foregoing the public support of the unemployed worker. An annual income of $4,160 (corresponding to an hourly wage of $2.00) is used in this analysis. For the 162 workers employed through the maximum plan, the total annual benefit amounts to $673,920; the intermediate plan produces a benefit of $403,520; and the minimum plan yields a benefit of $270,400.

To estimate the cost of each plan it is necessary to know the vehicle requirements as well as the amount of travel. The determination of the number and type of vehicles necessary to transport the newly employed workers depends on the demand volume that requires the service. The demand volume consists of two components:

1. The work trips of the newly employed, and
2. The work trips of those who currently travel to the areas of employment receiving transportation improvements.

This latter group should be included in the demand volume because the improved service, which is more direct and more convenient (the fare is assumed at 35 cents per trip, the same as the NYC transit fare), will attract travelers from other transit routes that serve the existing travel demand.

For the newly employed, the demand volumes between Brownsville and each employment zone are estimated with the gravity model method of trip distribution. Trip interchange results for each of the three plans are given in Tables 4, 5, and 6. The existing travel to each employment zone is calculated from the origin-destination data of the CBMC Study.

Table 7 summarizes the existing travel between Brownsville and each of the 12 employment zones. It will be noted that the existing travel demand is larger than the projected demand generated by the improved accessibility to the 12 employment areas. In this case, then, the number of vehicles necessary to implement an alternative plan far exceeds the number required to transport only the newly employed workers. The cost factor, therefore, will increase without corresponding benefits.

The combined travel demand for each of the three alternative plans is given in Tables 8, 9, and 10. For each of the plans, the number and type of vehicles are determined by this total demand, and cost estimates are developed.

The selection of the best plan for implementation (including the do-nothing alternative) is based on the criterion of least total cost to the government. The components of total costs are the subsidy of transit service and the cost of other public subsidy. These costs are tabulated in Table 11 and plotted in Figure 4. From these comparisons, the intermediate plan emerges as the least costly.

DECISION-MAKING UNDER UNCERTAINTY: THE DEMONSTRATION PROJECT

The decision process that has selected the intermediate plan as the best of the four alternatives considered does not account for the fact that the employment-accessibility model is a probabilistic model. Cognizance of this factor, in effect, is vital for the success of a demonstration project. The purpose of a demonstration project is to "test" if a certain "theory" works. The proof consists of providing tangible evidence (i.e., that people will become employed) to the decision-maker so that he will become "convinced" that improving transportation accessibility will reduce unemployment. This objective, however, may not be best achieved if the intermediate plan is used in Brownsville.

Table 9. Total demand on the intermediate plan.

Brownsville Subareas of Origin	Employment Zones of Destination Route I 1-2-3	Route II 4	Route III 5-6	Route IV 7-8-9	Route V 10-11-12
a	32	11	5	13	42
b	31	11	5	13	42
c	31	11	5	13	42
Total	94	33	15	39	126
Type of vehicle	Medium bus	Econo-line	Auto	Econo-line	Standard bus

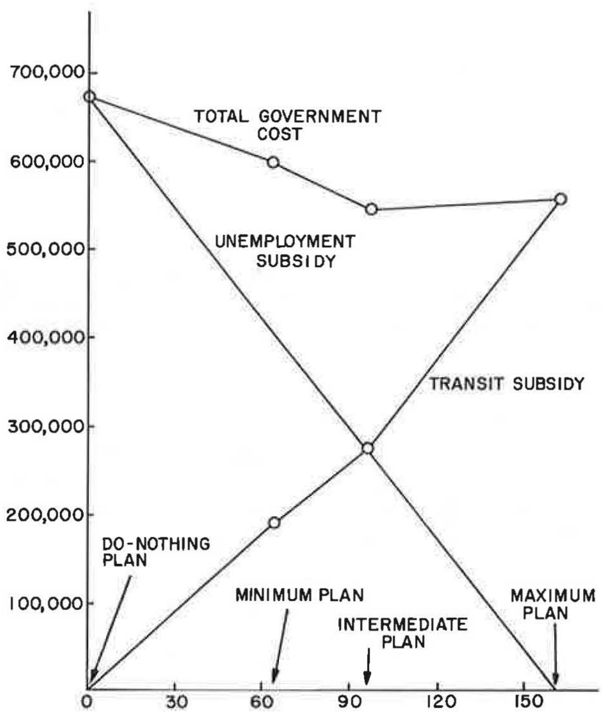
Table 10. Total demand on the minimum plan.

Brownsville Subareas of Origin	Employment Zones of Destination Route I 1-2-3	Route II 4	Route III 5-6	Route IV 7-8-9	Route V 10-11-12
a, b, c (combined)	88	28	14	36	112
Vehicle type	Medium bus	Medium bus	Econo-line	Medium bus	Medium buses

Table 11. Cost-effectiveness of door-to-door transportation improvements.

Alternative	Expected Number of Workers Becoming Employed	Annual Income Earned (dollars)	Cost to Government (dollars) Unemployment Subsidy	Transit Subsidy	Expected Total Cost to Government (dollars)
Maximum plan	162	673,920	0	549,930	549,930
Intermediate plan	97	403,520	270,400	274,275	544,675
Minimum plan	65	270,400	403,920	192,850	596,770
Do-nothing plan	0	0	673,920	0	673,920

Figure 4. Cost-effectiveness of alternative plans.



The employment-accessibility model predicts the mean value of the unemployment rate (Y) that corresponds to a given accessibility index (X). For a particular demonstration site, however, it is of interest to know how closely an individual value of Y can be predicted, rather than calculating the mean value of the regression line, which gives the best estimate of unemployment when many sites are concerned. This concept is discussed in the following.

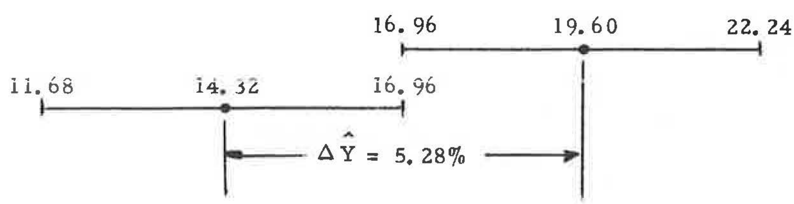
PREDICTION INTERVAL FOR INDIVIDUAL VALUE OF Y

The prediction interval for Y is given by

$$\hat{Y} \pm (t_{\alpha/2}, n-2)\, S_{y.x} \sqrt{1 + \frac{1}{n} + \frac{(X - \overline{X})^2}{(n-1)S_X^2}} \qquad (4)$$

where $\hat{Y}$ is calculated by the model and α is the confidence level.

It is clear, then, that calculating an expected unemployment reduction for one particular area does not guarantee that the expected $\hat{Y}$ will indeed occur but rather that area (i) may have a Y_i falling in range $\hat{Y} \pm$ interval, 100 (1 - α) percent of the time. What this means is that it is possible to detect no reduction in unemployment whatsoever for a particular area, even when transportation improvements are made. The likelihood of detecting an improvement generally increases, however, as the size of unemployment reduction increases. In general, the uncertainty of no improvement actually being detected is highest when the amount of unemployment reduction is very small. This concept is shown in Figure 5, in which the shaded areas (degree of overlap) of cases (a) and (b) represent situations in which improvements may not be detected. The amount of overlap is seen to decrease as the size of unemployment reduction varies from small to large. This example shows that, if the expected unemployment reduction would exceed 5.28 percent, the uncertainty of detecting the improvement of this size would be zero at the 5 percent confidence level:



It is possible to estimate the amount of uncertainty, or the probability of failing to detect an improvement, by calculating the conditional probability of falling in the joint sample space of the existing and future unemployment distributions. This is shown in Figure 6.

Characteristics of the Prediction Interval

Referring to Eq. 4, it should be noted that the prediction interval is not uniform over the range of the independent variable but in fact is smallest when $X = \overline{X}$ and largest when X approaches the upper or lower limit of the range, i.e., when $(X - \overline{X})$ is large. This property must be taken into account; for the case at hand, however, it is not a significant factor.

UNEMPLOYMENT REDUCTION IN BROWNSVILLE

The door-to-door transportation improvements proposed for Brownsville should now be evaluated in terms of the unemployment detection criterion. When this is done for each of the three alternatives, the following results occur:

Figure 5. Uncertainty of detecting a reduction in the unemployment rate of an area.

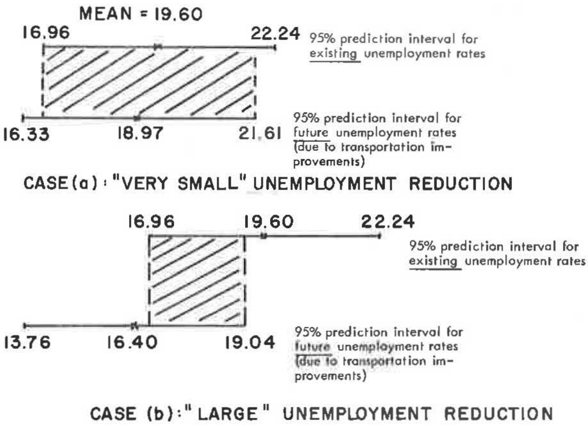
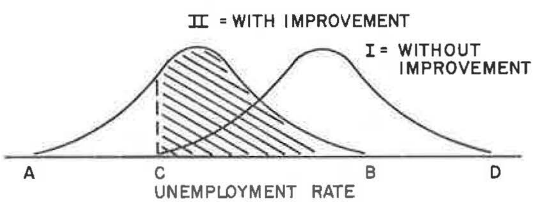


Figure 6. Hypothetical relationships of unskilled unemployment rate versus transportation accessibility to job sites.



The probability of no detection is calculated by:

$$P(\text{No Detection}/II) = \int_c^b dF_{II}$$

Table 12. Cost and benefit of express shuttle service to transportation centroid.

Alternate Plan	Expected Number of Workers Becoming Employed	Annual Income Earned (dollars)	Annual Cost of Service (dollars)	Net Benefit (dollars)
Express shuttle service	334	1,389,440	662,000	727,440

Table 13. Cost-effectiveness of alternative plans.

Alternatives	Projected Reduction in Unemployment Rate (ΔY), Percent	Expected Number of Workers Becoming Employed	Annual Income Earned (dollars)	Cost of Subsidy (dollars)		Expected Total Governmental Cost (dollars)	Probability of No Detection
				Unemployment Subsidy	Transit Subsidy		
1. Express shuttle and maximum door-to-door	4.94	496	2,063,360	0	1,211,930	1,211,930	0.20
2. Express shuttle and intermediate door-to-door	4.31	431	1,792,960	270,400	936,275	1,206,675	0.30
3. Express shuttle and minimum door-to-door	3.99	399	1,659,840	403,520	854,850	1,258,370	0.36
4. Express shuttle	3.36	334	1,389,440	673,920	662,000	1,335,920	0.48
5. Maximum door-to-door	1.58	162	673,920	1,389,440	549,930	1,939,370	0.81
6. Intermediate door-to-door	0.95	97	403,520	1,659,840	274,275	1,934,115	0.88
7. Minimum door-to-door	0.63	65	270,400	1,792,960	192,850	1,985,810	0.90
8. Do-nothing plan		0	0	2,063,360	0	2,063,360	1.00

Alternative	Probability of Not Detecting a Reduction in Unemployment
Maximum plan	0.81
Intermediate plan	0.88
Minimum plan	0.90

These results indicate the futility of recommending the intermediate plan for demonstration. The probability of failing to detect an improvement under this plan is much too high. In fact, none of the three alternatives should be considered—even the maximum plan.

The importance of these findings cannot be overstated. In fact, they strongly suggest the cause for the "non-results" of recent demonstration projects.

It is now apparent that the selection of the least-cost plan among a set of test plans does not necessarily imply that the planner has succeeded in identifying the best plan for implementation. He has only been able to select the "best" of the array of plans he is proposing. As has occurred in the above case, it is possible that none of the plans considered for evaluation represents a feasible alternative. It is obvious, then, that for Brownsville the proposed plans must be supplemented or substituted with additional transportation improvements to have at least a 50-50 chance of detection.

A feasible alternative to the door-to-door system that can be used in improving the accessibility of Brownsville consists of reducing the travel time from that area to a nearby transportation centroid located at the junction of Broadway, Fulton Street, Atlantic Avenue, and East New York Avenue. At this junction, where several subway and bus lines meet, the accessibility to employment areas is much higher than in Brownsville (the accessibility indexes are 357,000 and 180,000 respectively). The travel time from Brownsville to this transportation centroid is approximately 30 minutes—even though it is located only 1.5 miles away (over-the-road distance) (5).

A considerable reduction in travel time can be achieved if an express shuttle service is in operation. At an average peak-hour travel speed of 12 mph, this distance could be covered in 8 minutes. Assuming that an average of 4 minutes will be spent in walking to the express shuttle pickup points, the total travel time between Brownsville and the transportation centroid would be 12 minutes. On this basis, the new accessibility index for the area is found to increase to 221,700.

From Eq. 1 this improvement is translated to an estimated unemployment of 16.25 percent:

$$Y_{At} = 186.26 - 31.65 \log 221.700 = 16.25$$

which represents a reduction of 3.36 percent over the existing level (19.61 percent-16.25 percent). The proposed improvement, therefore, results in the employment of 334 low-income workers (10,225 × 0.0336), more than twice the amount estimated for the maximum plan for the door-to-door concept described earlier. To transport this volume during a 60-minute morning peak period, 6 minibuses are required operating at 4-minute headways. As discussed earlier, however, this new service will also attract travelers to the transportation centroid who now use other means of transportation. It is necessary, therefore, to provide additional capacity to transport approximately 2,700 travelers from Brownsville to the transportation centroid. This results in a total demand of 3,034 trips to be served by the proposed shuttle express. The required fleet size for this service is calculated at 16 standard buses operating at 90-second headways.

The results of the benefits and costs of this service are given in Table 12.

The net benefits accruing to the express shuttle service far exceed those of the maximum, intermediate, or minimum door-to-door transit systems described earlier (Table 11). It should be noted, however, that the express shuttle system and the door-to-door system can also be used in combination to provide varying levels of accessibility gains in Brownsville. The two systems can be combined because they are independent. A summary of possible alternatives and their cost-effectiveness is given in Table 13.

It will be noted that alternative 4, the express shuttle operation, has a much lower probability of no detection than any of the door-to-door alternatives. The least-cost solution, which is the combination of the express shuttle and the intermediate door-to-door system, has a very low risk of no detection; the second more costly alternative, which combines the express shuttle with the maximum door-to-door system, is shown to be the one with the highest probability of "success."

Using the criterion that a demonstration project should not be implemented unless there is at least a 50-50 chance that improvements can be detected, alternatives 1 to 4 could be recommended. To ensure the success of the demonstration project, alternative 1 is recommended, since the incremental cost over the least-cost alternative is not significant but the probability of success increases considerably (0.80 versus 0.70).

CONCLUSION

The foregoing analysis has demonstrated that each of the proposed improvements will not be self-supporting. In each of the alternatives tested, ridership revenues will cover less than 5 percent of the total system's cost. Even if this deficit were reduced by operating the vehicles during non-work travel periods to serve other purposes, it is unlikely that fare revenues will rise even to 50 percent of the total annual cost.

The total cost-effectiveness of the proposed improvements are realized, however, when one accounts for the number of potential workers who will become employed and consequently removed from public subsidy lists. Each of the alternatives foresees net savings when the costs of transit improvements are compared with the income earned by the newly employed workers. Transit subsidy is therefore economically justified for Brownsville.

This case study has demonstrated that transportation improvements in an area, for the purpose of reducing its unemployment rate, should be carefully evaluated. Minimal improvements are not likely to succeed since they are usually associated with a high probability of no detection (Fig. 5). It is important, moreover, to realize that using the transportation element as a means of reducing unemployment among low-skilled workers requires substantial public subsidies, since the improvements cannot be financed through the fare box. However, these improvements appear to be economically justified because they tend to reduce the total costs of public subsidy to the unskilled worker. Finally, this case study has shown that, although increases in transportation accessibility have projected the employment of a sizable number of low-skilled workers, its maximum contribution (alternative 1, Table 13) to lowering the rate of unemployment in the area was a change from an existing level of 19.6 percent to a projected level of 14.7 percent. It is apparent (for Brownsville) that even a very ambitious transit system improvement will not be sufficient to bring unemployment down to average levels.

The foregoing example has demonstrated that it is possible to improve the decision-making process beyond the level currently used in similar analyses for many cities throughout the United States. The utility of the unemployment-accessibility model for planning purposes rests primarily on its ability to estimate a more realistic expected level of improvement, avoiding the pitfalls encountered in recent demonstration programs. In addition, it guides the planner in selecting an improvement plan that most nearly meets the objectives of the potential demonstration, and, perhaps more importantly, it will help him in eliminating proposals that are not expected to reduce unemployment to the level that would at least cover the costs of improvements. Finally, it permits a rational development of test plans to achieve varying levels of improvements. In this manner the planner will be able to evaluate the expected results from each proposal more rationally, thereby enabling him to make well-founded recommendations to the policy-makers who must base their goals and objectives not only on what is desirable but also on what is technically possible and cost-effective.

CLOSURE

The Franchise Constraint

It should be noted that finding the best functional transit improvement does not necessarily imply that it may be implemented. Usually the project bus routes are not permitted to operate directly to areas of employment but are constrained to more indirect routings by the existing franchise patterns. In effect, a franchise reserves an area for the exclusive control of a transit company. There usually is no reciprocity between two adjoining franchise operations. A demonstration project in Long Island, for example, resulted in new project routes that provided improvements that were only marginally better than the already existing service. In some cases bus fares amounted to over $2.00 per round trip per day, or over 10 percent of the daily gross wage of a low-income worker. Thus the reduction of the time constraint may have been offset by retaining a high fare structure that must have inhibited work opportunities. As a result the potential impact of these improvements was significantly minimized.

It is incompatible to think that it is possible to improve low-skilled job accessibilities and expect that the riders of transit facilities will pay the costs of the service. Throughout the country, transit companies require subsidies to cover the difference between service cost and fare revenues. Although this is not the case for many individual transit routes that operate in high-density transit corridors, the costs of operating those routes that feed the travel lines far exceed their revenues; thus, on a system-wide basis, the transit industry requires public subsidy. When one considers that the wages of the unskilled worker are the lowest of all workers, it should be obvious that his ability to pay for transportation to a job is considerably less than that of an average worker. It follows, then, that the amount of subsidy required to operate a transit system serving a poverty area should exceed that provided for the average community. Whenever this condition does not exist, the attractiveness of a source of employment is greatly reduced, and the effectiveness of a physical transportation improvement will not be detected. Thus, providing a transit connection between a low-income area and an employment area is only one-half of the task; the other half requires fares that can be afforded by the potential rider. This proposition must be especially considered in cases where transit improvements from the inner city to suburban jobs are advocated.

Marketing the Service

It should be noted further that projected reductions in unemployment brought about by improvements in the transportation accessibility of an area should not be expected to materialize as soon as the improved service is in operation. During the project planning phase, and throughout the initial months of operations, vigorous marketing campaigns should be conducted in the affected areas to acquaint the potential rider and the potential employer with the newly established service.

Marketing the service through advertising the importance of the improvement, identifying areas of improved access, and explaining to the riding public how the improvements complement the existing transit system are necessary requirements in achieving the projected unemployment reduction. In addition, information about job openings should be made available in the vehicles and other readily accessible locations in the community.

Multiple Uses of Vehicles

Although this paper has dealt only with the home-to-work travel needs of the poor, it is usually the case that the transportation deficiencies of low-income areas are not confined to places of employment. The low rate of car ownership found in these areas renders the members of these communities entirely dependent on public transportation for their daily mobility requirements. This has been demonstrated in virtually every city where the problem has been researched.

It is possible, therefore, to use a large proportion of the vehicles and personnel acquired on the basis of the home-to-work transportation system for non-work purposes during off-peak hours. Additional mobility needs of poverty areas include trips to a doctor, hospital, or clinic, to shopping, and to social or recreational areas. Many of these activities are not located in the CBD and therefore do not have adequate transit accessibility. Utilization of vehicles for these purposes will aid in reducing the deficit of an exclusive home-to-work system.

The efficiency of vehicle utilization may be further realized by making available the vehicles of the home-to-work transit system for transporting persons whose taxi trips are now paid by the welfare agency or the Medicaid program. This secondary vehicle use would reduce the high travel costs of those who are currently taxi-captive (13).

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IMPROVING JOB ACCESS FOR THE URBAN POOR

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Transportation planners are beginning to learn that different population groups have different travel needs. This paper summarizes what has been learned about the work-related travel requirements of the metropolitan poor. It begins with a description of likely travelers, the already motivated poor; their preferences for good jobs paying at least $2.20 per hour; and the types of available jobs, most of which are unpleasant jobs paying unacceptable wages around $1.60 per hour. The needs likely to be faced by poor people when they have to travel—in search of work, to apply for a job, and to commute—require flexibly routed and scheduled vehicles. The suitability of buses, car pools, and private autos to meet these needs is considered, and their availability and service inadequacies are identified. Programs are recommended to reduce the need to travel for work-related purposes, to foster self-help transportation by facilitating car ownership among non-car-owning households, and to provide better transport options such as taxis or dial-a-bus systems for those who cannot help themselves.

•SINCE 1967, in more than 20 cities, suburban employers, anti-poverty agency staffs, transit operators, planners, and other groups have attempted to provide better public transportation for the urban poor. These efforts have involved over $7 million in federal assistance from the Department of Housing and Urban Development and the Department of Transportation that have helped to pay for bus demonstration operations between downtown ghetto areas and suburban industrial areas (1, p. 3). Additional funds helped pay for technical studies to evaluate the adequacy of existing local transit. These programs held the possibility of being a relatively simple strategy for helping both the poor and the economy. They had the political appeal of using available technology in a visible way to solve a pressing social problem.

Actual operations have raised serious doubts about the limited role that transportation can play in solving problems of poverty. Past programs have not shown that large numbers of poor people have been helped, that the small number of people who have been helped could not have succeeded without assistance, or that different transportation or other programs might not be better aids to the poor. Ridership on most federally subsidized bus routes was lower than anticipated and was far lower than the reported number of available jobs. Revenues on the most traveled lines barely covered operating costs (2). There was no evidence that unemployment rates had been significantly reduced in the long run as a result of the programs.

POTENTIAL URBAN WORKERS

What has been learned about the people to be helped? Which people constitute the market segment of the poor who will respond to work access improvement efforts?

Studies of ghetto residents and bus passengers suggest that transportation-poverty projects, like other social welfare programs, have failed to reach the hard-core poor families. The majority of this country's poorest people are too young, too old, or unable to work; they are not in the labor force. Hard-core poor families are frequently troubled by serious marital, health, and other problems that transportation improvements cannot solve. Employment activities of these people, including groups of adolescents and ethnic elderly, seem confined to local neighborhoods, possibly because of fears of strange places, travel, and discrimination rather than a lack of transportation (3, 4, 5).

Ridership on bus demonstration projects has consisted of people who already possessed some self-improvement motivation. These upwardly mobile people tended to be more self-confident, more informed, and more adventurous than non-riders from the same ghettos. Many riders had already taken advantage of other available community services such as job training and health care. Most worker-riders had had previous jobs (3).

While some individuals will ride to work regardless of a job's characteristics, most of the responsive market segment carefully consider whether a potential job and the travel associated with working are worth the effort. Their evaluations are affected by whether they are seeking a full-time or part-time job, whether they are looking for a different job while already employed, whether the job is to be the only one in the household or is to supplement other income sources, and whether the job is to be permanent or short-term. By understanding their job selection process, planning efforts may better provide access to jobs considered desirable by the poor.

Transport planners have rarely considered the poor job-seeker's views toward work that play a basic role in their complex process of job selection, rejection, or retention. Instead, past planning has operated under the assumption that all members of the unemployed labor force could be expected to respond favorably to any job offers. The number of bus seats to be provided by buses to jobs was merely equated to the total number of reported job vacancies.

Throughout existing imperfect urban labor markets, however, there are inequalities of applicants and job openings. The simple, one-to-one correspondence between job-seekers and vacancies that has been assumed seldom occurs. All different kinds of poor people are seeking different kinds of work and work conditions. Employers have many different kinds of vacancies and job requirements. The distribution of available labor over a region seldom corresponds to the distribution of vacancies—employers want the cheapest labor while workers tend to want the nearest jobs. Well-known national firms and institutions have large personnel staffs to handle long lists of job applicants while smaller regional and local firms may be hard-pressed to attract many job applicants. Finally, job vacancies are not always available at times when labor is available.

Many of the poor, especially the young and discouraged, do not view jobs and employment as ends in themselves. Recent increases in education, advertising, and communication have raised employment and living standard expectations of today's poor far beyond the expectations of earlier generations. The notion that a job is a good experience regardless of how nasty or unremunerative is not widely accepted among the poor (6). Most studies reveal that poor unskilled heads of households who can work want to enter the primary job market, which features good, secure jobs and advancement possibilities that will improve their social and economic status, rather than to enter the unpredictable, monotonous, secondary job market that barely pays enough in take-home pay to keep their families alive and healthy (7).

The typical poor job seeker has determined his own minimum "acceptable" wage that tends to be above the legal (federal) minimum wage of $1.60 per hour, or $64.00 gross, per week. Just to approximate modest public assistance would require a four-person family worker, for example, to earn a wage closer to $2.20 per hour, or $89.00 per week (8). These figures are both much lower than the wage rate considered necessary for the lowest rate needed by an urban family of four, approximately $3.50/hour, or only about $7,200 per year (9). From these gross figures, deductions must be made for taxes, fringe benefits, transportation, union dues, and other work-related expenses.

Job vacancies must offer "acceptable" wage levels and job conditions, or potential workers will consider other income sources such as welfare, unemployment compensation, or crime (7). A growing number of sensitive job-placement staff members agree with the informal, "acceptable" conditions set by job seekers of different age and family status; they do not bother to place a head of a household in jobs paying less than at least $2.00 per hour, and they avoid placements in positions that have high turnover rates, periodic layoffs, and no advancement (10).

EMPLOYMENT PATTERNS AND PROBLEMS OF THE POOR

The employment patterns of many poor people do not constitute careers; typically, the pattern consists of a series of unrelated jobs and little advancement from one job to another.

Frequently, poor workers experience a recurring cycle of job search, application, commutation, and involuntary termination. This cycle has high financial and psychological costs. The cycle becomes increasingly demoralizing with age and is especially difficult for older people and unskilled members of minorities. A comprehensive job-access improvement program must consider the transportation needed to fulfill the travel needs at each cycle stage.

Stage I: Locating Jobs

The Job Search Process—Good transportation plays a necessary role in the discovery of job openings. Poverty studies have shown that the principal ways the poor learn about jobs is by word-of-mouth, seeing help-wanted signs posted along transport routes, reading newpaper ads, and visiting job placement offices. Preliminary "outreach" efforts have been made by urban and county governments to send mobile employment centers with recruiters into high-density poverty areas (12); usually, however, the job searcher is on his own to find out about job vacancies. (Times of high unemployment create special problems. Not only are fewer new employees hired and more recent employees fired, but also normal turnover of regular employees between companies drops. Good jobs tend to be passed along to needy friends before being placed in the open market.)

Past poverty-transportation projects focused on a few ghetto areas without considering the poor who live scattered in non-ghetto areas within cities and in suburbs (13). This widespread distribution of poverty throughout metropolitan areas creates different kinds of job-discovery problems, depending on home location (14). Concentrations of the poor facilitate word-of-mouth communication and generate sufficient use by job-seekers and employers to support localized job-placement office branches. Information about nearby secondary jobs, such as janitors, short-order cooks, dishwashers, etc., is known to the poor, but information about the better jobs outside the local areas is more difficult to obtain, especially for those poor who live far from placement centers, job sites, and other people. Central-city placement offices tend to have many more job listings than suburban centers, which allows more careful matching of jobs with job-seeker needs and skills.

Suburban poor job-seekers have more trouble and costs receiving news of job openings, despite their relative nearness to much of the new construction and job sites. They are cut off from personal communications. Dispersed poor populations cannot support local job-placement centers. Because employers seek cheap (urban) labor and prefer to deal with a minimum number of job-placement offices, small suburban and neighborhood placement offices are not always notified of vacancies (15).

Available Jobs—Most of the federal transport-poverty programs dealt with job vacancies in the private manufacturing sector of the economy, one which has not grown very rapidly during the last 10 years. (The private sector of the economy failed to provide the 1 million low-skilled new jobs recommended after the Watts riot.) With automation, many jobs for low-skilled people have disappeared. Remaining jobs for the poor are often in unpleasant settings and involve dull or tedious tasks.

The programs were not geared to assist labor in the fastest growing sector of the economy. Service has offered the largest increase in job opportunities for the poor. The public sector, non-profit agencies, and government contracts with private industry have created 9 out of 10 net new jobs between 1950 and 1960. The former two groups provided 85 percent of the new jobs for black people from 1958 to 1962 (16). Public-sector jobs vary in quality from low-paying clerical and inspection positions to highly paid policemen and sanitation workers. Most of these jobs offer advantages of job security and good fringe benefits.

Many of the available jobs offer wages that are too low to be acceptable to principle wage earners. Companies offering wages above $2.00 per hour were marked by few primary job openings; companies most frequently complaining about labor shortages had poor jobs averaging around $1.60 to $1.70 per hour. In labor-intensive industries such as food processing and clothing, where automation is difficult, competition from southern and foreign low-wage areas keeps urban region wages at levels so low only supplemental wage earners and recent immigrants will accept them. Private and public managers are also constrained from increasing entry-level wages because that would likely lead to additional wage payments for all other employees.

Many jobs have undesirable qualities. These are held only for very short times because they are very physically demanding, unpleasant, or clearly dead-end (17). Some jobs are available only for short periods during peak production or sales seasons or to fulfill special contract requirements. Some jobs (corrections and medical institutions) have difficulty retaining workers because of the low status associated with low-skilled jobs or because of their demoralizing and depressing nature.

Sometimes employers have minimum job requirements the poor cannot meet. Simple jobs such as delivery boy, truck driver, or parking lot attendent may not be undesirable supplement jobs, but the poor without a driver license cannot qualify. Placement offices report that driver licenses are not common among the poor, who have relatively little access to a car. Many elderly poor have never learned to drive. People with criminal records can encounter legal difficulties in acquiring licenses.

The crude surveys of job vacancies used in transport-poverty studies did not usually inventory job vacancies or their characteristics throughout the metropolitan regions. They rarely considered job vacancies of those downtown employers that were already served by some transit and/or were near poor neighborhoods. Some evidence suggests that large numbers of jobs for low-skilled workers are unfilled in most downtowns and that these jobs are not much different from those now vacant in the suburbs (18).

Stage II: Applying for Jobs

In addition to the travel required to locate desirable job vacancies, the job-seeker must frequently travel to apply for and secure the job itself. Depending on the complexity of the process at employment and personnel offices, transportation may be needed for several trips between the applicant's home and place of application. If the applicant is lucky or the application process is streamlined, his first trip to the placement site might be combined with a job interview and he may be hired on the spot. (This is common practice in certain jobs in construction and dockwork.) More typically, several trips will be required for obtaining application forms, returning them for review, having an interview, reporting results of medical exams, and pressuring personnel staff for a positive answer. It is not unusual to be applying for several jobs during the search and application stages of the employment cycle, resulting in additional travel for each possibility.

Most of the hiring takes place at the job site. Large employers may have special recruiting staffs, but they rarely recruit in poverty areas because the number of job vacancies at any one time is often quite small and poverty recruiting assignments are viewed as too unpleasant or dangerous. Smaller companies seldom have special recruiting staffs at all. Instead of field recruiting, companies require job applicants to visit the plant or office as a sign of interest, to give the company a chance to show off its facilities or to demonstrate that the applicants can get to the job site without the employer's assistance (11). The applicant is frequently on his own to find out how to get to the interview site. To help him get there, as well as to keep him company during travel and the long waits that are incurred before interviews, it is not uncommon for a poor person to want to ask a friend or relative to come along. Job-improvement access programs should therefore have the capacity to transport job applicants, and perhaps one of their companions, from their homes to the job hiring site.

Job recruitment timing is an important planning input. Most job applicants need transportation during the middle of the weekdays, after the start of business and before the end of the business day. Interviews may be scheduled throughout the daytime shift, but relatively few are held before 9 a.m. or after 4:30 p.m. People already working days may need to have interviews during their lunch period. The applicant must assume that lateness will hurt his job chances, so reliable and predictable transportation is important. If the applicant seeks to minimize his time in a job interview waiting room, he will want to have transportation that can arrive close to the scheduled interview time and can leave soon after the interview is completed. Since the applicant rarely can predict how long the job application process will take, it is hard for him to know when homeward-bound transportation will be needed. Almost certainly, however, the process will last less than a full work shift, so that transportation at infrequent intervals or only during rush hours will seriously reduce or prevent application travel.

Stage III: Commuting to Work

For low-skilled employees, the first few days, weeks, or months can be a difficult transitional period. Transportation problems associated with commuting are only part of his adjustment problems. During this time, irritations can cause him to reevaluate whether working is worth the effort. He may be subject to discrimination. He is likely to slow down his work group's productivity while he acquires job skills. Seldom are there people around him to help settle problems with his supervisors. He must pay for work-related expenses before he gets his first paycheck. He may be anxious about his performance if he is on probation for a long-term position (11, 14). If he becomes too irritated, he may quit and have to start searching for still another job or income.

Commuting generates different travel requirements than job search and hiring, in terms of locations, scheduling, and costs. Most low-skilled jobs are not located in the central business district of a metropolitan area. They tend to be in older fringe areas of downtowns, in decaying satellite cities, in unpopulated areas and industrial parks near wastelands, swamps, and transport terminals, or strung out along highways. These jobs are usually not within walking distance of most workers' homes because zoning and economic and racial segregation tend to discourage low-cost housing near job sites. The dispersed nature of the poor and their job locations requires transport systems that can handle intersuburban, reverse-commute, and sparsely settled area needs as well as the more classic suburban-town commute. Several of the more common jobs for low-skilled workers require transportation that can carry employees to and from several different job sites (cleaning services) on a cyclical basis or on a continually changing basis (construction, home catering). For people working several jobs the same day, transportation should be able to link one job with another.

Commuter transportation must be available at the times required by the job. The times that many poor individuals must work are markedly different from the working days and hours of the majority of the working population. Many unskilled jobs (plant guards, hospital workers, hotel employees) work on weekends and holdays. These and other jobs are often worked two or three shifts a day; new employees are usually assigned the less desirable evening or post-midnight shifts. Certain industries (dairies, trucking, entertainment, newspapers, hotels) require job accessibility very late at night or during the early morning, between 1 a.m. and 6 a.m. Many jobs for women and the elderly (janitors, gardeners, cafeteria workers, domestics) require off-peak, daytime service. To complicate transport planning still further, some people do not always work the same time every day of the week (shift assignments may change from week to week, and some workdays are longer or shorter than others), and some work cycles do not coincide with the standard 7-day week (nurses' aides, firemen).

Formal job starting times can rarely be used by themselves for planning transportation services. Workers may need several minutes to walk from the place where they leave their access mode to the actual location where they must do their tasks or punch a timeclock. Time for job preparation (dressing in certain clothes or learning about recent activities) may be required before the work shift begins.

Formal ending times are not constant in many jobs. Workers may consider it very important to be able to work overtime when they need extra money or their supervisor asks them or requires them to stay late. Informal quitting times may vary with supervisors, the weather, the number of customers, or the varying nature of different work tasks.

If the motivations to work and the job satisfactions are low, high commuting costs can lead to job termination. Total travel time between home and worksite must be kept to a minimum for bad jobs of principle wage earners and for all part-time job holders. Trip times should probably be less than 1 hour if long-term employment is to be encouraged.

Money costs of transportation must be considered in several ways. In the early, transitional commuting stage, workers are sensitive about spending money before their job is secure. They do not want to tie up savings or early earnings in transportation such as transit or toll-road commuter tickets because they may go unused if the job ends or if the worker misses a particular ride to work. For supplemental and low wage earners, high commuting costs may discourage employment; transport charges to work should probably be less than the 10 percent of total family income that the Bureau of Labor Statistics considers as average for all transport costs.

Expenses to bad jobs should probably be far less than expenses for equidistant commuting to high-quality jobs. The poor seldom have the home location flexibility that affluent groups have. They do not always have the option of moving closer to their workplace in order to reduce commuting costs. Equivalent housing may not be available, they may have strong familial or ethnic ties to their neighborhoods, or they may be uncertain about the permanence of the employment and do not want to risk moving unnecessarily.

Transport programs that reduce commuting costs represent net increases in available income for the poor. With good, stable jobs, poor commuters become relatively insensitive to transport costs (2). At the least, cost reductions reduce the irritations that can discourage the marginally motivated worker.

AN ASSESSMENT OF TRANSPORTATION SUPPLY

The work-related travel needs just identified will now be compared to common-carrier bus transit, car pools, and car-driving to determine the role each of these modes might play in work access programs. (Other relevant modes for further study include walking, taxis, jitneys, bicycles, and charter-bus operations.) These specific modes have been chosen following suggestions that work access, especially to suburban jobs, begins on buses, switches to car pools as soon as acquaintances can be formed with co-workers, and ultimately ends when workers buy their own cars. Each mode's suitability and availability will be considered, along with barriers that inhibit their future use.

Common-Carrier Transit

In general, common-carrier bus transit operations on fixed routes and limited schedules meet only a fraction of the highly varied and often changing work trip needs of the poor. [In large cities, public transportation use for work trips declines from a high of 72 percent for incomes between $1,000 and $2,000 to about 31 percent for incomes between $5,000 and $10,000 (19). In cities with poor transit, poor worker use of transit is probably lower.] Those who live and work nearest the central areas of the urban core are likely to have reasonably adequate daytime service for downtown job search, hiring, and commuting, but few city systems operate frequent service late in the evening. The further the poor live or work from the core, the poorer the service is likely to be. Federally sponsored reverse bus operations from a few cities' ghettos to several suburbs' industrial parks did not provide the many-to-many travel services required by dispersed poor people and jobs; most of these buses ran only on weekdays and only served daytime shift changes, not off-peak or weekend hiring and work trip needs. Travel times over 1 hour were common, and most passengers had to pay fares of $1 or more per day, not including access costs to reverse buses.

Existing transit availability is difficult to estimate. Most city or community technical studies examine transit access by mapping residence distances to local transit routes. The entire labor market area is not usually considered, and many basic "user-oriented" dimensions of transit service are not studied.[1] Official records and engineer-

[1]Some of these "user" dimensions include (a) transit routes by company or operating agency; (b) frequency of service on each route in each direction at all times of the day, week, and year; (c) location of bus stops by time

ing maps are used, although it is the poor peoples' perceptions of available service and distances that affect their trip-making. Problems with information distribution to the poor about available transportation services and travel subsidy programs for job trainees continue to keep even existing services from being fully utilized (20).

Several barriers exist to prevent transit from assuming a large role in future worker travel in suburban areas. Even in developed suburbs, low land use densities, dispersed travel times, and high auto availability lead to few local routes that can generate sufficient ridership to support increasing labor and operating costs. As a result, suburban service has been declining (21).

Suburban passenger distribution and collection are made circuitous and time-consuming by a physical environment that has not been planned for bus or pedestrian movements. Deep setbacks of major traffic generators, limited-access highways, spiral-shaped industrial park roads, and narrow plant entrance driveways restrict buses; median strips, guardrails, security fences, and a lack of snow-cleared and lit sidewalks hamper pedestrians, even on short walks to and from transit stops.

Bus operators have great difficulty trying to schedule and route adequate bus service for suburban workers. Frequent service is required if workshift and recruitment times are scattered around the clock and not coordinated among the employers to be served. Employers will rarely change their work hours to facilitate transit use because only a small fraction of their work force is likely to use transit. The bus routes that run between suburban residences and urban jobs can rarely be the same as routes linking dispersed residences and suburban jobs. Since they must also be run at the same rush-hour times as other services, suburban and reverse bus operations increase transit manpower and equipment requirements rather than lead to more efficient use of transit resources just in off-peak periods.

As suburban bus ridership and revenues from scheduled services have failed to keep pace with increasing costs, transit management has become concerned with finding ways to reduce expenses rather than develop and market transit services that might attract more patronage. With limited available funds, managers are now reluctant to gamble on projects with high set-up costs (1, pp. 18-24).

Some financial assistance has been made available from governmental sources, but serious problems with innovative transport implementation will continue. In suburban areas, job- and road-building developments take place sporadically and unpredictably. In the absence of expensive and long-term operating subsidies, most transit companies cannot provide an area's earliest residents and employers with the same levels of service that might later prove economically viable. Small companies frequently lack the interest and/or resources to participate willingly in new programs involving time-consuming government red tape, community meetings, and planning sessions. Self-made transportation managers, trying to stay solvent, show little compassion for the problems of the urban unemployed; instead of devising aids that might help the poor (intercompany schedule and public information coordination, joint tariffs, transfers), managers fear that these aids might divert their captive ridership to competitors' lines.

The most restrictive barriers to better common-carrier service may be political and legal issues (21). Transit unions want job protection and resist operating changes that increase their productivity without compensating benefits. Managers want regulatory freedom to consolidate routes and schedules to cut costs at the same time they want public protection from existing and new competition. While various citizens' groups and taxpayers can be mobilized to fight against disrupting new transportation construction and service cutbacks, getting them to resolve their conflicting travel needs and to generate compromise services has proved difficult. Regulatory commissions and municipalities must make trade-offs between transit suppliers and consumer groups

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of day; (d) locations of pedestrian barriers; (e) fare zones; (f) transfer points and charges; (g) running times (express and local) between all stops by time of day; and (h) capacity of equipment and corresponding load factors on each run, by direction and time of day. This information about service is hard to obtain and keep up to date (10, 22). Regulatory commissions and transit companies rarely have money to maintain accurate, current maps and schedules of complete operations in a metropolitan area. Official "supplier" data are seldom available by small areas and by time intervals such as weekdays or off-peak and hence are not very useful for analyzing service to the poor or for planning particular trips.

when they use their legal authority to control bus route franchises and transit stops, the entry and exit of transit firms in local markets, fare structures, and insurance requirements (22, chapt. 5; 23, p. 26).

Car Pools

The suitability and availability of car-pool operations for work-access travel needs of the poor have not yet received professional scrutiny. Car pools do not appear to be a viable transportation mode during the job search, hiring, and early transitional commute stages of the employment cycle. High car-occupancy rates have been noted for some reverse-commute movements, but little is known about the long-term economics and operations of car pools among groups of low-income workers of various occupations, residential patterns, and other demographic characteristics (19).

New low-skilled employees may face several problems creating a new car pool or joining an existing one. In some workplaces, only a few co-workers may be interested in forming a car pool. These people may live too far apart to form car pools, or they may prefer to form car pools whose members are of similar status or race. Employers or employee organizations may not provide assistance to start car pools. Many poor workers have not developed the social skills necessary to locate and organize strangers into a reliable, cooperative car-pool operation. Until they form friends among their fellow employees, the poor may be reluctant to ask to join existing car pools.

Several conditions necessary to sustain a car pool may not be met because of the nature of many jobs and the limited resources available to the poor. Car-pool members do not always have phones at their jobs or homes that allow them to communicate easily with one another. Unless all members work the same shifts and hours, shift rotations and overtime work can split up car pools and leave some members stranded. Drivers and the cars used in the pool may not be reliable; driver tardiness and absenteeism or car breakdowns create hardships and tensions among non-drivers. Without a system of backup drivers and cars, car-pool members may not be able to get to work. Finally, high quit rates and terminations among the poor in low-paying or poor-quality jobs will be reflected in high turnover of car-pool participants.

Personal Automobile Use

Automobiles are particularly well-suited to the dispersed location and schedule travel needs of low-skilled workers. With an auto, job search, application, and commuting come directly under the traveler's control. If a car-owner can share operating costs with other passengers, his perceived costs might be quite reasonable and he has the benefits of car ownership for non-work trips as well as work trips. To the extent that he works in the off-peak hours, in employment locations with adequate parking, or in suburbs, his car commute is likely to avoid the congestion and other commuting problems of the downtown-bound day-shift workers.

Aggregated statistics make it difficult to ascertain car availability among poor urban and suburban workers. Nationally, for all households in 1970 with incomes of less than \$1,000, between \$1,000 and \$2,000, and between \$2,000 and \$3,000, the corresponding percentages of car-owning households have been 25, 41, and 50 percent respectively (24, p. 47). [Auto use to work in large cities by the poor ranged from a low of 14 percent (for \$1,000-\$2,000 incomes) to 49 percent (for \$4,000-\$5,000 incomes) (19). These figures are probably lower than in moderate-sized cities with poor transit.] Urban and suburban figures are probably somewhat lower than these figures, which include rural poor households. Higher car ownership rates are likely in newer cities and suburbs (22, pp. 1-5) and in poor households with incomes above \$3,000. Households with at least one worker might be expected (in any one setting) to have more access to a car than poor households with no member in the labor force.

A poor person is less able to deal with many car-related problems than a more affluent person. A poor car-owner's resources for alternative transportation are limited. He may be less familiar with existing transit service. He is less likely to have a second car available. He cannot afford to rent a car or take a taxi when unpredictable maintenance repairs must be made on his commuting car (2). He seldom has cash available to pay for expensive parts and labor. (The fraction of the car-owning poor population who enjoy repairing their own cars may be quite small. Many poor people do repairs because they cannot afford to pay costly car mechanics. Other poor people lack the skill, the specialized tools, the time, or a suitable workplace.) He is less likely to know about or take full advantage of consumer protection warranties. When accidents occur, the poor person without a good lawyer is apt to experience longer delays and receive lower settlement payments than a person who can afford better legal assistance.

RECOMMENDATIONS

Three general ideas for improved work-access programs emerge from this analysis of travel requirements, patterns of employment, and the suitability and availability of transportation.

Minimize the Need to Make Work-Related Trips

To minimize travel needs in the short run, greater efforts should be made to foster job search and hiring efforts near poor residence areas. Information about regional jobs should be locally available. To keep employers who offer good jobs from moving away from accessible locations, employers should be informed of the inconveniences that will be incurred by their employees and of the possibility of recruitment problems. For companies who are committed to moving to relatively inaccessible areas, information on transit services and programs to assist job application procedures and bus movements (both spatially and temporally) should be made available.

To minimize travel in the long run, policies to reduce the work needs to travel might include the attraction of new employment into labor surplus areas. Government officials contemplating new hospitals and other service facilities in outlying areas should consider unskilled employee access in their location criteria or be sure to include sufficient funds for employee, job-seeker, and visitor access if they anticipate recruitment and high-turnover problems. Guaranteed incomes and the 4-day workweek are two non-transportation programs that will help reduce total work travel levels. Low-cost suburban housing may or may not reduce commuting distances (13) but will not solve the problems of job search and hiring that already exist in suburban poverty areas (8).

Reduce Barriers to Self-Help Transportation Efforts

When the constraints on car pools and transit are all considered, the least costly and most practical long-run solution for improving work-access travel needs of the poor seems to rest with some form of self-help vehicle such as a car. [The subsidy costs on demonstration bus projects have run so high on some routes ($1,500 per rider) that the provision of a car, gas, insurance, etc., would have been cheaper to the taxpayer and would have given each owner and his family multipurpose transportation instead of transportation only to work sites (25)]. Except for those who live in the densest traffic corridors or who are not able to drive, autos provide the flexibility needed for work needs without having to pay for driver labor. (In warm, dry climates such as the Southwest, motorcycles might be economical alternatives to cars.) Although this solution will be anathema to several groups (anti-automobile, middle-class citizens and planners; transport bureaucrats with a restricted mandate to help their poorer clients; environmentalists; people who want glamorous, centrally planned, technological projects), a car-oriented approach that helps more poor people acquire, insure, drive, and maintain an automobile may be the only way, in many cities, to help poor workers who want to travel. With increased car ownership among the poor, more non-owners may have car-owning friends who can drive them to look for and to apply for jobs.

Easing car ownership and operating problems can be a politically sensible approach to encouraging self-help if it does not provide cars just to poor members of the labor force. A broad program to help car owners will benefit a wide range of citizens—the "silent majority" and the poor worker—with relatively small additional government outlays. Government-backed car purchase and insurance schemes and government resale or off-peak rental of its vehicles should be geared to helping families with no current access to cars. [Past increases in car sales have been to families who already had at least one car, while the number of families with no car has remained steady (26).] Improvements and simplifications in car financing, insurance, and claim processing; non-regressive regulations in automobile taxation and fees, air pollution, and safety; and pressures on manufacturers to develop inexpensive, reliable, safe, and easy-to-maintain cars are programs that make auto ownership and operation less of a burden.

It seems unlikely that the newly acquired cars of the working poor would greatly increase congestion, pollution, and other problems associated with autos in general. These additional cars will not be the "straw that breaks the urban highway system's back," because of the likely timing and location of their use. It is unfair to discriminate against poor families by denying them some measure of increased mobility if they want and need it to work, while planners will spend years trying to devise alternative solutions to fundamental, car-related problems.

Provide Transportation for Those Who Cannot Help Themselves

Work-access improvement programs must make some provision for those who cannot provide their own transportation, or else programs will result in major reductions in common-carrier service. Reductions will restrict the mobility of the autoless poor worker still further. Improved information and marketing techniques, coordinated and faster door-to-door transit service, and education programs that help people plan trips and overcome fears associated with travel will help people take advantage of already existing services. Mere expansion of the number of buses in operation, the availability of more capital and operating subsidies, or the reduction of fares will not necessarily help meet work-travel needs. Institutional, legal, scheduling, and managerial barriers to service innovation in the transit industry must be minimized.

Planners must view improved access to jobs from the perspective of their poor clients who are looking for jobs they will accept. Any service planning, analysis, and evaluation must consider job quality as well as quantity. These job search, application, and transitional commuting requirements of poor travelers suggest flexible modes such as taxis or a dial-a-bus system. Operations must be carefully supervised by competent, sensitive managers who can solve problems and market services effectively among employers and job-placement counselors (2, 3, 8, 11, 14, 15, 17, 23).

Paying for Improvements

Who should pay for improvement programs? The principal burden may be borne directly by benefiting employers whose location decisions make self-sustaining transit operations unprofitable and by benefiting workers. These payments might be higher wages, which employees then use to buy their own transportation, employer-provided transportation using its own vehicles, or increased taxes and assessments for publicly provided transportation. At the least, employers might accommodate the travel schedules of transit-dependent workers. Transportation funding may be provided by groups like placement services, chambers of commerce, industrial park members, and unions. Church and other community service organizations might be mobilized to help provide help for job search, hiring, and emergencies. Unless government was itself an employer, government efforts would be required in planning and developing programs, not necessarily in direct operations or subsidies.

CONCLUSIONS

Over the past few years, many people have had unrealistic expectations that the improvement of access from ghettos to suburban jobs would result in significant decreases in poverty. Experience has suggested that the poor will rarely travel anywhere in large numbers to get to poor-quality jobs.

The routing and scheduling flexibility needs of the unskilled poor when they travel to look and apply for jobs and to go to work are met most satisfactorily by the private automobile or by publicly provided modes with similar performance capability and availability. Conventional bus service and car pooling have serious service deficiencies that limit their usefulness for many work-related travel situations.

Reductions in the need to travel, self-help travel aids, and assistance for travel-dependent people are pragmatic programs for lessening travel barriers encountered by many persons. The programs offer advantages of low public investment costs, decentralization of travel decision-making and planning, and a more equitable distribution of transportation costs and benefits among employers and the urban poor seeking work.

It seems important to conclude that access to good transportation is not, by itself, necessary and sufficient to eliminate unemployment or poverty. Work-access improvement programs for poor urban residents will only be of assistance to people with job information, marketable labor skills, and the knowledge and confidence required to travel. Anti-poverty program success depends on increasing the total number of acceptable jobs and alternative income sources that provide people not in the labor force with enough money to live.

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MEASURING THE EFFECT OF TRANSPORTATION ACCESSIBILITY ON INNER-CITY UNEMPLOYMENT

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This study presents some empirical evidence on the manner in which transportation service to job sites influences the employment potential of low-income workers who inhabit the inner city. In addition, it describes an employment-accessibility model that considers the direct relationship of transportation service and employment characteristics in a manner that permits quantification of the expected benefits in unemployment reduction through a proposed improvement in transportation accessibility. Unlike other studies of a similar nature, this research has demonstrated the feasibility of obtaining estimates of unemployment reduction attributable to proposed accessibility improvements before the implementation of a demonstration program. The implications of these findings are, therefore, of significant importance in evaluating the worth of a capital or operating expenditure for improving transportation accessibility because they will lead to more efficient utilization of resources in the quest for "optimum" transportation improvements.

•MOST of us still recall the ghetto riots that rocked several American cities from coast to coast in the mid-1960s. The major such tragedy occurred in the Watts area of Los Angeles in the summer of 1965.

The McCone Commission in its report (1) on the causes of the Los Angeles riots stated that the lack of skills and apparent discrimination are the primary causes of Negro unemployment. The Commission, however, also recognized the factor of inadequate and costly transportation as a contributor to the unemployment barrier for ghetto residents:

> Our investigation has brought into clear focus the fact that inadequate and costly public transportation currently existing throughout the Los Angeles area seriously restricts the residents of the disadvantaged areas such as South Central Los Angeles. This lack of adequate transportation handicaps them in seeking and holding jobs, attending schools, shopping and in fulfilling other needs. It has had a major influence in creating a sense of isolation, with its resultant frustrations, among the residents of South Central Los Angeles, particularly the Watts area.

This finding by the Commission and its recommendation to improve public transit service to employment centers as a means of reducing the geographic isolation of minority neighborhoods was followed immediately thereafter by a federally sponsored (HUD) demonstration program in East and South Central Los Angeles designed to test the hypothesis that improved transit service from that area to inaccessible employment centers would be helpful in reducing the high unemployment rate among low-income residents.

In the past 5 years several cities conducted studies to investigate the possible link between inadequate transportation and unemployment (2, 3, 4, 5, 6). Available literature, however, gives no determination of the magnitude of cause-effect measures between transportation availability and employment. Such a deficiency was also stated by Ornati (7) in his study of New York City's low-income areas:

> Policies aimed at reducing employment-related poverty must respond to the self-evident fact that travel inconvenience is a barrier to employment. THE EXTENT OF THIS BARRIER IS NOT KNOWN. Nor has any estimate been made of the degree to which increasing the convenience of travel can reduce employment-related poverty.

The costs for conducting operational tests and experiments to demonstrate the feasibility of improving public transportation service to lower unemployment in low-income areas are high. Table 1 gives an example of their magnitude (8).

The results produced by these projects do not, however, present a clear picture of the role of transportation in the low-income labor market. For example, Floyd stated, "That other factors may be more critical is apparent from the Los Angeles employment data which shows that of 9,383 project area residents who applied to the Department of Employment for jobs, 7,980 (85 per cent) had not even been referred because they lacked the necessary skills" (8). Similar findings were reported for the Long Island project (9).

Clearly the need exists for methodologies that would permit an evaluation of measures of transportation effectiveness prior to project implementation. Such an approach would provide the decision-makers with a priori payoff measures before embarking on a costly demonstration project that may be ineffective due to poor judgment or because of unjustified expectations.

It is the purpose of this paper, therefore, to present a method for measuring the relationship between transportation availability and its resultant effect on the employment of low-income workers. This is done in a manner that permits quantification of the expected benefits in unemployment reduction through proposed improvements in transportation accessibility.

TRANSPORTATION IMPROVEMENTS AS A SHORT-RANGE SOLUTION

Presumably the availability of appropriate transport services linking low-income areas and employment centers is only one aspect of the complex problem associated with a reduction in the disparity between unemployment rates of ghetto residents and other parts of society. Another aspect is concerned with the broader issues of motivating and assisting the unemployed to take advantage of educational and training opportunities available to them. Perhaps the broad scope of the problem is best illustrated by the following statement (10):

> It is self-evident that the problems we are struggling with form a complicated chain of discrimination and lost opportunities. Employment is often dependent on education, education on neighborhood schools and housing, housing on income, and income on employment. We have learned by now the folly of looking for any single crucial link in the chain that binds the ghetto. All the links—poverty, lack of education, underemployment, and now discrimination in housing—must be attacked together.

It is believed, however, that many proposed approaches to solving the poverty problem are of a long-range nature. Reversing the trend of industry's decentralization patterns, reducing discrimination in housing patterns, improved education, and effective training programs are all examples of possible solutions that are very much time-dependent for their effectiveness. This is not to say that they are not appropriate measures. Rather, it is believed that they are not sufficient in offering immediate interim solutions. Transportation, however, appears to offer one applicable linkage to a short-range answer.

The sections immediately following present the study area from which the data are obtained, the role of transportation in the work-not work decision, and an exposition on the logic of transportation being a causative factor in unemployment rate in such cases. Regression analyses are then done to quantify the relationship. The elimination of hard-core unemployed from the data base is discussed and done prior to this analysis.

THE STUDY AREA

This analysis of the transportation variable as the causative effect of unemployment among unskilled workers is based primarily on an empirical study of transportation problems in the Central Brooklyn Model Cities (CBMC) area of New York City. In the summer of 1969, extensive surveys were made in the CBMC area to determine, among other things, the unemployment-related problems of poor transit service.

The CBMC area is made up of three communities, known as Bedford-Stuyvesant, Brownsville, and East New York. The area is approximately 5 square miles and contains over 404,000 people, 40 percent of whom live in households earning less than $4,000 per year. In 1969, the unemployment rate in the area was 14 percent of the total labor force of 121,000 persons. The predominant population in the area is Black (78 percent) and the other major component of the population (19 percent) is Spanish-speaking (19).

THE CHOICE BETWEEN WORKING AND NOT WORKING

An individual either works or does not. For an unskilled member of the labor force whose annual income seldom exceeds $4,000 before taxes, the probability of his employment is dependent on several factors.

There will be some persons who, due to their individual characteristics, will (a) only work occasionally at so-called "odd jobs" or seasonal jobs or (b) become "discouraged" with seriously looking for work. These persons manage somehow to live from public assistance or may earn their living through illegal means. This group could be classified as long-term or hard-core unemployed. As such, therefore, it is unlikely that they will benefit from even substantial improvements in transportation access to job sites. [The term "hard-core" unemployment is used to describe persons who are continually between jobs for extensive periods of time. The reasons for the habitual unemployment status are not clearly identifiable but they may include personal attitudes toward work, seasonality of jobs suitable to the unemployed, and availability of public assistance that is competitive with the low wage scale for unskilled workers. For a more comprehensive discussion see Newman (20). For the purposes of this paper, it may be assumed that the hard-core unemployed will not respond to transportation improvements. As defined by the U.S. Bureau of Labor Statistics, the hard-core unemployed include those persons out of work for 3½ consecutive months or longer.]

The remainder of the unskilled workers' group consists of persons whose employment characteristics are largely dependent on the job market and the forces of public institutions (primarily welfare), which compete with the job market in influencing the employability of an unskilled worker (11).

It is not intended, however, to discuss the sociological and psychological factors that affect the individual preferences that influence an unskilled person in the choice of working or not working. Instead, just as it is standard practice in economic analysis to take tastes and attitudes as given, the approach taken in the development of the employment-transportation model assumes that all unskilled workers—whether they work or do not work—exhibit an aggregate behavior that is essentially identical when they rationalize the choice between working and not working.

The concept implicit in the employment-accessibility model is that the quality of public transportation service from a worker's residence to a potential job site will affect his choice of working or not working, all other things invariant. Thus the unskilled unemployment rate in a residential area is expected to vary according to some measure of transportation quality that expresses the ease of access from that area to job sites suitable to the unskilled worker.

CAUSE AND EFFECT

In the study of urban problems such as economics, transportation, employment, and a whole host of social issues, one is primarily concerned with cause-and-effect relationships. This concern stems from the need for establishing policies and courses of action to bring about effective solutions to serious problems.

The employment-accessibility model presented in this paper is one such attempt in establishing and measuring a cause-and-effect relationship between transportation accessibility and employment.

In general, to prove that one variable causes an effect on another variable is not an easy task. In most cases, in fact, there is no fail-safe proof. Logic and common sense seem to be the best means of avoiding variables that are not fundamentally related. The simplest concept of causation is one according to which one particular event (the "cause") is followed by another particular event (the "effect"). For example, if a proper switch is flipped, the electric light goes on, and if it is flipped back again, the light goes off.

In justifying the effect of transportation accessibility on unemployment, however, a more complex logic is required.

Low-income unemployment may be related to several non-transportation variables. Since the non-transportation variables are assumed to affect low-skilled workers equally, regardless of where they lived in the CBMC area, it is possible to isolate the transportation variable as the only variable that varies from subarea to subarea. Caution, however, should be exercised with this approach. This refers to the possiblity that the association between transportation accessibility and employment levels might in fact be due to the phenomenon that the unemployed might live in low-rent areas and low-rent areas might be found where there is poor transportation accessibility. Thus, if this were the case, there would be no cause and effect between transportation and employment levels. Unfortunately, no rent data are available for the CBMC area to compare rents paid by welfare and low-income households as a function of their transportation accessibility to work places. There is strong evidence, however, that rent differentials, if any, might not be present:

1. In New York City the Welfare Department reimburses the clients for the cost of rents, thus eliminating the incentive to shop for "low cost" housing.
2. The Long Island Study (12) found that the average monthly rents for poverty and welfare households were higher than the average rent paid in the seven communities surveyed: \$173 versus \$165 per month in Suffolk County and \$110 versus \$104 per month in Nassau County.

Thus it appears safe to eliminate the possibility of the rent differential concept as the underlying cause for unemployment variations among the low-skilled workers in the CBMC area.

It is well to state at this point that most of the unemployment in the CBMC area is attributable to the unskilled workers. Other labor force members exhibited extremely low unemployment rates (Table 2). Labor force members who are not unskilled, however, also live within the same areas occupied by the unskilled worker. Why is it, then, that they exhibit low unemployment and are seemingly not affected by poor transportation? The answer to this question will illustrate the rationale for using transportation accessibility as the logical causative variable that tends to inhibit employment of low-skilled workers.

The earnings of skilled workers are considerably higher than those of unskilled workers. The skilled worker, therefore, has no substitute source of income that would permit him to provide for his family at the same level that he can while working. He is willing then, to keep his job even if he must make a complicated and time-consuming trip. His probability of working, therefore, is always very high—even when transportation access to his job is very poor (Fig. 1).

For the unskilled worker, however, whose annual wages are low, the incentive to work is low because the income that he can earn by working can also be provided by public assistance. In the present social system, therefore, the transportation element may be viewed as the causative variable that affects the employment status of the low-income worker. It is postulated, then, that the probability of employment for unskilled workers varies as a function of their access to work places. This is shown in Figure 2.

ACCESSIBILITY MEASURES

Accessibility may be described as the ease of travel from one area to other areas. Since trips are made to satisfy a particular desire, accessibility measures are usually related to the set of activities that may satisfy the purpose of the particular trip. Thus,

Table 1. Demonstration program funding.

Location	Federal Grant (dollars)[a]
Los Angeles (East and South Central)	2,700,000
Long Island (Nassau and Suffolk Counties)	2,000,000
St. Louis Metro Area	1,150,000
Buffalo Metro Area	500,000

[a]Usually 90 percent of total project costs are covered by the federal government.

Table 2. Unemployment rates by occupational status of CBMC area labor force.

Status	Rate (percent)
Professional/technical	0.6
Skilled	0.9
Semi-skilled	1.2
Unskilled	29.4
Total	14.0

Figure 1. The decision to work, for skilled workers.

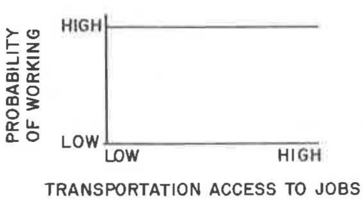


Figure 2. The decision to work, for unskilled workers.

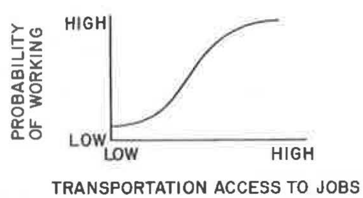


Figure 3. Distribution of jobs versus travel time from zone of residence.

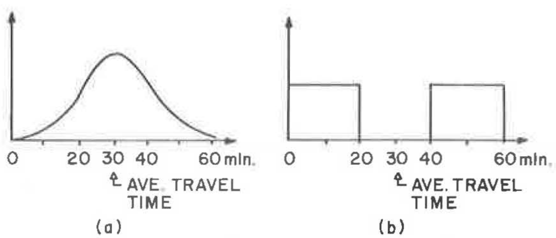


Figure 4. Travel time factor for unskilled work trips.

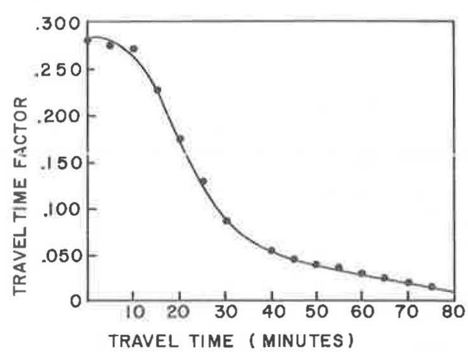
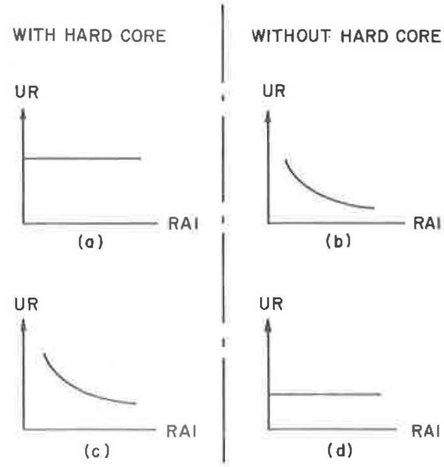


Figure 5. Hypothetical relationships of unskilled unemployment rate versus transportation accessibility to job sites.



to measure accessiblity to jobs requires knowledge of (a) where the activities (E_j) are located and (b) the parameter of separation (T_{ij}) between a residential area (R_i) and the places of employment (E_j).

Hence, it may be hypothesized that residential accessibility to job sites is a function of the number of jobs and the travel time (travel time is an overall measure that includes, in addition to riding time, access time to and from the transit facility, waiting time, and transfer time) required to reach these jobs, or

$$X_i = f\left(E_{jk}, T_{ij}\right)$$

where

X_i = accessibility to jobs or zone i;
E_{jk} = number of jobs of type k located in zone j; and
T_{ij} = travel time required to travel between zones i and j.

If travel time is held constant, say at 30 or 45 minutes, the accessibility to jobs of a zone becomes a measure of the number of jobs that could be reached within this travel time interval, or

$$X_i = \sum E_j \mid (T_{ij} \leq 30 \text{ minutes}) \qquad (1)$$

Another measure of accessibility might be the weighted travel time required to reach all jobs within the area, or

$$X_i = \frac{\sum E_j T_{ij}}{\sum E_j} \qquad (2)$$

Equations 1 and 2 are easy to understand but do not provide for a complete and accurate determination of accessibility. For example, Eq. 1 includes only those jobs within a specified travel time (30 minutes) and takes no account of the potential effect of jobs located beyond this boundary. The travel time boundary could be expanded to include all jobs, but this approach would result in values of X_i that would be identical for each zone.

Equation 2 is weak because it does not consider that travel time is perceived as a nonlinear variable by the traveler and it assumes that jobs are normally distributed about the mean. Where this latter assumption is not found [Fig. 3(b)], the mean values of travel time calculated from Eq. (2), for each zone, are not comparable. For example, under the normal distribution the mean travel time for zone 1 adequately represents the central tendency of job concentration around the mean value. But in the case of the uniform bimodal distribution for zone 2, the mean value is a poor descriptor of job dispersion. Therefore, although the two zones may have identical average travel time values, their accessibilities to jobs are definitely not the same.

A more appropriate measure of accessibility is found in the following expression:

$$X_i = \sum_{j=1}^{n} \frac{E}{\left(T_{ij}\right)^{\alpha}} \qquad (3)$$

It may be seen that Eq. 3 corresponds to the denominator of the gravity model of trip distribution. The numerical value of this equation represents an index of accessibility. Thus for an area containing n residential zones, n accessibility indexes would be obtained, and those zones with the higher numerical values have the higher accessibilities. Conceptually, Eq. 3 is appealing because it states that accessibility increases with an increase in the number of jobs or with a decrease in travel time. In addition, it states that the effect of travel time is perceived as a disutility, which varies with the power α of travel time.

The exponent α of travel time was calibrated by observing the distribution of work travel for unskilled CBMC area workers to work areas throughout the New York City region. This is discussed elsewhere (13, 14). The resulting travel time factor, $1/(T_{ij})^{\alpha}$, or F_{ij}, is shown in Figure 4.

MEASURING THE EFFECT OF TRANSPORTATION ON LOW-SKILLED UNEMPLOYMENT

As was previously observed, it is important to divide unemployment data into two categories. One set includes those who are hard-core or chronically unemployed, and another comprises unemployed persons who may repond to transportation improvements. This concept is illustrated (in its extreme cases) in Figure 5, where it may be seen that there is apparently no relationship between unemployment and transportation accessibility when the hard-core unemployed are not separated from the rest [Fig. 5(a)]; when this is done, however, the relationship [which in Fig. 5(a) is "clouded" by the presence of the hardcore unemployed] may be clearly visible [Fig. 5(b)].

Similarly, Figure 5(c) shows that it is possible to measure a causal effect of transportation on unemployment when the hard-core are not separated from total unemployment. When the hard-core unemployed are removed, however, there may be little or no correlation between the unemployment and accessibility variables, as shown in Figure 5(d).

For these reasons, the unemployment rate variable calculated for the CBMC area was made to conform with the requirement that it should not contain hard-core or chronically unemployed individuals. These adjustments were possible at the community level from a study (15) made available by the Central Brooklyn Model Cities office. The unemployment rates calculated for the CBMC area transportation study were separated into hard-core and non-hard-core unemployment, as given in Table 3.

The results obtained in using non-hard-core unemployment only are shown in Figure 6. It appears further that the relationship might be described by a negative exponential function of the type

$$UR = a + e^{-kX} \tag{7}$$

This negative exponential function is conceptually appealing because it states that the importance of the accessibility variable on unemployment decreases as accessibility increases. For example, according to the hand-fitted line, a greater reduction in unemployment is obtained for a from a 20,000-unit increase in accessibility if the initial accessibility of an area was measured at 200,000 instead of 360,000 units.

For ease of computations, the negative exponential function may be transformed to a linear function by using a logarithmic transformation and then fitting the linear function to the data by linear regression, using the least-squares method. Thus, the final employment-accessibility model takes the following form:

$$Y = a + b \log_{10}X \tag{8}$$

where Y = the unemployment rate in percent and X = the residential accessibility index.

The calibrated form of the model (see also Fig. 7) in the CBMC area is

$$Y = 186.26 - 31.65 \log_{10}X \tag{9}$$

The correlation coefficient (r) was 0.93 and the standard error of estimate $S_{yx} = 1.61$ percent. The hypothesis of zero slope was rejected at a significance level of 0.05. It may be concluded, in conjunction with the cause-effect development, that the transportation accessibility variable significantly affects the unemployment levels of the unskilled non-hard-core labor force living in the CBMC area.

RELATIONSHIP TO OTHER STUDIES

Although the results of the foregoing analysis demonstrate that the transportation

Table 3. Accessibility index, hard-core, and non-hard-core unemployment by CBMC analysis area.

Analysis Area Identification	CBMC Identification[a]	Accessibility Index (in 100,000)	Hard-Core Unemployment (percent)	Non-Hard-Core Unemployment (percent)
1	BR and ENY	1.8	12.9	20.1
2	BR and ENY	2.0	11.1	17.4
3	BR and ENY	2.2	11.1	17.4
4	BR and ENY	2.4	10.9	17.1
5	BR and ENY	2.6	10.4	16.1
6	BR and ENY	2.8	9.0	14.0
7	BS	3.0	21.4	13.6
8	BS	3.2	13.4	8.6
9	BS	3.4	21.0	13.5
10	BS	3.6	14.4	9.1
11	BS	4.0	16.8	10.7
12	BS	4.2	11.9	7.6

[a]BR = Brownsville; ENY = East New York; BS = Bedford-Stuyvesant.

Figure 6. Non-hard-core unskilled unemployment versus residential accessibility.

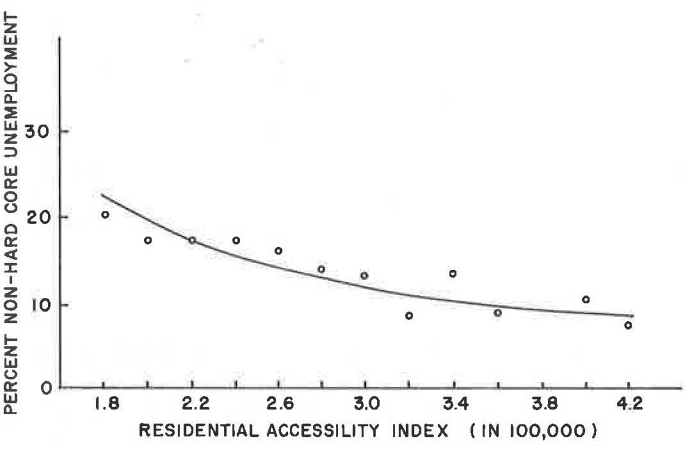
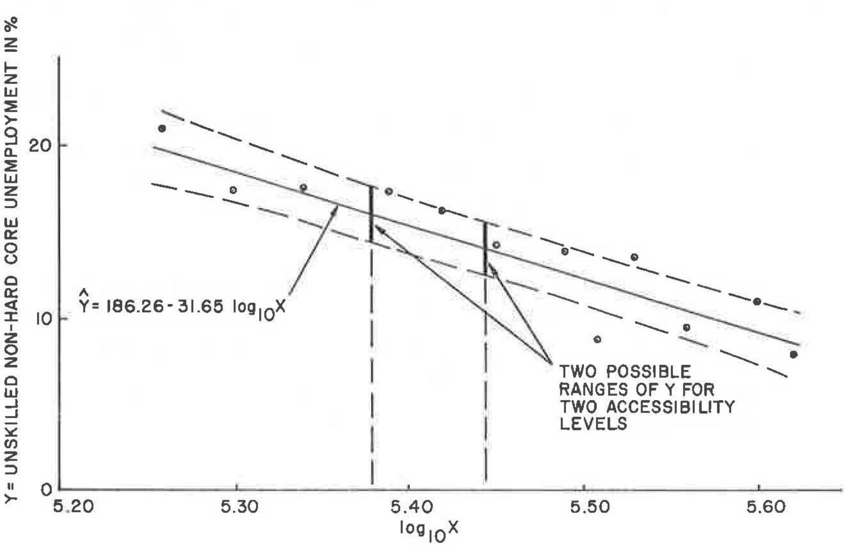


Figure 7. The employment-accessibility model.



variable may be used as a means of reducing the unemployment of low-skilled workers, this finding should not be interpreted as a contradiction of previous findings (8, 9). Instead, these results may be used to shed light into one possible cause that made these projects "fail"; i.e., the amount of improvements provided by the Long Island and Watts demonstration projects were probably not sufficient to raise the accessibility of these areas to a level sufficient to detect an improvement. [This concept is extensively discussed in another paper in this Record (21)]. This is attributable to the overlapping confidence bounds at any two accessibilities, as shown in Figure 7.

THE UTILITY OF THE MODEL

The results of the employment-accessibility analysis may be summarized as follows:

1. The employment-accessibility hypothesis was found valid for the CBMC area.
2. The model is intended for use in short-range planning projects.
3. Up to 11.1 percent (10.6-8.5 percent, from Fig. 7) of the non-hard-core unskilled unemployment in the CBMC area is attributable to lack of adequate transportation to job sites.
4. The unemployment reduction that can be expected in an area depends on the increase in accessibility programmed for the area and the level of existing transportation service found in the area.
5. Since the model parameters were found through calibration, the model is, of necessity, site-specific and cannot be used in other areas in its present structure. The model should undergo calibration if intended for use in other areas, to reflect the prevailing conditions.
6. The model's most desirable feature is that it permits more comprehensive cost-benefit analyses of improvements of transportation to job sites. This occurs because the model estimates the social benefits accruing as a result of increased employment. These benefits consist primarily of reducing the costs society must bear to subsidize the income of the unemployed.

APPLICABILITY OF THE MODEL IN OTHER AREAS

Although the accessibility-employment model in its present form is limited in use for the CBMC area, its conceptual development and structure should not vary from area to area. Thus the same approach can be replicated in another city. The components of the model are (a) transit travel times, (b) employment concentrations, (c) unemployment rates, and (d) travel time factors.

The first two are relatively easy to obtain at minimum cost. Transit travel times can be calculated from a knowledge of transit routes, service headways, and roadway speeds. Employment concentrations can be estimated from federal and state Bureaus of Labor Statistics data or regional employment data banks kept by a planning agency or commercial associations.

A comprehensive survey of unemployment conditions in the area should be undertaken. Distinction should be made between hard-core and non-hard-core unemployed. The historical frequency of unemployment and its duration should prove to be helpful in this regard. A home-interview survey would be helpful in this task as well as in the analysis of the work-trip distribution for unskilled workers. This latter information is required for the travel time factors (F_{ij}) needed for the calculation of accessibility indexes. This is all that is required for calibrating the model. The process of implementation, however, requires more specific data on the number of job openings in an employment area. This information may be obtained through state and city employment offices and/or by actual employer interviews. Either of these two tasks is time-consuming and requires skilled personnel to perform.

Benson and Mahoney (16) in a recent paper discussed extensively the data requirements (and their sources) for transportation planning for the poor.

CONCLUSIONS

1. This paper has developed a mathematical model for quantifying the relationship between transportation availability and its resultant effect on the employment of low-income workers. Its contribution to the efforts to alleviate the problems of poverty lies primarily in the ability of the model to translate transportation improvements into a meaningful objective measure (the number of persons put to work). The outcome of a proposed transportation improvement may be estimated without the need for a costly demonstration project. In addition, various alternative plans may be evaluated prior to implementation. This will provide the planner with a necessary tool with which to design a transit system or improvement of maximum cost-effectiveness.

2. Throughout the foregoing analyses and discussions it was implicitly assumed that the total job vacancies in New York City at least equal the number of unemployed. According to a recently completed study (17), it appears that such an assumption is valid. If this were not the case, the potential benefits of transportation improvements would not be fully realized.

3. As shown in Figure 7, the minimum unemployment rate that could be achieved in a zone of poorest accessibility would not go below 8.5 percent. For the CBMC area it was found that the marginal reduction in unemployment decreases at a slower rate for zones of higher accessibility, and when the accessibility index of 420,000 is exceeded the marginal reduction approaches zero. Thus it appears that the elasticity of the model is highest when the initial accessibility conditions are poorest and it becomes inelastic as the accessibility of a zone approaches 420,000 units. The implication of this observation is the apparent conclusion that lack of adequate transportation in the CBMC area can explain up to approximately 56 percent (11.1 ÷ 19.6) of the total unskilled non-hard-core unemployment (Fig. 7).

4. The model is restricted in its application to zones whose accessibility indexes fall in the range of calibration. This restriction, however, does not appear to be a serious one for the CBMC area, since a transportation improvement in a zone of low accessibility is not likely to increase the accessibility of that zone beyond the upper range of calibration. Furthermore, any improvements made in zones of high accessibility can be assumed to produce insignificant unemployment reduction, since the model is highly inelastic at the upper range of calibration.

5. The recent concern for who benefits from transportation improvements rather than the traditional concern of what is the benefit stems from the need of viewing transportation facilities not only as engineering systems but as components of the urban system (18). This concept requires, however, the ability to relate the transportation attributes to the goals of a community. It has not been easy, for example, to specify the transportation requirements in the achievement of goals such as an attractive environment, lower crime, improved public health, and low unemployment.

This paper has demonstrated, however, that it is possible to convert the goal of low unemployment into transportation system requirements—but, unfortunately, not with the elasticities and/or detectability desired by planners.

ACKNOWLEDGMENT

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TRANSIT PLANNING FOR THE TRANSPORTATION-DISADVANTAGED IN A SMALL TOWN

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High auto ownership rates and low population densities have resulted in large-scale elimination of public transit systems in small towns. This trend exacerbates the mobility problem of the transportation-disadvantaged: the poor, the elderly, the handicapped, and the young. Lumberton, North Carolina, is typical of the transportation situation of towns with a population of less than 25,000. Located along an important Interstate highway, the town has attracted industries that offer jobs within a few miles of the town. Yet, unemployment rates are high among the carless, predominantly Black population of Lumberton. A group of concerned citizens from the transportation-disadvantaged community tried to organize a bus company. The company went bankrupt within 2 months. The Transportation Institute of North Carolina Agricultural and Technical State University performed an economic autopsy and drew up a proposal for an innovative transit program designed to minimize cost and give service specifically to the transportation-disadvantaged. The success of the program depends on the willingness of the City Council to underwrite approximately $30,000 of operating deficit yearly. The authors suggest that in the case of a low-wage area such as Lumberton the major costs are those of overhead, namely management, and the necessary backup system of extra buses and a maintenance crew. The authors propose that towns such as Lumberton join into a transit consortium with nearby communities and make a joint application for funding from the capital grants program of the Urban Mass Transportation Administration.

•THE design of a conventional public transportation system for any small town in the United States is extremely difficult because of twin constraints: a high automobile ownership rate and lack of population density needed to support a conventional bus line. High population density is necessary for conventional transit operations because for most people most trips are more conveniently made by automobile. Even in larger cities, use of transit outside of the downtown core area rarely exceeds 3 to 4 percent of total trips.

The mitigating factor in larger metropolitan areas is, of course, sufficient size to support a minimum conventional bus transit system despite the transit system's low level of trip attraction. Further, even in the largest and densest cities, which have somewhat higher per capita rates of transit use, most transit systems are, at best, marginal operations requiring both capital and operating subsidies.

Recent transit passenger ridership trends show sharp drops in small towns, and there is a concomitant widespread bankruptcy of bus companies serving towns of 50,000 population or less. The U.S. Department of Transportation has documented the elimination of many transit operations and the precarious financial condition of the remaining ones. During the period 1959 to 1970, of the 235 private companies that have gone bankrupt, 89 (38 percent of the total) have been taken over in the public sector, and the remaining 146 have completely gone out of existence (1). These are mainly in smaller cities and towns.

Given the evidence of declining ridership and increased car ownership, one still can make a strong case for a continuing need for public transit in small towns. In all areas, particularly in poorer, rural towns, a significant number of people either do not have access to a car or are incapacitated to an extent that they cannot use a car. The "captive ridership" in urban transit systems—the carless, the elderly, the poor, the handicapped, and the young—is left to arrange informal car-pooling in the smaller, outlying districts (2, 3).

Where jobs are available within commuting distance of a small town but without a transit link between the transportation-disadvantaged and those jobs, the labor force tends to migrate to distant cities rather than remaining in the small town. Programs for retaining the population in rural areas may be frustrated by the high costs of transporting the labor force to remunerative employment.

Given the selective need for public transit, one must ask whether there is any economically sound arrangement that can provide this service in a low-trip-density area where demand for non-automotive transportation is scattered. Funding sources are few and far between. Fare-box receipts cover only a fraction of the total costs of operations. Large public subsidy is unlikely since town budgets are already strained, and city councilmen are generally unwilling to vote funds for a transit operation that serves only one segment of the community, namely the poor and carless. Moreover, in towns where traffic congestion has not yet reached crisis proportions, public transit is low on the list of priorities.

It is for these reasons that the capital grants applications submitted to the Urban Mass Transportation Administration have only very seldom come from towns with populations under 50,000. (Approximately 95 percent of the capital grants awarded by UMTA since the program's inception in 1965 have gone to cities with populations greater than 50,000.) Since nothing in the guidelines precludes smaller towns from applying, one must conclude that (a) smaller towns and cities are only just beginning to recognize the need for continuing public transit, (b) the one-third requirement of local matching funds eliminates many small towns from the competition, or (c) lack of widespread information about the program, coupled with the need for comprehensive and continuing long-term planning, discourages applications.

What happens in the case where local residents of a small town do recognize the need for selective public transit service? Can an economically defensible plan be developed? How much public underwriting of expected continuing deficits is necessary to sustain the system? Are there ways of spreading the overhead costs?

These are precisely the questions posed by a group of concerned citizens in Lumberton, North Carolina, a town of 17,000 devoid of public transit since the demise of a local bus operation that started operation on January 9, 1971, and ceased all service 8 weeks later. This case study illustrates the need for innovative solutions based on close study of local conditions and sound short- and long-range planning.

LUMBERTON, NORTH CAROLINA

Lumberton is the county seat and principal city in Robeson County, one of the largest counties in North Carolina. The city's population of 15,305 in 1960 increased 10.8 percent by 1970, resulting in a population of 16,961.

Located along the major north-south Interstate highway, I-95, Lumberton has managed to attract quite a number of manufacturing firms in recent years. These firms tend to locate a few miles outside the Lumberton city limits. Since the unemployment rates in the rural counties of eastern North Carolina can run as high as 11 percent, these companies have little difficulty in pulling a sizable work force from the surrounding rural areas.

Despite the advent of these important job sources, unemployment in downtown Lumberton still remains high—critically high for many in the Black labor force.

Table 1 indicates that, although the population of Lumberton increased between 1960 and 1970, there was a small decrease of 227 in the number of Blacks who lived within the city limits.

Table 1. Lumberton population data.

		Black		White		Indian	
Year	Total	Number	Percent	Number	Percent	Number	Percent
1960	15,305	4,128	27	10,835	71	342	2
1970	16,961	3,901	23	11,533	68	1,526	9

Table 2. Employment, unemployment, and labor force participation by ethnic group.

Ethnic Group	Labor Force[a]	Number Employed[b]	Number Unemployed[c]
Black	1,919	1,535	384
Indian	545	491	54
White	5,428	4,994	434
Total	7,892	7,020	872

[a] 14 years of age and older, based on estimates of overall unemployment rate of 11 percent (North Carolina Employment Security Commission).

[b] Based on data from Lumberton Origin/Destination Traffic Survey, 1965.

[c] Assuming 20 percent unemployment rate among Blacks and 8 percent unemployment rate among Whites and Indians.

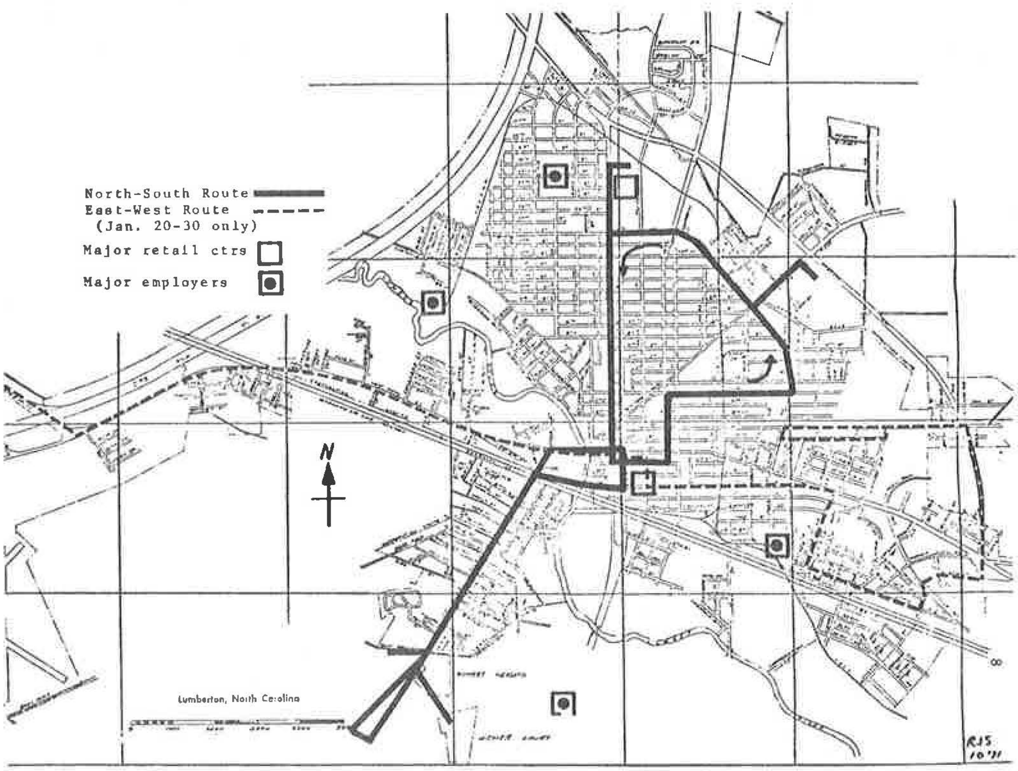
Table 3. Number of autos in predominantly Black neighborhoods.

Traffic Zone[a]	Cars	Workers
40	96	147
41	308	497
42	348	464
26	129	244
50	188	183
Total	1,069	1,535

Source: Planning Department, North Carolina State Highway Commission, Lumberton Origin/Destination Traffic Survey, 1966.

[a] These are the zones shown in Figure 2 that contain a predominantly Black population.

Figure 1. Routes operated by Lumberton Transit Authority, Inc., January 9 to March 5, 1971.



The school population of the City of Lumberton was as follows:

Year	Total	Black	Percent Black
1960	4,768	1,095	23
1970	5,500	1,456	26

Table 2 was constructed from various data sources to present an overview of the employment situation in Lumberton. A disproportionately small share of manufacturing employment on the periphery of Lumberton is Black. Whereas Blacks constitute 25 percent of the Lumberton population, they are between 10 and 20 percent of the work forces in the two major firms surveyed. Much of the industrial labor force comes from rural areas in the vicinity of Lumberton, particularly White and Indian labor forces.

The data in Table 3 indicate that in the predominantly Black neighborhoods there was approximately 0.70 auto per worker. This means that 466 persons, or 30 percent of Blacks in the labor force, do not go to work in an automobile that they own. This is based on the assumption that, if there is an auto in a family, then it is used to commute to work by the person or one of the persons who is employed in that family.

These autoless workers currently either are getting to work by some other mode or are in car pools. Based on a visual survey, it was determined that there is an extensive amount of car-pooling taking place in Lumberton.

The Failure of Privately Organized Public Transit in Lumberton

Between January 9, 1971, and March 5, 1971, a private, church-sponsored group incorportated as the Lumberton Transit Authority (LTA) ran a conventional public transit service almost wholly within the city limits of Lumberton. This service was instituted without a preliminary feasibility study. There was a long-felt need, primarily within the Black community, for non-automobile transportation in the town. Because of excessive operating costs, the private company went bankrupt within 2 months, even before maximum ridership could be developed.

Transit service consisted of three to four routes radiating from the town center, as shown in Figure 1. Two buses initially were assigned to the North and South routes (often operated as one contiguous route without transfers). A third bus began operating on the East-West route on January 20 but was terminated on January 30 when one of the regular buses broke down. Fares were 25 cents per ride.

By the end of the first week of operation, almost 300 trips per day were being made on LTA buses. As shown in Table 4, traffic tended to fall Wednesdays and Thursdays, down to 150 to 200 trips per day. Traffic rose toward the end of each week, with Friday and Saturday showing the highest patronage. The peak use occurred at the end of the third full week of operation, a Saturday, when over 350 trips were made. The following week one of the North-South route buses broke down and had to be withdrawn from service; the East-West bus replaced it, with service on the East-West route suspended.

Although the East-West line rarely carried more than a small percentage of the daily total, overall LTA patronage dropped significantly when service was curtailed. This drop is more likely ascribed to the unreliable service caused by the malfunctioning bus on the heavier North-South routes rather than the lack of coverage due to the elimination of the East-West route. Also, the drastic fluctuations of traffic shown on the East-West route probably occurred because its bus was occasionally assigned to one of the North or South routes as a substitute vehicle.

Buses on the North route and the eastern part of the East-West route had difficulty meeting the intended schedules and took more than the originally scheduled times to make their runs.

During the sixth and seventh weeks maintenance difficulties reduced the operations to one vehicle, with service discontinued after 6:00 p.m. Two buses, on the short operating day, were reinstated during the last week and a half of operation, with significant rises in patronage to the former levels.

Table 4. Number of passengers carried per day, Lumberton Transit Authority, Inc., January 9 to March 5, 1971.

Week	Day	Date	Combined Routes	South Route	North Route	East-West Route	Total Passengers	Number of Buses
	Sat.	1-9	163				163	1
I	Mon.	1-11	127				127	1
	Tue.	12	141				141	1
	Wed.	13	107				107	1
	Thur.	14	116				116	1
	Fri.	15	130				130	1
	Sat.	16	298				298	1
II	Mon.	1-18		77	63		140	2
	Tue.	19		74	92		166	2
	Wed.	20		104	114	29	247	3
	Thur.	21		80	91	52	223	3
	Fri.	22		386	282	34	702[a]	3
	Sat.		no data					
III	Mon.	1-25		164	66	10	240	3
	Tue.	26		101	88	56	245	3
	Wed.	27		108	66	11	185	3
	Thur.	28		116	113	12	241	3
	Fri.	29		138	92[b]	90[b]	320	3
	Sat.	30		203	136	13	352	3
IV	Mon.	2-1		90	89		179	2
	Tue.	2		146	103		249	2
	Wed.	3		177	108		285	2
	Thur.	4		121	106		227	2
	Fri.	5		155	110		265	2
	Sat.	6	no data					
V	Mon.	2-8		202	29		231	2
	Tue.	9		147	140		287	2
	Wed.	10		121	102		223	2
	Thur.	11		140	94		234	2
	Fri.	12		228	96		324	2
	Sat.	13		254	30		284	2
VI	Mon.	2-15[c]		224	3		227	2
	Tue.	16		202			202	1
	Wed.	17		206			206	1
	Thur.	18		161			161	1
	Fri.	19		171			171	1
	Sat.	20		216			216	1
VII	Mon.	2-22		168			168	1
	Tue.	23		141			141	1
	Wed.	24		131	22		153	2
	Thur.	25		130	53		183	2
	Fri.	26		111	150		261	2
	Sat.	27		189	151		340	2
VIII	Mon.	3-1		100	109		209	2
	Tue.	2		59	169		223	2
	Wed.	3		55	158		213	2
	Thur.	4		154	94		248	2
	Fri.	5		156	167		323	2

Source: Derived from cash receipts per bus of the Lumberton Transit Authority, Inc.

[a]Suspect this is two days' receipts: 702/2 = 351.

[b]The east-west bus was probably substituted for the north-south bus part of this day.

[c]Service cut back to 6 p.m.

Table 5. Estimate of capital requirements.

Buses (4 at $15,000)		$60,000
Fare registers (4 at $400)		1,600
Tires		2,400
Office furniture and fixtures		1,000
Working capital:		
Insurance deposit premium	$1,000	
Rent, deposit and advance	500	
Utility deposits	100	
Cash balance	3,800	5,400
Total		$70,400

Service was terminated on Saturday, March 5, 1971. (That day, interestingly, had one of the highest levels of patronage, despite service cutbacks, of the entire operating period.) The Lumberton Transit Authority, Inc., had been plagued by relatively high costs, unreliable vehicles, and service undercapitalization throughout its history. Lack of ability to meet its operating expenses forced the company to suspend operations.

A study of the patronage of the now-defunct Lumberton Transit Authority reveals that there is definitely a demand for an alternative transportation service other than the private automobile, principally on the North-South axis in Lumberton.

Judging from the gyration of patronage between routes on certain days and discussions with some of the principals in the LTA, operations were plagued by bus breakdowns and other service reliability problems. The company purchased old vehicles and did not have a large enough number to provide needed back-up services. Regular and reliable service can sustain a higher patronage than unreliable operations, and most probably for the latter reason the LTA did not reach its highest demand levels.

Since the principal route (North-South) served primarily the business and retail districts (both downtown and the shopping centers), it must be assumed that most of its patronage was made up of shoppers and some employees in the retail establishments. The bus routes did not provide access to most of the major employers in the Lumberton area (Fig. 1), although the North loop did terminate at the shopping centers at North Elm (the principal regional shopping center) and only 2 short blocks from the Southeastern General Hospital. The short-lived East-West route had one pair of runs per day serving the B.F. Goodrich plant and on its eastern segment passed within 3 blocks of Jones Knitting. Other than that, the routes were primarily oriented toward the downtown, the county seat, and a major retail district.

The financial difficulties that caused ultimate termination of all service indicate that conventional operations (buses running on fixed routes and fixed schedules despite variations in demand) could only be applied to Lumberton in special circumstances.

The Lumberton Transit Authority operation can be usefully considered as a valuable experiment in determining which types of transit would be best for Lumberton and can also be used to aid in determining patronage and operating structure of proposed systems.

The LTA system's biggest pitfall was in trying to operate a fixed-route system in a low-density area with obsolete buses, lack of sufficient cash flow, and top-heavy administrative structure. For the first 4 weeks of operation, its gross passenger revenue was $1,494.18, while its total expenses, including start-up costs, were $16,705. Of total expenses, approximately 25 percent could be considered recurring operating expenses, exclusive of insurance and depreciation. About $4,000 was spent for the used buses, and insurance came to some $4,000 per year. While a larger capital investment would have kept the company solvent, about $4,500 per month in revenue would have been needed to cover operating costs alone, including insurance but exclusive of vehicle depreciation or interest on outstanding debt. It is doubtful that the type of system being run, particularly with the aged and expensive vehicles utilized, could ever have generated enough income to cover operating costs.

LTA, during its 8 weeks of operation, accumulated more than 1,300 bus-hours of service. Not including their non-operating overhead, at $4,500 per month, LTA's per-hour bus operating costs were close to $7.00.

In Fayetteville, the nearest city with a transit system, the transit operators figure that it costs $5.00 an hour to cover operating costs. They operate 25 General Motors TDH-3162's, a 31-passenger bus dating from the early 1960's. Total revenue to cover all overhead and depreciation, as well as a fair profit, would come to about $7.50 per hour; however, their revenue is insufficient to reach that level and they estimate a loss of $4,000 per year on the regular transit service. Profits come from contract operations for the U.S. Army in Fort Bragg and for several small towns nearby. For contracts they charge $8.00 per hour or 50 cents per mile.

At LTA's high overhead rate it would have been cheaper to contract with Fayetteville for service. For $1.00 more per hour, LTA would have been buying a higher level of reliability and skilled management. Fayetteville is a 30-minute drive north of Lumberton along the Interstate. The Fayetteville bus company has invested extensive capital in buying spare parts and maintains a trained mechanic on duty whenever buses are in operation. Such a large investment in overhead could economically be spread over several smaller bus operations in adjacent towns. The private operator has extended his service to one other town, Goldsboro, but as yet has not developed any proposal for serving Lumberton.

Minimizing the Public Cost of Transit to Low-Income Neighborhoods: Innovations in Public Transit for Lumberton

The Transportation Institute of North Carolina Agricultural and Technical State University was invited by local sources to study the problems of transit planning in Lumberton and devise an innovative solution that would have only limited requirements for public support. The study group consisted of an interdisciplinary team of faculty and selected external consultants. This team included a management specialist, an economist, and two urban transit specialists.

The "Lumberton Transit Feasibility Study" (4) suggested a system consisting of a 2-bus operation over substantially what was formerly called the North-South route, offering 30-minute headways from 7:00 a.m. until 9:00 p.m. Monday through Thursday and continuing until 10:00 p.m. on Friday and Saturday. The fare would be 25 cents on this route. The operating costs of the proposed service were based on a 60-minute round-trip running time and a 10-mile round-trip route. In addition, a one-bus dial-a-ride operation was proposed that would operate over what was formerly called the East-West route offering a 120-minute headway from 7:30 a.m. to 3:30 p.m. and from 4:30 p.m. until 8:30 p.m. Monday through Thursday and extending until 10:30 p.m. Friday and Saturday. This would not be a conventional fixed-route operation because there would not be a sufficient volume of demand to justify a conventional system along this route.

The dial-a-bus route would allow the bus to deviate from its route at the request of the passengers to allow for doorstep service. Any customer living within ¼ mile of this route could request doorstep service by telephoning the dispatcher from his home or by giving the driver his request as he boards the bus. Before starting each run, the driver would be given the phoned requests. These requests must be phoned in before the driver starts his run unless a 2-way radio system is utilized. The high quality and convenience of the service being offered on this route dictated the 50-cent fare that was recommended.

The vehicle used for this route would run a premium-special home-to-work service between 6:30 and 7:30 a.m. and 3:30 and 4:30 p.m. (Premium-special is the name given to a home-to-work subscription service that operated under a federal demonstration grant program in Peoria, Illinois.) This would be subscription service for workers at the major employers in Lumberton. The routing for this service would be determined by the subscribers' locations, although initially service would be offered only to residents of a small area in a specific part of the city. This so-called premium-special service could as it catches on be expanded through use of the fourth vehicle. Persons wanting to use this service would sign up in advance for 1 month's or 1 week's service for a prepaid 50 cents per ride.

The projected cost and expected revenue of this recommended system are as follows:

System: Three 18- to 23-passenger air-conditioned buses and one spare

Routes, schedules: North-South route to be conventional fixed route service with 30-minute headways; East-West route to be dial-a-ride service with 120-minute headways

Estimated yearly operating costs:

Drivers' wages (12,954 hours at $2.07)[a]	$26,814
Fuel and maintenance (129,540 miles at 5.88 cents)	7,617
Dispatchers (4,080 hours at $2.07)[a]	8,446

[a] Basic rate of $1.80 per hour plus 15 percent for vacations, sick leave, FICA, unemployment insurance, etc.

Utility man (part-time)	1,300	
Tire replacements	4,500	
Utilities	1,300	
Subtotal		$49,977
Operating rents		1,200
Insurance and safety		4,500
Traffic and advertising		500
Manager ($12,000 + 15 percent fringe benefits)	13,800	
Accounting and legal fees	500	
Office forms and supplies	100	
Subtotal		$14,400
Total operating expenses		$70,577
Passenger revenues		$45,900
Net operating surplus (or deficit)		(24,677)

The total yearly operations and maintenance costs of $49,977 are for a projected 12,954 bus hours of service. The resulting $3.86 per hour operating costs are extremely low compared to most transit operations. This is primarily due to the relatively low wages being paid the driver. Adding the administrative expenses to the operations and maintenance costs drives the costs up to $70,577 ÷ 12,954 = $5.45 per hour.

Passenger revenues are estimated at $45,900 for the first year's operation. To allow the new bus service to break even in its second or subsequent years of operation (not including its capital recovery costs) would require an additional $24,677 in passenger revenue, which means a 54 percent growth in ridership. This growth is feasible, but only starting the system into operation will determine whether it will be realized.

Capital Recovery Cost

Table 5 lists the estimated capital requirements for setting up such a service. The capital recovery costs are not generally considered as part of the operator's expenses by transit operators. They are presented here so that the true cost of providing the services can be computed. Capital recovery costs of the 18- to 23-passenger buses and fare boxes are based on a 6-year period at 8 percent interest:

(4 buses at $15,000) + (3 fare registers at $400)
($60,000 × 0.21632) + ($1,200 × 0.21632)
($12,979) + ($260) = $13,239

Thus, the yearly deficit will be $24,677 + $13,239 = $37,916 if capital recovery costs are included.

Conventional Fixed-Route System

For purposes of comparison, an analysis of the expected equipment costs, operating costs, and revenues from operating a conventional fixed route system like the one attempted by LTA was prepared:

System: Three operating 18- to 23-passenger air-conditioned buses and one spare.

Routes, schedules: North-South route and East-West route to be conventional fixed-route service with 30-minute headways on the North-South route and 90-minute headways on the East-West route because of time saved by elimination of the dial-a-bus feature.

Estimated yearly operating costs: The costs of operating this system would be virtually identical to the cost of the system that includes the dial-a-bus feature on the East-West route except for the elimination of the necessity of having a dispatcher available at all hours of operation. If a part-time dispatcher is hired it would result in a savings of approximately $4,000. Thus, the total operating expense for this system would be $70,577 - $4,000 = $66,577.

Figure 2. Lumberton traffic analysis zones (Source: North Carolina State Highway Commission).

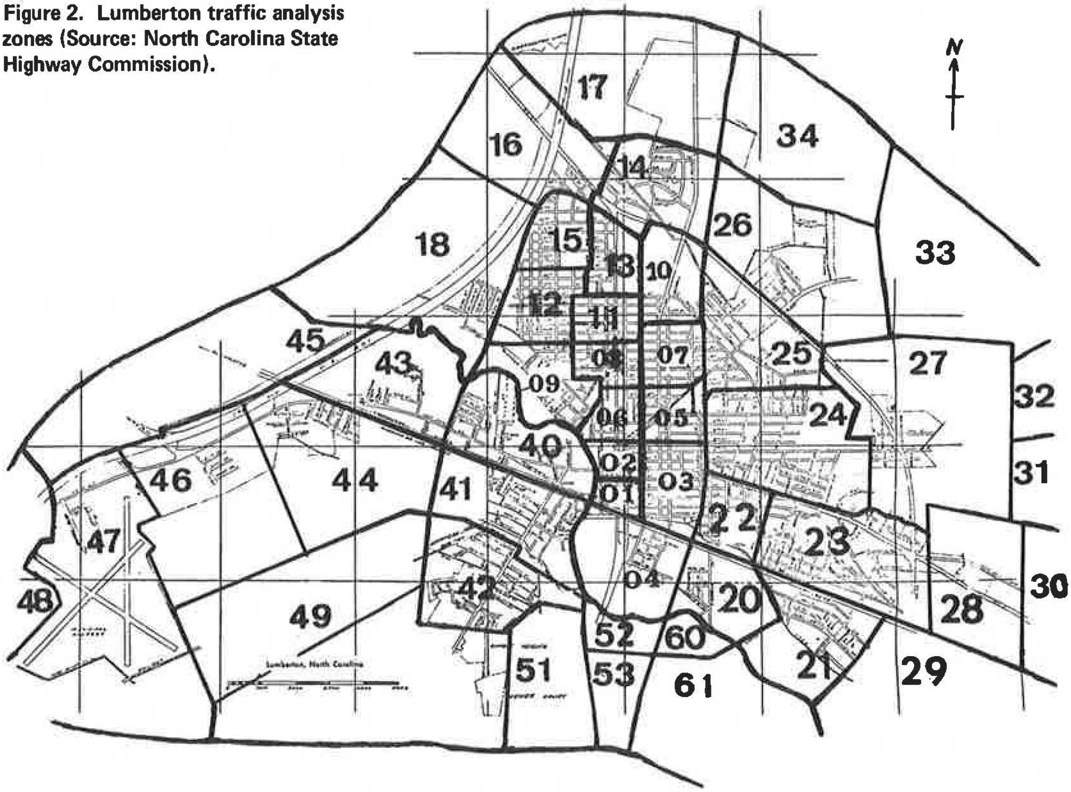
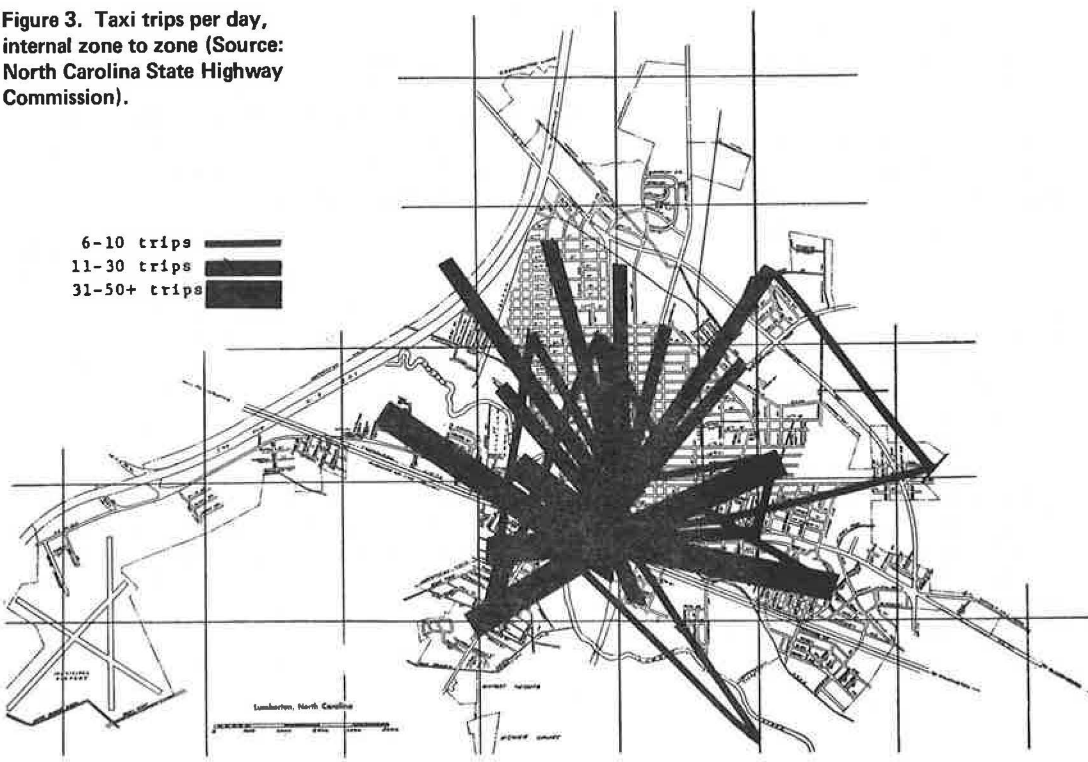


Figure 3. Taxi trips per day, internal zone to zone (Source: North Carolina State Highway Commission).



Passenger fares for the East-West system would increase 25 percent because of the better headways, but the fares would be reduced 50 percent from 50 to 25 cents. Thus, as detailed in the section on passenger revenue, estimated revenue for this route would decrease from $47,900 to $40,162.

Therefore, the net operating deficit for a conventional fixed-route system would be $40,162 - $66,577 = $26,415. This deficit is $1,738 larger than the one predicted for the recommended system.

DEMAND FOR PUBLIC TRANSPORTATION IN LUMBERTON

Public transportation is usually used by persons who have either no automobile or no access to one. In some congested areas, auto owners and users have been diverted to mass transit, usually transit that runs on exclusive rights-of-way to bypass the congestion. However, this is an unlikely candidate for Lumberton since there is both ample parking and street space in the more congested sections of the city.

Normally, some 40 percent of public transit trips are made during the two peak travel periods of the day—to and from work. The remainder of transit trips, for work, recreation, or personal business purposes, are spread over the remainder of the day, with very few trips being made at night and on Sundays. This characteristic of transit is termed the "peaking phenomenon"; it makes such services extremely difficult to operate economically. Because of severe peaks in demand, most of an operation's capital and labor are only used a few short hours per day. Few transit lines lose money in the rush hours; it is the rest of the day that drains an operation of any profit. Where density is sufficient, transit service is quite economical in the peak hours.

It is unlikely that Lumberton is any different in characteristics of total travel than the average small city; most firms start work at the same time in the morning and end their shifts at the same time in the afternoon. Traffic congestion does not appear high enough to encourage employers to stagger their working hours, although a small amount of staggering would probably eliminate whatever auto congestion there is near the major factories. If a conventional mass transit bus system were planned for Lumberton, with the usual grid system of routes, it is certain that the system would be inordinately expensive to run and would generate little more revenue than that produced by the four-route system tried by the LTA in 1971.

For a small town like Lumberton there is no magic formula to aid in determining the potential demand for a transit service in advance of operating the service. The prior existence of a service, which Lumberton fortunately can benefit from, is one of the best indexes of success or failure of proposed services. Furthermore, there is some reason to suspect that the riders generated by the LTA did not fall into the normal journey-to-work category of public transit in small cities, with the consequent uneconomic patterns of highly peaked use.

One reason for this suspicion is the very low use of the East-West route, which did serve potential work sites. (Note that the North-South route generated almost its full potential by the end of the first week.) And, as indicated previously, traffic rose on typical shopping days and fell during midweek. Some patronage of the bus routes must have been work trips, but such trips were likely a smaller percentage of the total than normally found. Work trips made on LTA's buses could only have been oriented toward downtown, the hospital, and the shopping centers.

The level of automobile ownership and use and data on non-auto trips such as car-pooling and taxi use are other indications of potential transit use. It is generally recognized that car-pooling is very high among low-wage employees in Lumberton, although no hard data have been developed in this respect. Taxi use, fortunately, was surveyed in 1965 as part of the North Carolina State Highway Department's Origin/Destination Traffic Survey (2). The zones for the traffic survey are shown in Figure 2, and the taxi "desire lines" or number of taxi trips each day between zones are shown in Figure 3, which was developed from the highway department's data.

Not surprisingly, the downtown area is shown as either the origin or destination of most of the taxi trips in Lumberton. The heaviest use is approximately along the routes

Table 6. Population and automobile ownership by zone.

Zone	Persons 5 Years Or Over	Automobiles	No. of Automobiles per Household	No. Employed per Household	No. Employed per Auto	No. Persons Over 5 per Auto
01	12	6	1.00	1.00	1.00	2.0
03	322	120	1.00	1.27	1.27	2.7
04	266	82	0.86	1.06	1.23	3.2
05	367	148	1.09	0.86	0.78	2.5
06	367	228	1.50	1.21	0.80	1.2
07	464	203	1.23	1.07	0.88	2.2
08	451	237	1.52	0.81	0.53	1.9
09	449	256	1.41	1.20	0.85	1.8
10	160	70	1.37	1.75	1.27	2.3
11	430	228	1.35	1.19	0.82	1.9
12	602	350	1.72	1.34	0.78	1.7
13	95	51	1.34	1.00	0.75	1.9
14	155	81	1.50	1.63	1.09	1.9
15	417	216	1.88	1.43	0.76	1.9
16	73	37	1.68	0.68	0.40	1.9
17	20	4	1.00	1.00	1.00	5.0
18	421	145	1.16	1.21	1.04	2.9
20	84	12	0.67	1.00	1.50	7.0
21	384	117	0.90	1.20	1.33	3.4
22	947	256	0.86	1.09	1.27	3.7
23	1,625	466	0.92	0.96	1.04	3.5
24	1,954	752	1.24	1.37	1.11	2.6
25	689	214	1.09	1.52	1.39	3.2
26	658	129	0.82	1.17	1.42	5.1
27	371	156	1.33	1.44	1.08	2.4
28	315	89	1.07	1.25	1.34	3.5
29	133	51	1.34	1.50	1.12	2.6
30	172	77	1.51	1.74	1.16	2.4
31	78	12	1.00	2.50	2.50	6.5
32	76	19	1.00	1.00	1.00	4.0
33	296	65	1.00	1.78	1.78	4.5
34	16	8	1.00	1.00	1.00	2.0
40	339	96	1.00	1.53	1.53	3.5
41	980	308	0.85	1.37	1.61	3.1
42	1,262	348	0.92	1.22	1.33	3.6
43	228	36	0.55	1.36	2.50	6.3
44	554	174	1.27	1.77	1.40	3.2
46	297	89	1.00	1.34	1.34	3.3
47	169	54	1.17	1.00	0.85	3.1
49	104	13	0.50	0.65	1.30	8.0
50	717	188	1.00	1.30	1.30	3.8
51	57	17	1.70	1.70	1.00	3.3
52	175	40	1.14	1.29	1.13	4.3
53	118	38	1.15	1.73	1.30	3.1
61	123	43	1.16	1.00	0.86	2.9

Source: North Carolina Highway Commission 5 percent sample traffic survey.

that LTA buses used, although with far less daily patronage in the North-South axis than the buses generated. This is easily explained by the difference in the fare: $1 for the taxi versus 25 cents for the LTA bus. Along the East-West routes, on the other hand, taxi use surpassed the average LTA bus patronage for that route. The 2-hour headway on the East-West route could not have been sufficiently attractive to sustain the same level of patronage as the North-South routes, even though the population characteristics and level of auto ownership are about the same (auto ownership is a bit lower) for both areas of the city. (It should be noted that a 1-hour headway on the East-West route was originally planned by using the fourth bus, which was inoperative. Even a 1-hour headway would not be sufficient to attract patronage, and reliability of service would hardly have improved since there still would not have been a spare vehicle.)

Automobile ownership rates by zone and occupancy rates were obtained from origin-destination survey data and are given in Table 6. Figure 4 shows those zones with the highest and lowest number of persons (over 5 years old) per auto. Two out of 6 zones with 5 or more persons per auto are located on the LTA bus routes; the other 4 zones were too far on the edge of the city to be easily served by conventional bus transit. There was general correlation between the highest income areas and zones with low auto occupancy rates. For the rest of the city, only the pockets noted show a particularly severe deficiency in auto availability that might affect mobility. These pockets should be taken into account when planning any future public transportation services, recognizing that the degree of poverty in these areas that shows up in low automobile ownership also indicates a lessened demand for journey-to-work trips and probably a higher demand for social service mobility.

Another indicator of demand, location of major employment centers, clearly shows the difficulty of improving general mobility in Lumberton for the non-auto-owner by running a conventional transit system. Almost all of the major employers, except two factories and the retail centers, are located beyond the city limits, spread out primarily along Interstate 95 (south) and State Highway 72 and US-74. These are shown in Figure 5; firms employing more than 100 persons are listed in Table 7. Telephone interviews with several of the major firms revealed a willingness on their part to cooperate in improving transportation for their lower income employees, but it was pointed out that more than half of their employees do not live in Lumberton or nearby, and the region's fairly high unemployment rate has, of course, not constrained the availability of labor.

PASSENGER REVENUE ESTIMATES

As has been mentioned earlier, there is no magic formula for determining the potential demand in advance of operating the service. However, to make financial projections, it is necessary to have some estimates that will be used to determine the potential revenue that will be generated.

Projection A, given in Table 8, represents the estimate of the expected revenue passengers per month for the first year's operation of the recommended system. It was derived from a consideration of the items previously discussed, with an emphasis on the past experience of LTA and projections of the growth that could be expected with the higher quality of service that will be provided by the recommended system.

For comparison, a more conservative estimate of expected passengers is given in Table 9 for Projection B. However, Projection A is used in all financial projections and represents expectations for the first year's operations. It is expected that a successful first year of operation would lead to increased ridership in the second and subsequent years of operation, but no accurate estimates of this increase are practical. It is not expected, however, that this passenger increase would be sufficient to cover the operating costs of the system unless there is an unusually favorable community response to the system. This will be elaborated on in another section of this paper.

In another section of this report the cost of operating a conventional fixed route system is estimated. Table 10 gives a projection of the revenues that would be generated by this system.

Figure 4. Automobile availability, persons over 5 years old (Source: Table 3).

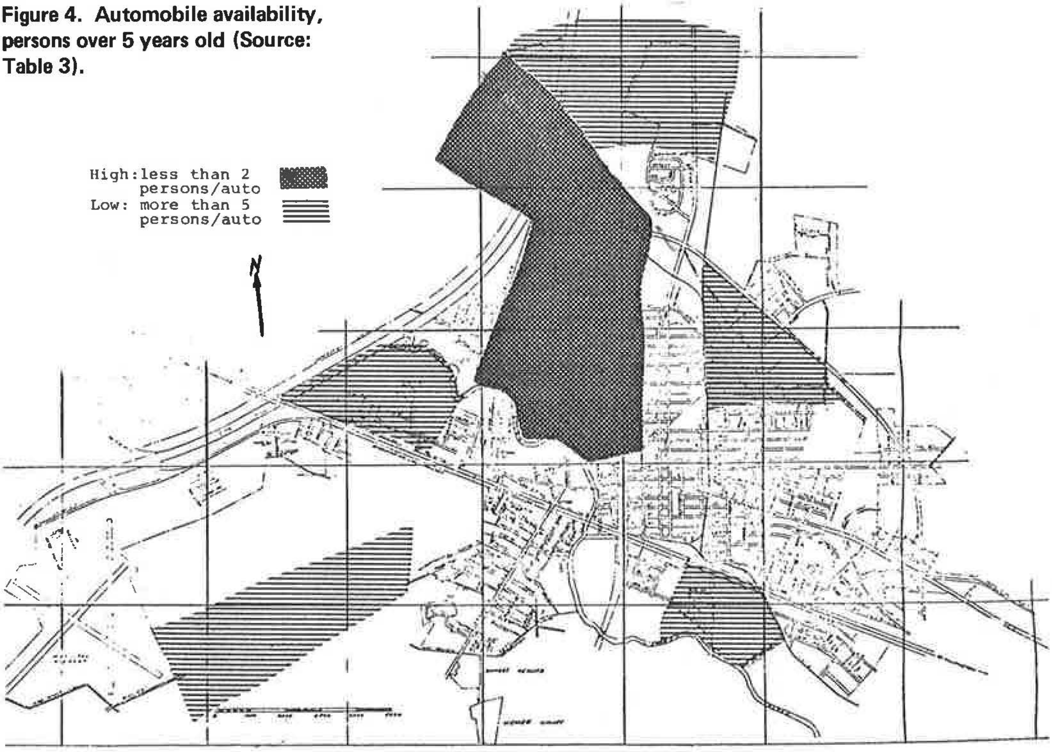


Figure 5. Industries with over 100 employees (see Table 7).

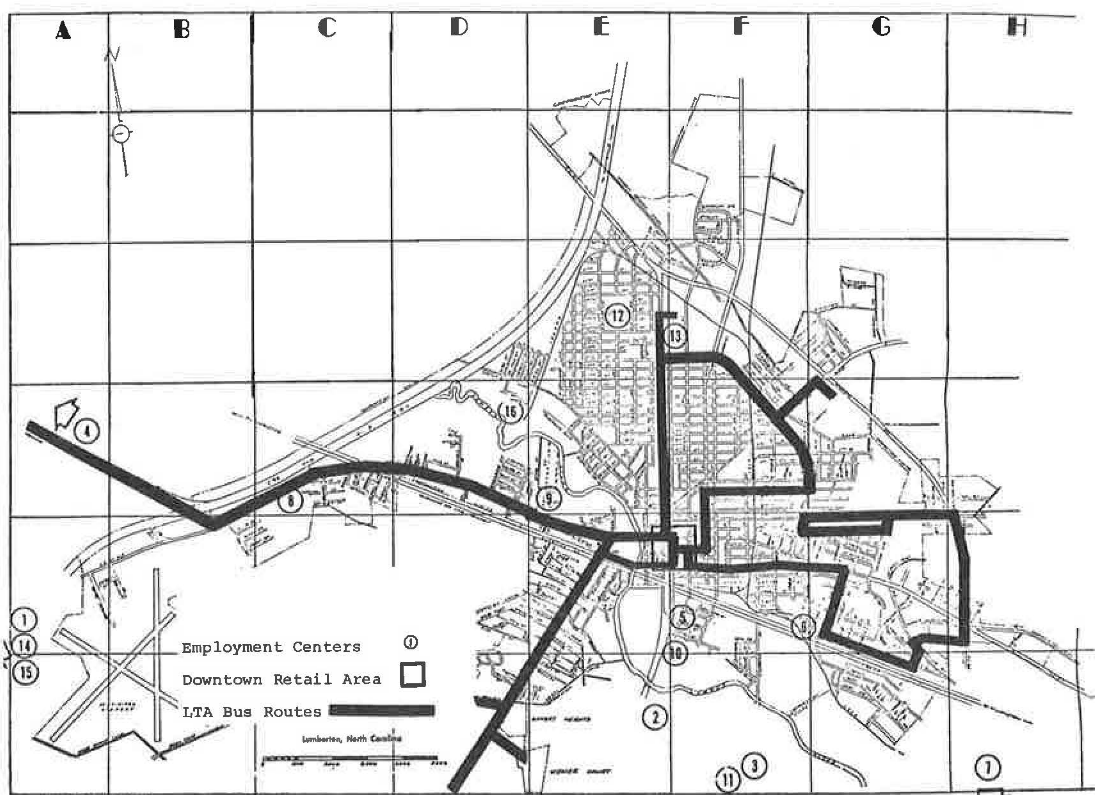


Table 7. Lumberton industries with employment of 100 or more.

Firm	Location	Product	Number of Employees
1. Acme Electric Corp.	I-95 South	Transformers	220
2. Alamac Knitting Mills	S. Chestnut Ext.	Knitting and dyeing	801
3. Cannon Foods, Inc.	S. Chippewa	Canning	100[a]
4. B. F. Goodrich Footwear	Highway 72	Tennis shoes	1,810
5. Henderson Manufacturing Co.	S. Walnut	Fatigues	160
6. Jones Knitting Corp.	Dresden Avenue	Knitted garments	365
7. Kendall Company	US-74 East	Infants' wear	140
8. Lumbee Corp.	2100 W. Fifth St.	Robes and dusters	176
9. Osterneck Industries	McQueen St.	Polyethylene bags	123
10. Pembroke Manufacturing Co.	S. Walnut	Ladies' sportswear	190
11. Pepsi-Cola Bottling	S. Chippewa	Beverages	125
12. Southeastern General Hospital	27th Street		
13. Shopping Centers			
Briggs Park	North Elm		
North Elm	North Elm		
14. TexFi	I-95 South	Textiles	785
15. Temptation	I-95 South	Stockings	235
16. Balcord	Velcord Drive	Textiles	250

[a]Seasonal.

Table 8. Revenue projection A for recommended system.

Route	Passengers[a]	Days[b]	Fare (cents)	Revenue (dollars)
North-South	400	306	25	30,600
East-West	100	306	50	15,300
Annual revenue				45,900

[a]Projected average weekday passengers.
[b]6 days per week x 51 weeks per year (holidays excluded) = 306 days of operation per year.

Table 9. Revenue projection B for recommended system.

Route	Passengers	Days	Fare (cents)	Revenue (dollars)
North-South	300	306	25	22,950
East-West	75	306	50	11,475
Annual revenue				34,425

Table 10. Revenue projection A for conventional system.

Route	Passengers	Days	Fare (cents)	Revenue (dollars)
North-South	400	306	25	30,600
East-West	125	306	25	9,563
Annual revenue				40,162

Fares

The recommended fare for the North-South route is 25 cents per ride, and the fare for the East-West dial-a-bus service is 50 cents. Higher fares should not be considered if the transportation system is to be regarded as a service as opposed to a profit-making venture. Fare increases would tend to drive passengers from the system to alternative modes. The overall effect of increased fares will be to slightly increase total revenue. For example, a 5-cent increase in the 25-cent fare (20 percent) would probably divert less than 20 percent of the passengers to alternative modes. Thus, the total revenue would be greater with a 30-cent fare than with a 25-cent fare. This higher fare is not recommended, however, because a high level of patronage should be one of the goals of the new transportation system.

SOURCES OF FINANCING

Depending on the type of ownership of the transit operation, there are a varied number of sources of financial support for mass transit. Privately owned transit systems will finance their capital improvements and operating costs primarily from fare-box revenues.

Lumberton may aid the private operator by obtaining a federal grant for up to two-thirds of the cost for capital improvements such as rolling stock and terminal facilities and then giving the equipment to the operator. Because capital grants are available only to legally authorized public bodies, private transit operators may participate in federally aided projects only through a public agency. The remainder of the money would be provided from local sources. These could include local businessmen or the City of Lumberton.

The Urban Mass Transportation Act of 1964 initiated a federal grant program that is administered through the Urban Mass Transportation Administration (UMTA) of the U.S. Department of Transportation. This program has provided grants of various types to aid cities in their public transportation problems. Projects eligible for capital grants include acquisition, construction, reconstruction, or improvement of facilities and equipment for use in mass transportation in urban areas. Repairs, maintenance, and other operating costs and ordinary governmental or non-project operating costs are not eligible as part of the grant.

A grant may be made for not more than two-thirds of that part of the cost of the project that UMTA determines cannot reasonably be financed from revenues, provided that all comprehensive and transportation planning has been completed. UMTA must be assured by the applicant that the local one-third share of net project cost is or will be available prior to the completion of the project.

Lumberton will require approximately $70,000 of capital to initiate operations. The minimum time necessary to process an application for a capital grant is from 3 to 6 months. It was therefore suggested that an application be made as soon as possible to cut down on the delay before the federal funding is received.

Financing of Operating Costs

It was expected that the bus transit system would not be able to pay for all its operating costs out of its fare-box revenues. Some other source of operating funds must be found to supplement the passenger revenues. A request for an operating subsidy should be made to the city officials. This request must have the proper support from the citizens of Lumberton, or the city officials are not likely to want to take this subsidy from the general tax funds.

Other local sources of operating funds may be available through poverty agencies or church groups, but these may not be appropriate sources for operating subsidies that may be required annually.

If the City of Lumberton wants to assume the responsibility for providing an operating subsidy for its transit system, then it was recommended that it buy transit services from the private operator. The city would pay the transit operator the difference between his costs and the passenger revenues that accrue from the operations.

LESSONS FROM THE LUMBERTON CASE STUDY

Despite thorough investigation of ridership possibilities, innovative transit operations to serve employers and shopping destinations, and cost-saving programs, the City of Lumberton will have to contribute in the vicinity of $30,000 per year to the fare-box receipts in order to maintain an adequate selective public transit program. It remains to be seen whether many small towns are willing to assume such a financial responsibility.

These considerations lead one back to a reanalysis of why the local transit operation appears so expensive. Two reasons stand out: Management costs are high, and maintenance of vehicles is necessary at all times. Further costs are inherent in the need to have standby vehicles always available. It is interesting to note in the Lumberton case that labor costs, which normally constitute a high percentage of the total costs of operation, are quite low in view of the overall abundance of a labor supply.

Public transit in small towns such as Lumberton would be much more economically feasible, therefore, if the costs of overhead could be spread among several towns within a 50-mile radius of each other. It was noted in the case study that such spreading of overhead among several operations has already occurred under private initiative in Fayetteville.

Since capital grants from UMTA are available only to public agencies or private operators subcontracting from public agencies, it would appear sensible for several towns in the area to submit a joint proposal for selective public transit to serve the transportation-disadvantaged. A proposal could be channeled through the regional planning agency (the regional council of governments).

To date, no such joint proposal has been submitted. Lumberton and the rural towns surrounding Fayetteville provide an opportunity to test the feasibility of this design.

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