ESTABLISHING SUBSIDY LEVELS FOR RURAL PUBLIC TRANSPORTATION SYSTEMS

prepared by

Richard S. Marshment
Division of Regional and City Planning
University of Oklahoma
Norman, Oklahoma 73019

prepared for

Mack-Blackwell National Rural Transportation Research Center
University of Arkansas
4190 Bell Engineering Center
Fayetteville, Arkansas 72701

Oklahoma Department of Transportation
Transit Programs Division
200 NE 21st Avenue
Oklahoma City, Oklahoma 73105

December 20, 1998

DISCLAIMER

The contents of this report reflect the views of the author, who is responsible for the facts and accuracy of the information presented herein. This document is disseminated under the sponsorship of the U.S. Department of Transportation, University Transportation Centers Program, in the interest of information exchange. The U.S. Government assumes no liability for the contents or use thereof.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Section 5311 of Title 49 of the U.S. Code provides federal grants to states to assist in the provision of public transportation services in rural areas. The program has multiple objectives of which the most prominent is improving access for economically disadvantaged rural residents to employment, health care, and shopping opportunities. Federal monies are allocated to states using a formula based on a state's proportion of the nation's rural population. States have considerable discretion in establishing funding levels for individual rural operators. Most states make awards on the basis of applications submitted by rural operators. States usually consider a variety of performance measures when reviewing operator applications. Nine states rely on formulas to make awards; none of the formulas are the same.

Determining proper operator funding levels is complicated by vague goals for rural public transportation. Vague goals lead to disagreements over evaluation measures. Particularly vexing are controversies surrounding measures of need for rural transit. Consequently, state practices vary greatly. Different states would award the same operator dramatically different funding.

Discretionary processes in which states establish awards by reviewing operator applications take many forms. One version employs review panels who score applicants on weighted criteria. Reviewer scores are then summed, averaged, or otherwise manipulated to yield composite scores which form the basis for ranking applicants. Rankings do not directly translate into specific awards. Other discretionary processes are less formal and rigorous. Application procedures have several advantages: they are flexible, capable of recognizing unique circumstances, responsive to shifting policy priorities, and less data intensive than more quantitative processes. The most prominent disadvantage is the risk of large annual fluctuations in funding levels due to personality conflicts, changes in the composition of review panels, and adjustments in evaluation criteria.

The alternative is allocation by formula. The small number of states using allocation formulas attests to difficulties encountered in their application. Indiana notes that their formula occasionally results in funding levels exceeding the needs and desires of individual operators. Other problems include an inability to accommodate new participants due to a lack of an operating history, insensitivity to unique local circumstances, and disagreements over the variables to include in the formula. Nevertheless, formulas offer funding stability and remove personalities from the allocation process.

Economic theory provides a basis for establishing subsidy levels given a few basic assumptions: (1) the need for rural public transportation is distributed uniformly with respect to rural population; (2) the social value of a trip is the same regardless of the length or duration of the trip; (3) there are worthwhile rural transit projects in which to invest; (4) rural systems operate with constant returns to scale; and (5) the principal users

of rural transit are economically disadvantaged persons. These conditions lead to an operational service objective of minimizing the subsidy per trip. Properly and consistently applied, states which award money to those operators with the lowest subsidy per trip will maximize ridership and social welfare. States must distinguish between operating and capital expenditures, and must amortize capital costs before including them in the subsidy per trip evaluation statistic. Systems desiring to expand capacity must estimate their operating costs with and without expanded capacity.

States may find the single objective of minimizing the subsidy per trip ignores other important state goals, such as assuring a minimum level of mobility, minimizing annual funding fluctuations, encouraging self sufficiency, and rewarding local fiscal effort. Multiple state priorities can be accommodated by creating a tier structure, with the total state Section 5311 allocation apportioned to each tier in proportion to the importance the state assigns each goal. A tier structure leads to a two step allocation process in which the total Section 5311 budget is first subdivided according to the priority a particular tier has in the state program. The state evaluates operator performance according to criteria specific to each tier. Different allocation formulas could be employed for each tier, with an operator's award the sum of the allocation from each tier. Tier structures are found in several states; at least two states, Indiana and South Carolina, have created formulas for the allocation of each tier.

Continuing controversies over rural public transportation goals renders formula based allocation procedures problematic in most situations. Total reliance on operator applications also present imposing difficulties. A compromise approach would incorporate the best aspects of both procedures. A tier structure with a formula for each tier seems advisable for states with multiple goals. One of the tiers should allocate money on the basis of the subsidy required per unit of mobility. Candidates for mobility measures include numbers of trips and passenger-miles of travel. Another tier could be based on service area population, thereby accommodating new operators who lack a service history. The awards resulting from this procedure would constitute initial rather than final allocations. States could make discretionary adjustments in the preliminary awards based on unique circumstances. The tier/formula approach simplifies the discretionary process by making it a zero sum game. Pennsylvania and Vermont currently employ discretionary processes similar to the one proposed in this report.

PART I

INTRODUCTION

This report describes and analyzes methods of allocating Federal Transit Administration (FTA) Section 5311 rural transit subsidies to individual operators. This report documents the state-of-the-practice and state-of-the-art and compares the two, identifies deficiencies and opportunities for improvement, shows the results of tests performed on new procedures applied to actual systems operating in rural Oklahoma, and contains recommendations which can be used by states and rural operators to improve their grant evaluation procedures and decisionmaking processes with respect to who gets funded and in what amounts.

Early in the Section 5311 program states undertook system sponsorship as much on the basis of willingness to participate as the merits of the proposed service. The current situation is much different. Despite expanded funding for the Section 5311 program, many states confront shortfalls in their fully subscribed Section 5311 programs as a result of rising costs and new funding demands. States have a serious dilemma. They can either (1) forego subsidizing new, more efficient systems in order to continue prior commitments; (2) reduce the level of subsidies for all willing participants, thereby shifting more of the financial burden onto rural communities; or (3) concentrate funding on those services which produce the greatest net benefit.

State policies toward rural public transportation are shaped by the multiple goals which govern their Section 5311 programs. The mobility objective establishes minimum levels of transport service for rural residents lacking viable alternatives. The welfare objective directs aid to communities with especially large low income populations. The efficiency objective rewards operators who can provide service at a low unit cost. The federal legislation enabling the Section 5311 program makes reference to all three objectives but does not establish priorities or indicate relative importance, giving the states considerable latitude to design their own programs. Consequently, there are a wide variety of state Section 5311 programs which achieve varying degrees of success in realizing their operating objectives.

The goal of this research project is to advance knowledge and practice in planning, operating, and financing state assisted rural transit systems. This report is intended to provide state transportation agencies with a theoretical and practical foundation for (1) determining the contribution a rural transit assistance program makes to state mobility, welfare, and efficiency goals, and (2) establishing appropriate levels of state financial assistance. Ancillary objectives include compiling a central source of bibliographic references on rural transit systems and demonstrating the data requirements and computational procedures for different types of evaluation systems. This research project is intended to be practical and useful to state transportation agencies, planners, and rural transit operators.

METHODOLOGY

This study addresses rural public transportation systems supported by FTA Section 5311 assistance program. While eligible for Section 5311 assistance, intercity bus systems are not included in this analysis. Otherwise, Section 5311 systems possess the following characteristics: (a) can be used by the general public; (b) have an on-board operator; and (c) fares are either free or subsidized. The research method involves documenting and comparing the state-of-the-practice and the state-of-the-art in establishing Section 5311 operator awards; determining from this comparison weaknesses and deficiencies in existing practices; developing improved financial and performance evaluation procedures; testing these procedures on actual operating systems; presenting the results to operators, state program administrators, and academicians for practicality and theoretical foundation; and developing recommended Section 5311 allocation procedures.

A convenient way to visualize the research method is illustrated in Figure 1, which depicts program impact theory.[1] This model is based on the notion that elected officials find a problem in some sector of society and direct that government undertake a program to remedy or ameliorate the problem. In some cases elected officials will dictate in the legislation what the remedy is to be. A program is initiated which consists of certain inputs, the first box in Figure 1, which are consumed in a process yielding outputs. If the specified program is the correct remedy to the problem, the outputs will produce outcomes which comport with the desired change.

Figure 1 is annotated with the components of the program impact theory which apply to this examination of the Section 5311 program. Inputs consist of money. The process is the distribution of those monies to operators who in turn plan service, hire drivers, and acquire vehicles. The output is the service. The outcome depends on the problem Section 5311 was created to correct. As will be evident, the loosely defined goal of Section 5311 explains much of the variation found among state practices. The evaluation contained in this report examines three program impact theory components: inputs, process, and outputs. Outcomes, especially whether rural transit has improved rural mobility, is a topic for another research project.

Data Collection

Three principal data sources were used in this study. First, a telephone survey of state agencies responsible for administering the Section 5311 program was conducted in 1994-95. The questionnaire used appears in Appendix A. This survey sought information on statewide rural public transportation goals and methods of administering the Section 5311 monies it receives. Many state management plans and similar documentation was obtained through this survey. Appendix B lists the states submitting written

---

[1]Lynch, Thomas. *Public Budgeting*, 4th ed., Prentice-Hall, 1996, pp. .

documentation. Second, there were six on-site, in-depth interviews with Oklahoma operators regarding their experience with the Section 5311 program and the manner in which awards were made. Third, a literature search of published Section 5311 and rural public transportation research yielded some information.

LITERATURE REVIEW

Two categories of literature relate to the research topic: public finance, and transit system evaluation. Economic theories from public finance which relate to the research topic include those concerning government subsidies to transportation industries and the distributional impacts of government programs. The literature on performance measures concerns types of measures and their use in establishing appropriate subsidy levels. As the literature on this topic is vast,[2] only representative articles are included in this review.

Government Subsidies to the Transportation Sector

Savage and Schupp studied the effect of transit subsidies in Chicago.[3] Their work builds on previous research in the United Kingdom and Australia in which government policy called for allocating subsidies based on the benefits generated. While Savage and Schupp's research concerns urban transit, and peak versus off-peak fares, they find that transit subsidies generally exceed the benefits generated. This conclusion is consistent with similar findings from the United Kingdom and Australia. In separate work Small also concludes that transit subsidies have resulted in the oversupply of transit service.[4]

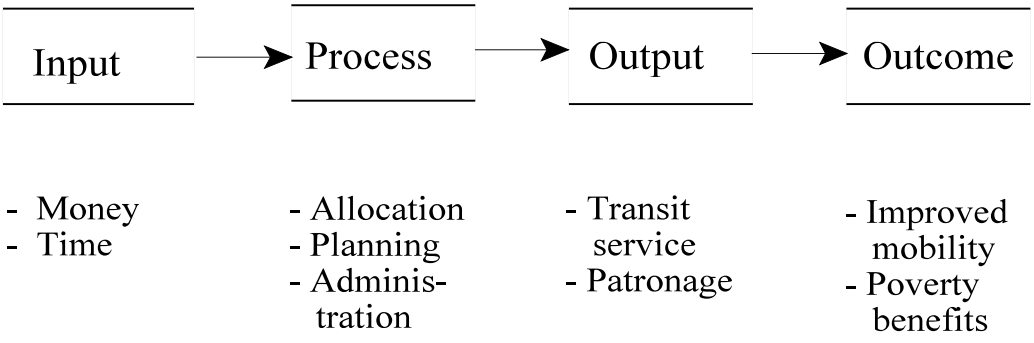
---

[2]Bitzan, John, and Denver Tolliver, *An Analysis of the Efficiency and Effectiveness of Selected Rural Transit Systems in the State of North Dakota*, Upper Great Plains Transportation Institute, North Dakota State University, 1990; *Rural Public Transportation Performance Evaluation Guide*, U.S. Department of Transportation Report DOT-I-83-31, November 1982; Long, L., and S.D. Crowther (1983), *Transit Costs, Performance Evaluation, and Subsidy Allocation: Special Bibliography*, U.S. Department of Transportation Report UMTA-DC-06-0258-83-3.

[3]Savage, Ian, and August Schupp (1997), *Evaluating Transit Subsidies in Chicago*, Paper Presented at the 76th Annual Meeting of the Transportation Research Board, Washington, January 1997.

[4]Small, Kenneth, *Urban Transportation Economics*, Harwood Academic Publishers, 1992.

FIGURE 1 Program Impact Theory for the Section 5311 Aid to Rural Transit Program



Ceglowski, Lago, and Burkhardt studied rural transportation system costs, concluding there are no economies of scale in most rural systems.[5] The American Association of State Highway and Transportation Officials Task Force on Rural Public Transportation surveyed state administrators with respect to their method of allocating subsidies to individual operators.[6] This study reported that most states had formal and quantitative procedures for allocating subsidies. A close examination of the survey results, however, indicates most state formulas allow for some degree of administrative discretion. Comparing the task force findings with similar results from Johnson on state practices in allocating highway funds to rural areas[7] indicates that states rely on formulas more heavily in their highway programs than in their transit programs.

Evans suggested a method of allocating subsidies to British transit operators based

[5]Ceglowski, Kenneth, Armando Lago, and Jon Burkhardt (1978), Rural transportation costs, *Transportation Research Record 661*, Transportation Research Board.

[6]Task Force on Rural Public Transportation, American Association of State Highway and Transportation Officials, *Rural and Specialized Transportation: UMTA Programs and the States*, Washington, August 1984.

[7]Johnson, Thomas, *State Rural Transportation Programs in an Era of Contraction*, National Governors Association, 1989.

on equalizing the level of service for all regions.[8] Specifically Evans sought a method that gave all eligible recipients the same quality of service while recognizing local fiscal effort and need. He experimented with various measures of local fiscal effort, need, and level of service. Evans develops a procedure to equalize level of service whose consequence would be an increase in rural subsidies and a decrease in urban subsidies. Although Evans' approach differs from that of Savage and Schupp, his findings are essentially the same. His conclusion is heavily influenced by the greater need for public transportation in rural areas which he measures on the basis of per capita auto ownership.

The American Association of State Highway and Transportation Officials (AASHTO) describe a method of establishing bus operating subsidies using cost-benefit analysis.[9] The AASHTO method seeks to maximize consumer surplus, an economic concept related to social welfare. This work notes the limitations of cost-benefit analysis when applied to programs with distributional objectives. Wohl and Hendrickson emphasize the importance of clearly defining the analysts' perspective in conducting such studies, since an expense to one group is income to another.[10]

Button discusses the conditions under which transit subsidies can be justified on the basis of a need for mobility.[11] Button suggests that subsidies based on need are appropriately set through political rather than economic processes. He also proposes a method for establishing subsidy levels based on maximizing passenger-miles of travel subject to a budget constraint. Passenger-miles on certain routes could be weighted if distributional considerations warranted.

Performance Measures

In a study not limited exclusively to rural systems, Hartman, Kurtz, and Winn[12] examined state use of performance measures in awarding transit subsidies. Their methodology

---

[8]Evans, Andrew (1985), Equalising grants for public transport subsidy, *Journal of Transport Economics and Policy*, 19:2, pp. 105-138.

[9]American Association of State Highway and Transportation, *A Manual on User Benefit Analysis of Highway and Bus-Transit Improvements*, Washington D.C., 1977.

[10]Wohl, Martin, and Chris Hendrickson, *Transportation Investment and Pricing Principles*, John Wiley, 1984.

[11]Button, Kenneth, *Transport Economics*, 2nd ed., Edgar Elgar Publishers, 1993.

[12]Hartman, Ronald, Elaine Kurtz, and Alan Winn (1994), The role of performance based measures in allocating funding for transit operations, *Synthesis of Transit Practice 6*, Transit Cooperative Research Program, National Academy Press, Washington.

included a survey of selected state transportation agencies, operators, and regional financing agencies with respect to the manner in which states allocate funds and specifically the role performance measures play in those allocations. The researchers found widespread state use of performance measures, although the role of these measures in allocating funds varied widely, from no use at all to substantial reliance. The survey revealed that state agencies believe performance measures encourage efficiency. However, transit agency responses to the survey indicated state performance measures have little influence over operating policies. Public agencies do collect data in order to monitor transit system performance, but performance based funding is rare to non-existent. The researchers found no cases of agencies relying exclusively on performance measures to allocate transit subsidies.

Hartman, et. al. conclude that a major impediment to performance based funds allocation is lack of clear state transit goals. Ambiguous state transit goals, in turn, are the result of disagreement over what function transit is supposed to play in a state. The researchers found that states pursue fully or partially three goals for transit: enhanced mobility, economic development, and environmental improvement. The goals produce conflicting priorities which leads to disagreements over the proper measures of operator performance. The researchers indicate that the performance measures most commonly encountered in the allocation process were ridership, efficiency (cost per some service unit), local support, and service expansion.[13] Specifically these performance measures related ridership to population or ridership to expense. Those measures with a cost element included the subsidy per revenue mile, cost per revenue mile, and subsidy per passenger.

The U.S. Department of Transportation (U.S. DOT) examined a wide range of potential rural transit system performance measures.[14] This report concluded that a major impediment to the development of reasonable performance measures derives from the vague goals specified by rural operators. Nungesser, Nordstrom, and Urbanik, in their study of Texas rural transit operators, confirm this finding.[15] Clear and quantifiable goals are a prerequisite for performance measures. U.S. DOT identified three possible evaluation schemes based on performance measures: evaluation by comparing to a fixed goal; evaluation by comparison among systems; and evaluation by comparison with alternative operating schemes.

---

[13]Hartman, et. al., pps. 12-13.

[14]*Techniques for Analyzing the Performance of Rural Transit Systems*, two volumes, U.S. Department of Transportation Report DOT-RSPA-DPB-50/80/23, 1980.

[15]Nungesser, Lisa, Janet Nordstrom, and Thomas Urbanik II, *Analysis of Rural Public Transportation in Texas*, Texas Transportation Institute Report 1069-1F, August 1982.

Matherly examined alternative performance based formulas for allocating state transit subsidies to operators in Indiana.[16] The Indiana Department of Transportation (IDOT) employs a formula to allocate state assistance to public operators throughout the state. The formula distinguishes five classes of operators on the basis of the size and type of operation. Available monies are allocated first to one of the five classes and then within the class. Within each class, operator awards are based on two components termed a "base allocation" and a "performance allocation." The base allocation is proportional to service area population. The performance allocation contains three measures, each weighted equally: local fiscal effort, passengers per vehicle mile, and passengers per capita. IDOT noted several problems with the formula, one of which is that some operators receive more money than they need for the service they provide.

Matherly experimented with several alternative formula structures before recommending a version similar to the extant Indiana procedure, continuing the peer group system but abandoning the population based component. Matherly also recommends revisions to the performance measures, placing greater emphasis on efficiency and eliminating the measure of local fiscal effort. Finally, Matherly suggested Indiana reconfigure its peer groups according to the type of service rather than the size of the operator, and that allocations be based on an average of three years of data.

Matherly demonstrates that it is easier to advance efficiency goals than it is to develop consensus measures of mobility. She also addresses the important issue of funding new systems which do not have an operating history. Matherly provides criteria useful to others wishing to construct allocation formulas. Her criteria include: (1) a requirement that formula data be easily obtained and auditable; (2) the fomula be simple to compute; (3) administration of the formula not impose an unreasonable burden on the state or the operators; and (4) the formula not result in dramatic annual variations in allocations.

In yet another study of Indiana's allocation procedure, Karlaftis and Sinha performed a before and after study of Indiana's performance based allocation formula to determine its impact.[17] Using data from Indiana's transit systems, Karlaftis and Sinha assessed the impact of the formula on four performance measures: local financial support to transit divided by operating expense; passengers per capita; locally derived income; and passengers per revenue-vehicle-mile. They found that the formula had inconsistent

---

[16]Matherly, Deborah (1997), Developing a performance based transit allocation formula, *Transportation Research Record 1604*, Transportation Research Board, pp. 83-91.

[17]Karlaftis, Matthew, and Kumares Sinha (1997), *Performance Based Transit Operating Subsidy Allocation: A Before and After Study*, Paper presented at the 76th Annual Meeting of Transportation Research Board, Washington, D.C., January 1997.

effects on operators, and that the effects varied by the size of the operator and the type of service provided. Those measures intended to encourage local financial support for transit were more influential in the small and medium properties than large operators. The passengers per capita measure was positively affected by Indiana's performance based formula for all size operators. Passengers per revenue-service-mile was negatively affected.

One of Karlaftis and Sinha's principal findings is that performance based formulas have a greater impact on small systems than large ones. They state: "The large systems were the only ones whose performance did not respond favorably to the objectives of the subsidy allocation procedure." They also conclude: "Performance based subsidy allocation has helped transit systems of all sizes largely improve their accessibility ...."

Roy studied the relationship between state goals for rural transportation and their methods of allocating subsidies.[18] Roy correlated the variables in state subsidy allocation formulas with state goals for rural transportation. Using a goals achievement matrix method, Roy found a "moderate" relationship between state goals and formula variables.

Carter, Lomax, and Jenson studied different performance measures for possible use by the state of Texas in setting rural transit system subsidies.[19] The purpose of this study was to develop consensus performance measures for diagnosing problems and, indirectly, awarding subsidies. Various features of the Carter et. al. research relates to establishing subsidy levels. First, the researchers rejected use of transit dependents as the target population, reasoning that transit is a public service. Second, they experiment with peer grouping, whereby transit operators are evaluated against other similar operators. Interestingly, Carter et. al. did not find that peer grouping would meaningfully improve allocations, mostly because of difficulties in agreeing upon the proper classification criteria. However, they did state that if peer grouping was employed, the best classification criteria would be fleet size.

Carter et. al. recommended using a formula to allocate subsidies, and found that the Texas formula was a good basis (Texas abandoned its formula in 1992). They found that the data requirements of formulas did not present an overwhelming impediment to their use. Also significant was the researchers use of standardized scores to rank

---

[18]Roy, Mark, *An Evaluation of the Relationship between the Goals of State Rural Public Transportation Funding Programs and Their Methods of Allocating Subsidies*, Final Project, Division of Regional and City Planning, University of Oklahoma, 1997.

[19]Carter, Dave, Timothy Lomax, and Ronald Jenson, *Performance Measures for Rural Transit Operators*, Texas Transportation Institute Report 2008-1F, Texas A&M University, October 1990.

operators rather than measure performance on an absolute scale. As such, there is not a minimum level of performance which might be regarded as “good” or “acceptable.”

PART II

STATE OF THE ART

In this part of the report existing allocation practices are contrasted with procedures based on economic theory. An assessment of the efficacy of replacing existing procedures with new methods is also provided. The assessment employs four criteria. First, the people who use the procedure and are affected by it must understand how the procedure works. Second, the procedure relies on easily obtained, reliable, and comparative data. Third, the procedure advances the state's rural transit goals. And fourth, people feel the procedure is reasonably fair.

As already noted, states have considerable discretion in developing allocation procedures which are "fair." A far more difficult problem has been creating procedures which advance the goals of the state programs and are at the same time easy to use. This difficulty can be illustrated by considering the allocation schemes necessary to advance two categories of rural transit assistance program goals: economic efficiency and aid to low income rural residents.

ECONOMIC EFFICIENCY

Federal legislation creating the Section 5311 program suggested two possible goals for rural public transportation: "... a safe, efficient, and fast ...." system, and "... enhancing mobility for economically disadvantaged rural residents...."[20] The first goal refers to economic efficiency by which is meant maximizing social welfare.

To establish appropriate subsidy levels when there are multiple transit operators competing for a limited amount of money, states must analyze the specific market conditions confronting each operator. Figure 2 illustrates how a state might determine the level of subsidy for two operators serving different market areas given that the state desires to maximize efficiency. The diagram depicts long run conditions, so all costs are variable. Additional detail on the structure of this model can be found in Wohl and Hendrickson.[21] Costs comprise all operator expenses including a normal rate of return, plus user time and monetary costs. Marginal benefit, *mb*, refers to the extra user benefit realized with each additional passenger and equates to demand, *d*. Average cost equals total cost divided by the number of passengers. Marginal cost, *mc*, is the additional cost resulting from each additional passenger.

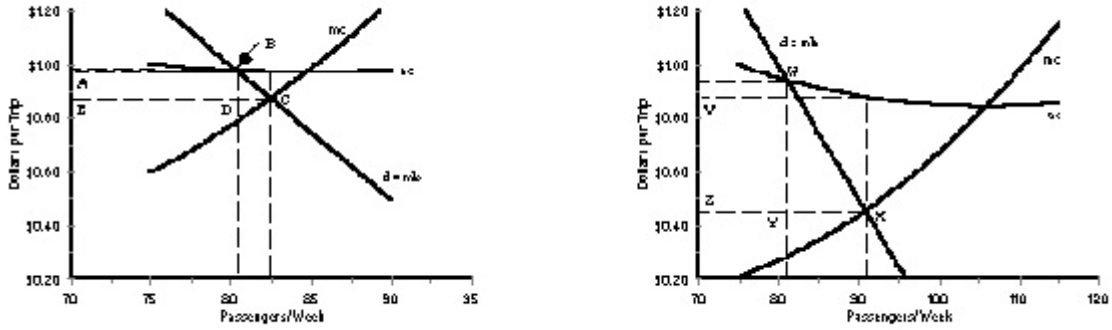
---

[20]U.S. Statutes, PL 95-599, 1978.

[21]Wohl, Martin, and Chris Hendrickson (1984). *Transportation Investment and Pricing Principles*, John Wiley & Sons, pp. 108-112.

FIGURE 2 Rural Transit Market with Two Operators

OPERATOR A OPERATOR B



Notes: *ac* = average cost per passenger; *mc* = marginal cost per passenger; *mb* = marginal benefit per passenger; *d* = demand.

Examining this market from the government's perspective, passenger fares should equal marginal cost at the point where marginal cost equals demand, since this is the condition for maximizing net social welfare, i.e. consumer surplus.[22] However, unsubsidized rural transit operators cannot afford to operate at this fare since unit operating costs, which equal average cost, exceed per passenger revenue, i.e. the fare. To be financially viable an unsubsidized operator must charge average cost with the unfortunate consequence of yielding a suboptimal volume. To realize its efficiency goal, the state government has to offer a per passenger subsidy to operators equal to the difference between average cost and marginal cost at the optimal volume.

In Figure 2, prior to applying for a subsidy, both operators carry enough passengers per week to just break even, i.e. *ac* = *mb* = fare. For operator A this volume is 80 passengers per week at a fare of $0.98 per trip. Operator B must carry 81 passengers per week and charge $0.95 per trip to break even financially. If enough money is available, government would prefer operator A carry 82 passengers per week and operator B carry 90, since these volumes maximize social welfare, *mc* = *mb*. Operator A will require a per passenger subsidy equal to the difference between the fare charged and the average cost of providing service to increase volume to 82 passengers. Operator A's average cost at volume equal 82 passengers is $0.98, and the fare is $0.90, yielding a per passenger subsidy of $0.08. The total weekly subsidy would be $6.56, i.e. 82 passengers per week times $0.08 per passenger. Operator B requires a subsidy of $0.39 per passenger to increase volume to 90 passengers per week, a total subsidy of $35.10 per week with a fare of $0.50 per trip.

If the state is subject to a budget constraint, i.e. there is insufficient money to subsidize both operators at the levels necessary to maximize net social welfare, the state must calculate the welfare gain for each operator and allocate its subsidies so as to generate the greatest amount of net benefit possible. Such a determination requires exact knowledge of the demand for rural transit service and operator cost functions. In the Figure 2 example, both the demand and cost functions are known. For mathematical convenience, the demand function is the same for each operator. Table 1 shows the net benefit calculation for the two operators in Figure 2.

As is evident, the net gain in social welfare for the additional cost incurred is greater for operator B up to a volume of 87 passengers, when the the net social gain from a subsidy which increases B's patronage from 86 to 87 passengers per week is $0.27. The state could continue to subsidize B and increase ridership to 88 passengers and realize another $0.20 increase in social welfare. Alternatively, the state could subsidize A, allowing A to increase patronage from 80 passengers to 81 passengers per week, and realize a $0.22 gain in social welfare, which is clearly preferable to the $0.20 gain from

---

[22]Wohl, Martin, and Chris Hendrickson (1984). *Transportation Investment and Pricing Principles*, John Wiley and Sons, pp. .

subsidizing B. If the state can only provide a total weekly subsidy of $30, which must be divided between the two operators, the state should award operator B $26.40, allowing operator B to expand service to 88 passengers, and award operator A $2.43, which allows it to carry 81 passengers per week.

This allocation is optimal, that is, efficient, because there is no other allocation which yields as much increase in social welfare, measured using *consumer surplus*, which is the amount consumers are willing to pay less what they have to pay for a particular service or good. Consumer surplus consists of two categories: benefits to existing riders and benefits to new rider. Benefits to each group are calculated separately. For example, operator A maximizes social welfare by carrying 82 passengers. Benefits to the 80 weekly passengers already using the rural transit service is the area labeled *ABDE* in Figure 2, and equals the number of riders times the decrease in the cost of travel. To attract two additional passengers requires the operator to decrease the cost of travel to $0.90 per passenger from the original cost of $0.98 per passenger, a savings of $0.08 per passenger. For the 80 original passengers, this represents an increase in consumer surplus of $6.40 ($0.08 X 80 passengers). New riders gain consumer surplus equal to the triangular area in Figure 2 labeled *BCD*, an amount equal to $0.08, calculated as follows: 0.5 X $0.08 X 2 new passengers. The total gain is thus $6.48.

There are two possible ways the state could allocate a $30 subsidy. Option #1 grants operator A $6.56 which is enough to attract two new riders (total ridership 82) and grants operator B $21.75 which is enough to carry 6 new riders. Option #2 allocates operator A $2.43 to attract one new rider, and provide operator B with $26.40 to serve seven new riders. The total subsidy for option #1 is $28.31; the total subsidy for option #2 is $28.83. There is no other allocation scheme which uses more of the $30 total budget without exceeding it. Option #1 generates $27.48 in consumer surplus, and option#2 produces $27.77 in consumer surplus. While these totals are close, option #2 is superior. This result is evident from Table 1, where the gain in net benefit for operator B from adding new riders exceeds operator A up to a total volume of 87. Operator A then generates more benefit than operator B by adding another rider, after which the advantage again switches to operator B.

Practical Considerations

States will not ordinarily know the demand for rural transit service, nor will they know each operator's marginal costs. In typical situations, a calculation such as that illustrated in Table 1 would be impractical and would likely violate two of the criteria for a desirable allocation procedure: the method must be intelligible and the data requirements reasonable. However, if the state distinguishes between capital and operating subsidies, the allocation process for operating subsidies can be simplified by making four assumptions: (1) marginal costs are low (probably reasonable since most rural operators have excess capacity in their systems); (2) constant returns to scale; (3) the marginal

benefit from an additional rider is the same statewide; and (4) the subsidy will lead to an increase in patronage. Under these conditions, the net gain in social welfare from adding riders will be the same for all operators in the state, and states can allocate operating subsidies to those operators who can add riders at the lowest cost, i.e. the lowest average variable cost.

Capital Grants

States can employ this decision rule as long as there is excess capacity in the systems, ridership increases are possible, and the states are allocating operating subsidies The situation can change if the operators compete for capital grants whose purpose is to increase capacity. Rural transit capital investment could include either vehicle replacement or fleet expansion. Vehicle replacement does not lead to an expansion of capacity and should be evaluated in a manner similar to that described for operating subsidies. If an operator seeks additional capacity, project comparisons rely heavily on the amount of patronage they attract.

The state may reasonably assume each new user benefits the same as each previous user, i.e. marginal benefit is constant. Under this assumption, and given competition for capacity increasing grants, the efficiency criterion leads states to compare capital grant applications on the basis of the public cost of adding each new user. The operator who can add patrons at the lowest per passenger subsidy should be awarded the grant. The most difficult element of this procedure is the patroange forecast.

ENHANCING THE MOBILITY OF LOW INCOME RURAL RESIDENTS

The second justification for rural transit service is to aid low income rural residents, specifically to enhance their mobility. Aiding rural economically disadvantaged rural residents would seem consistent with federal intent for the Section 5311 program, since Congress specifically mentions this concern in the Surface Transportation Assistance Act of 1978, which created the Section 5311 program. Unlike economic efficiency, targeted aid to low income rural residents does not require the benefits of the public expenditure to exceed its costs. In fact, the two operators depicted in Figure 2 would fail an economic efficiency test if the benefits of the service are less than the subsidies required for its provision.

TABLE 1 Per Passenger Marginal Costs and Benefits of Two Rural Transit Operators

		Operator A		Operator B	
Passengers Per Week	Marginal Benefit	Marginal Cost	Net	Marginal Cost	Net
80	$1.00	$0.78	$0.22	$0.27	$0.83
81	0.95	0.81	0.14	0.28	0.67
82	0.90	0.86	0.04	0.30	0.60
83	0.85	0.90	-0.05	0.31	0.54
84	0.80	0.94	-0.14	0.33	0.47
85	0.75	0.99	-0.24	0.35	0.40
86	0.70	1.04	-0.34	0.36	0.34
87	0.65	1.08	-0.43	0.38	0.27
88	0.60	1.13	-0.53	0.40	0.20
89	0.55	1.19	-0.64	0.42	0.13
90	0.50	1.24	-0.74	0.44	0.06
91	0.45	1.29	-0.84	0.46	-0.01

In reality, virtually no rural public transportation service will pass an economic efficiency test. Were it otherwise, some private operators would try to serve the market, albeit at volumes well below those deemed socially desirable. The absence of private, for profit, providers of rural transit service indicates an inhospitable market environment, one which requires government intervention to sustain. Rural operators provide service only with fairly high subsidies. In Oklahoma in fiscal year 1995, the average cost per trip was $4.20 while the average fare was less than $0.50, resulting in an average per trip subsidy of $3.63.[23] Given that the bulk of rural transit patrons have low incomes, it is unlikely there would be any demand for service if the operator charged the real cost of providing the service.

When Congress created the Section 5311 program, it made two assumptions regarding the need for rural transit: (1) rural poverty is evenly distributed with respect to population; and (2) economically disadvantaged rural residents are the principal users or rural transit. These assumptions permitted Congress to allocate Section 5311 monies to states using the following population based formula:

$$Dollar\ Allocation = \left(\frac{State's\ Rural\ Population}{Nation's\ Rural\ Population} \right) X \left(Section\ 5311\ Appropriation \right) \qquad \textbf{(3)}$$

Aid to low income rural residents requires states to consider economic local conditions in their allocation procedures. At best states do so indirectly, using such factors as local fiscal effort. A better procedure would specifically measure the size of low income populations and direct Section 5311 aid proportionally. Figure 3 demonstrates how this might be achieved.

We make the same two assumptions in Figure3 as the federal government, i.e. the rural poverty population is distributed proportional to the rural population in general, and the principal beneficiaries of rural public transportation are low income rural residents. In addition, we assume that longer trip lengths yield the same benefits to travelers as do shorter trips. Given these assumptions, programs which maximize patronage will be most consistent with the federal goal of aiding low income rural residents. Figure 2 depicts a rural transit operator confronting a market in which there is effectively no level of service which recoups costs.

In this diagram, the operator would prefer to offer service quantity Q_1 and charge mc_1, since this combination yields the maximum surplus to the operator, equal to the difference between average revenue and average cost at this service volume. Given that we define cost to include a normal return on the operator's investment, the operator will earn a small excess profit. From the government's perspective, the operator should

[23]Oklahoma Department of Transportation.

provide service volume Q_2 and charge mc_2, since at this volume social welfare is maximized. However, at Q_2 the operator will lose money equal to the difference between ac_2 and mc_2. A subsidy equal to this difference is required to induce the operator to provide the socially optimal level of service.

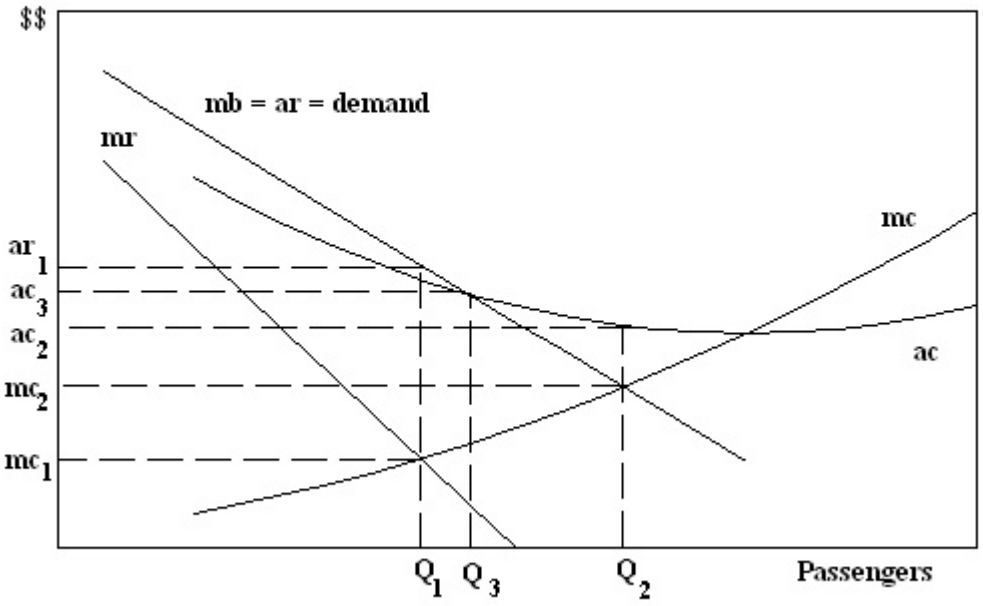
In the situation depicted, and given competing operators, government will want to increase patronage up to the socially optimal ridership for each operator. If there is insufficient money to accomplish this objective for all operators, the state should allocate money to those operators who can add ridership at the lowest cost, i.e. subsidy. This allocation policy leads to a statistic which can be used to guide state decisions on award amounts:

$$Subsidy/Passenger = \frac{Total\ Operator\ Cost - Local\ Revenue}{Number\ of\ Passengers} \quad \textbf{(4)}$$

The state should subsidize the operator who can add passengers at the lowest subsidy per passenger. In so doing, the state will maximize statewide rural transit patronage and thus provide benefits to the most number of rural residents.

One concern with this policy arises in those instances where additional patronage is unlikely within the state. That is, expansion of service will not attract more riders. This condition brings into question the amount of Section 5311 monies allocated to a state. This type of problem arises when the monetary allocation is made without a true measure of the need. Although this issue lies beyond the scope of this report, the federal government should at some point attempt to measure the total extent of the need for rural public transportation service.

FIGURE 3 Low Demand Market for Rural Public Transportation



where

ar = average revenue
ac = average cost
mc = marginal cost
Q = passenger volume offered and consumed

PART III

STATE OF THE PRACTICE

This part of the report documents procedures currently used by states to administer the Section 5311 program. Subsections of the report itemize state goals for rural public transportation, describe procedures currently in use by states to allocate Section 5311 monies to individual rural operators, analyze the impacts these alternative allocation methods have on project funding, and assess the effectiveness of the different subsidy allocation processes in realizing state rural public transportation goals. Much of the data on actual state practices came from the forty nine states responding to the telephone survey and/or submitting written materials. Table 2 shows that most states have fewer than twenty operators.

THE GOALS OF STATE RURAL PUBLIC TRANSPORTATION PROGRAMS

The telephone survey of state agencies combined with the documentation many states submitted provided a basis for grouping states according to the goals they express for rural public transportation. Ninety percent of the states report improving and increasing rural mobility as one of their goals (Table 3), making virtually all the states policy compliant with the federal mobility goal, as articulated in Title 49 of the U.S. Code:

> "significant mass transportation improvements are necessary to achieve national goals for improved air quality, energy conservation, international competitiveness, and mobility for elderly individuals, individuals with disabilities, and economically disadvantaged individuals in urban and rural areas of the United States;"[24]

Referring again to Table 3, the five most frequently reported state goals are all contained in the Federal Transit Administration's published policy on rural public transportation.[25] The evidence supports a finding that states have crafted programs whose stated purposes are consistent with federal policies. The main inconsistency is the reference in the U.S. Code to economically disadvantaged rural individuals. The states, for the most part, only indirectly distinguish rural populations by socioeconomic groups.

---

[24]Title 49, *U.S. Code*, §5301(b)(7), 1994.

[25]Federal Transit Administration, *Circular 9040.1D*, May 8, 1997.

TABLE 2 Numbers of Operators by State

Number of Operators	Number	Percent
0 to 5	7	14
5 - 10	5	10
11 - 15	9	18
16 - 20	6	12
21 - 30	8	16
31 - 40	5	10
41 - 50	3	6
51 - 60	3	6
More than 60	2	4
Indeterminate	2	4
Totals	50	100

TABLE 3 Frequency with which States Report Specific Goals for Rural Public Transportation

Goals and Objectives	Number	Percent[a]
Improve Access and Increase Mobility[b]	44	89.80
Increase Cost Effectiveness[b]	30	61.22
Improve System Equipment and Maintenance[b]	29	51.18
Encourage Private Sector Participation[b]	26	53.06
Improve Intercity Bus Connections[b]	18	36.73
Encourage Public Transportation Use	6	12.24
Elderly and Handicapped Transportation	4	8.16
Promote Financial Self-Sufficiency	3	6.12
Rural Economic Development	3	6.12
Intermodal/Multimodal Integration	3	6.12
Provide Alternative to Automobile Use	2	4.08
Environmental Quality	1	2.04

Notes: [a]Number of States surveyed = 49. No goals reported for Iowa and Massachusetts.
[b]Stated as an objective in Federal Transit Administration Circular 9040.1D (1997).

PROCEDURES FOR DETERMINING OPERATOR GRANTS

The states characterize their allocation procedures in the manner listed in Table 4. The data were constructed from the results of the telephone survey and written documentation provided by the states. The term "application" in Table 4 means a written application is used to evaluate the operator. The response provides no information on the factors the state considers in reaching an award decision.

State allocation procedures can be classified into two categories: formula and discretionary. Practices vary widely within these two categories. No two formula states use the same variables in their formulas, and states which use discretionary processes evaluate and rank applicants using different techniques and criteria. Ten states use or used formulas to establish award levels for rural transit operators.[26] Currently forty one states have discretionary processes. Figure 4 is a taxonomy of allocation processes.

The great advantage of discretionary processes is the flexibility afforded states to consider unique or mitigating circumstances. Disadvantages include less predictable operator funding levels and additional staff time. Formula approaches require states to quantitatively measure the characteristics of each operator and allocate monies based on how those measures compare to other operators in the state. Formulas are more rigid, rigorous, predictable, transparent, and data intensive than application processes but often involve less staff time.

Allocation Formulas

Despite great similarities in state rural transit goals, project funding outcomes can vary widely. Table 5 demonstrates just how dramatic the variations can be. Ten state formulas were applied to Oklahoma to determine how much six different operators would receive. The actual award from the State of Oklahoma is also listed in the table. All of the states except Iowa specifically adopt the federal rural mobility enhancement goal, yet they would award competing operators significantly different amounts.

[26]Alabama, Indiana, Tennessee, Texas, Iowa, Nebraska, Louisiana, Maine, South Carolina, and New York. Texas abandoned its formula in 1994.

TABLE 4 METHOD OF ALLOCATING FUNDS TO OPERATORS FROM THE STATE TELEPHONE SURVEY

Method of Determining Award Amount	Number	Percent
Application	20	41
Need	10	20
Formula	3	6
No Criteria	2	4
Equally Divided	1	2
Historical Precedent	1	2
Combination or Indeterminate	12	25
Total	49	100

FIGURE 4 Taxonomy State Methods of Allocating Section 5311 Subsidies to Operators

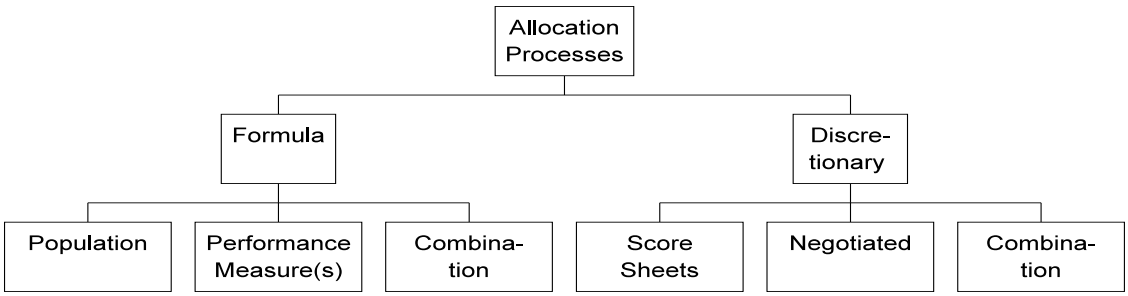


TABLE 5 Section 5311 Allocations to Oklahoma Operators Under Different State Formulas, Fiscal Year 1995

	Oklahoma Rural Transit Operators					
State	CAR	BCT	SORTS	RED	MCT	PEL
Alabama	$127,170	$21,195	$375,455	$257,368	$251,313	$269,480
Indiana	$130,198	$39,362	$302,786	$308,842	$254,340	$257,368
Iowa	$142,310	$21,195	$323,981	$299,758	$163,505	$281,591
Louisiana	$139,282	$21,195	$308,842	$293,703	$169,560	$323,981
Maine	$84,780	$99,919	$336,093	$475,374	$142,310	$221,034
Nebraska	$133,226	$18,167	$317,925	$266,452	$184,700	$345,176
Oklahoma	**$188,178**	**$21,485**	**$293,624**	**$555,766**	**$154,855**	**$271,797**
New York	$105,975	$112,031	$442,068	$224,062	$169,560	$230,118
S. Carolina	$142,310	$72,669	$336,093	$330,037	$178,644	$254,340
Tennessee	$121,114	$45,418	$354,260	$411,789	$163,505	$260,396
Texas	$151,393	$154,421	$284,619	$317,925	$221,034	$202,867

Sources: Roy, Table 4.4; Federal Transit Administration, Table 11; Oklahoma Department of Transportation.

Other goals might account for the differences among the states. A pairwise comparison between South Carolina and Texas, which both at one point used formulas, and which have essentially identical program goals, tests this hypothesis. The states differ on two program goals: South Carolina adopts the first federal project category (rural mobility enhancement) and Texas does not, and unlike South Carolina, Texas sets a goal of operating efficiency and effectiveness through state technical assistance, performance measures, and management objectives. Texas' omission of the federal mobility goal is not especially significant since the federal goals apply to the Section 5311 program whether adopted by the states or not. Texas efficiency/effectiveness goal is potentially significant. The South Carolina formula yields a dollar allocation to each operator:

$$Dollar\ Allocation = \left[\left(\frac{p}{\sum p}\right)T_1\right] + \left[\left(\frac{c}{\sum c}\right)T_2\right] = \left[\left(\frac{g}{\sum g}\right)T_3\right] + \left[\left(\frac{d}{\sum d}\right)T_4\right] + ma \qquad \textbf{(1)}$$

where

p = service area population
c = number of counties in service area
g = passengers in service area
d = revenue service miles in service area
ma = a minimum allocation which all eligible operators receive
T = one of four categories into which the Section 5311 money is divided

The denominators in the South Carolina formula refer to the summation of the numerators for all areas participating in the Section 5311 program. South Carolina divides its money into five groups or tiers, referred to a T in the formula. Each tier reflects a different South Carolina priority. All eligible operators receive a minimum allocation which is simply the total allocation to that tier divided by the number of operators. The other four tiers reward systems based on performance or unique qualities of the service areas.

The Texas formula also has five components but no minimum allocation:

$$Percent\ Allocation = \left[\left(\frac{p}{\sum p}\right)0.2\right] + \left[\left(\frac{q}{\sum q}\right)0.2\right] + \left[\left(\frac{w}{\sum w}\right)0.2\right] + \left[\left(\frac{e}{\sum e}\right)0.2\right] + \left[\left(\frac{j}{\sum j}\right)0.2\right] \qquad \textbf{(2)}$$

where the variables are defined as before plus:

q = service area in square miles
w = service area revenue recovery
e = system average cost-per–mile
j = service area passenger-trips per capita

To make the comparison easier, each South Carolina tier was assigned one-fifth of the

total allocation, in essence converting the tier amounts into 20% weights, as in the Texas formula.

The impacts on the operator in Beaver, Oklahoma, illustrate the funding significance of the two formulas. The Beaver service area is small both geographically and in population. Beaver patronage is small but passenger-trips-per-capita is high. As shown in Table 5, the operator in Beaver, Oklahoma, would receive half the subsidy in South Carolina as it would in Texas. Much of the difference is due to the high per capita trip making in Beaver which Texas favors and South Carolina ignores. The differences in the two allocations result from the four non-population terms in the two formulas. Twenty percent of each state's allocation is made on the basis of population. Texas advances its efficiency goal by allocating 60% of its money on the basis of cost-effectiveness, while South Carolina seeks to distribute its money as widely as possible using service area demographic characteristics. This comparison suggests that goals other than improving rural mobility play a significant role in determining operator awards.

Roy confirms this finding. Examining data from the ten formula states, Roy found that allocation differences could at least in part be explained by differences in state programmatic goals.

> Overall, the ten state management plan formulas moderately relate to the state management plan goals. Therefore, based upon [Roy's] goal and formula evaluation, allocations resulting from the formulas should be moderately equitable and consistent with program goals.[27]

Roy determined that the ten formula states had nineteen different goals. Roy used a *goals achievement matrix* to assess the strength of the relationship between state goals and their funding formulas. Table 6 summarizes Roy's analysis. In Roy's scheme, the higher the score the better. The upper limit on a state's score occurs when a single variable in its funding formula which strongly supports multiple goals.

The average score for all ten states was 2.07, and ranged from scores of 4.4 and 4.8 for New York and Texas respectively, and 0.9 and 1.2 for Nebraska and Tennessee. The state management plan for Iowa did not include program goals and was consequently assigned zero. The average without Iowa was 2.3. Only two states (New York and Texas) had composite scores above the average.

---

[27]Roy, Mark. *An Evaluation of the Relationship Between the goals of State Rural Public Transportation Funding Programs and Their Methods of Allocating Subsidies*, Professional Project, Division of Regional and City Planning, University of Oklahoma, 1997, p. 40.

Discretionary Procedures

The most popular allocation technique is a discretionary process in which operators submit applications to state administrative agencies which then evaluate them using various criteria. Ninety percent of the states responding to the telephone survey indicated they employed criteria when evaluating applicants. The criteria ranged from simply eligibility to specific performance measures and service area characteristics such as service area population and size, numbers of vehicles, administrative costs, fares and cost recovery, and sources of local revenues. Typical performance measures were revenue-miles and revenue-hours of service, passenger-miles of service, numbers of trips, cost-per-mile, and cost per trip. Sixty three percent of the administrators indicated they used performance measures to evaluate Section 5311 operators. The list of potential performance measures is quite extensive.[28] Discretionary states often specify performance measures in their state management plans. Few states report they use incremental budgeting (Table 3), meaning they do not include the size of previous awards in their evaluation criteria.

Ranking Procedures

Some states employ discretionary processes which yield a rank order of applicants. One popular means of ranking employs score sheets. One or more individuals will use one or more performance measures, such as cost-per-passenger and cost-per-revenue-service-mile, to rate individual applicants. The score sheet may also include qualitative criteria in order to recognize special needs and circumstances. To assure objectivity, scoring can be done by committee, with both agency and non-agency personnel represented.

Scores are interpreted in many different ways. One approach yields a composite statistic which can be the basis for awards. Administrative staffs and/or transportation commissions can assign weights to evaluation criteria reflecting the importance of each factor. The products of the scores and weights are summed or averaged or otherwise manipulated to produce a summary statistic. Score sheets create an opportunity to make awards in proportion to the scores applicants receive.

Other versions employ qualitative scores such as plus's and minus's. Rankings developed through qualitative processes do not directly translate into award amounts. Instead, state administrators, after ranking applicants, assess the monies requested and reach decisions on awards.

To assure fairness, the State of Washington goes to considerable effort to create

---

[28]Hartman, Ronald, Elaine Kurtz, and Alan Winn, The role of performance measures in allocating funding for transit operations, *TCRP Synthesis 6*, Transportation Research Board, 1994.

multi-disciplinary, multi-jurisdictional evaluation committees to establish applicant rankings. Committee members are sent applications along with objective data on operator performance. They are then asked to complete an evaluation form based on the data they were provided. The process is managed by the state transportation agency, but committee participants include officials from other state departments.

Peer Grouping

Georgia and Illinois illustrate the practice of ranking applicants within geographic peer groups. The state's total Section 5311 allocation is apportioned to subdistricts using some formula, generally population based. Substate planning organizations, often district level state transportation agencies, rank applicants within their district and make awards. This method does not assure equal treatment of comparable operators within a state but does promote geographic and population dispersion of the subsidies. While Illinois and Georgia use geographic peer groups, other organizational subdivisions are possible, such as fleet size or density of service areas.[29]

[29]Lomas, Timothy and Ronald Jenson (1990), *Performance Measures for Rural Transit Operators*, Report 2008-1F, Texas Transportation Institute, pp. 21, 29-31.

TABLE 6 Relationship between State Goals for Rural Public Transportation and Funding Formulas

State	Total Score	Average Score
Alabama	3	1.7
Indiana	13	2.6
Iowa	0	0
Louisiana	8	1.3
Maine	6	2
Nebraska	9	0.9
New York	31	4.4
South Carolina	7	1.8
Tennessee	6	1.2
Texas	19	4.8

Source: Roy, Mark C. Table 3.13, *An Evaluation of the Relationship between the Goals of State Rural Public Transportation Funding Programs and Their Methods of Allocating Subsidies*, Division of Regional and City Planning, University of Oklahoma, 1997.

PART IV

RECOMMENDED PROCEDURE

This part of the report demonstrates how a state can improve rural mobility through its Section 5311 allocation procedure. The proposed procedure incorporates existing good practices and can be modified to advance other common state goals. Examples of these non-mobility goals include minimum distributions on the basis of need and geography, encouraging operating efficiency, equalizing fiscal capacity, and stabilizing the quantity and quality of service. The proposed procedure measures mobility in terms of the number of trips by public transportation. Other mobility measures, such as passenger-miles of travel, can be used instead of the number of trips. Subsections of this part describe the proposed method, its rationale and operation; the effect of the proposed method on allocations to six Oklahoma operators; and sensitivity tests illustrating the effect of relaxing assumptions.

LEAST COST PLANNING

The recommended procedure rests on several assumptions. Two of the assumptions were discussed in Part II regarding the rationale for the federal Section 5311 program, namely that the target population is distributed evenly throughout the rural population, and that users of rural transit services consist principally of the target population. Five additional assumptions are: (1) the need for rural transit is the same for all users, that is, people making longer trips do not have a greater need than persons making short trips; (2) there are worthwhile projects in which to invest; (3) operators can add passengers at a constant subsidy per trip (constant returns to scale); (4) the demand for transit is normal (such that additional patronage is possible); and (5) operators have an operating history which can be used to forecast future ridership and operating costs.

Given these assumptions, a state's rural mobility goal effectively becomes maximizing patronage. A state will seek to accomplish its rural mobility goal at the lowest possible cost. Since the state program is budget constrained, administrators will allocate subsidies so as to provide as much service as possible given the available money. Measuring service as the number of trips suggests a means of establishing operator awards on the basis of the average cost per trip. This methodology can be termed "least cost planning," meaning the goal is achieved at the lowest cost. When the service objective is specified in monetary terms, least cost planning is synonymous with benefit-cost analysis.[30]

---

[30]Moore, Terry, Daniel Malarkey, Randy Pozdena, and Terry Thorsnes (1995), *Least Cost Planning Principles, Applications and Issues*, Parsons, Brinckerhoff, Quade and Douglas, and EcoNorthwest.

The operational service objective for a rural public transportation program is to maximize patronage given the resources provided, which is equivalent to maximizing the ratio of total passengers to total subsidy. Since the reciprocal of this statistic, subsidy per trip, is more intuitive, the service objective becomes minimizing the subsidy per trip. The state can achieve its operational objective by incrementally allocating Section 5311 monies to operators in ascending order of average subsidy per passenger until all money is distributed.

SINGLE GOAL ALLOCATION

This method of awarding Section 5311 awards to operators given a goal of maximizing the number of trips is demonstrated using the six operators listed in Table 5 in Part III. Calculating the average subsidy requires each operator to provide certain data on the most recently completed full year of operation plus similar data for the upcoming year. The necessary data for the six Oklahoma operators for FY 1995 is shown in Table 7. This data would be available to state administrators in FY 1994 as the basis for making FY 1995 awards.

Operators are divided into two groups, those desiring to expand capacity and those seeking to continue existing operations. Patronage forecasts resulting from a capacity expansion may or may not be available depending on state policies. The data in Table 7 are historical. In practice, states will have to work with forecast data which will contain an element of uncertainty. The evaluation statistic in Table 7 is the state cost per trip, which must be carefully calculated to produce the desired result. State costs include the operating subsidy plus the amortized cost of rolling stock. For simplicity, rolling stock is assumed to have a ten year functional life with no salvage value. Amortized values are not adjusted by an interest rate. These assumptions could be easily modified if states felt they were unrealistic. FY 1994 patronage and operating grant values are used in Table 7 in those columns under the "Without Capacity Increase" heading for the two systems proposing capacity expansions. All figures in Table 7 refer to the Section 5311 subsidies requested. Operators often request capital items other than rolling stock and which do not affect capacity, such as office equipment. Requests of this type are not reflected in the Table 7 figures, although the procedure allows for their inclusion if they could be classified as with and without expansion as are the other items in Table 7.

The total amount of money requested is $1,033,188. The number of trips which would result if the money were allocated in the manner requested would be 537,650. Were there sufficient demand and capacity, the state could serve more than twice as many trips (1,283,463) if all the money were allocated to Beaver City Transit, with an average subsidy per trip of $0.805. In reality, Beaver City Transit has neither the capacity nor the market to support this level of ridership. However, the state should encourage Beaver City Transit and other operators with low subsidy per trip ratios to expand service as

much as possible as long as their average cost per trip lies below other operators.

To illustrate the allocation procedure, assume that $1,000,000 in Section 5311 money is available to Oklahoma in FY 1995. Table 8 shows how money would be allocated if Oklahoma awarded money in ascending order of subsidy per trip. In this allocation, Pellivan is denied an expansion award, since it has the highest cost per trip. To show that the Table 8 decision rule results in more trips than other allocations, Table 9 distributes Section 5311 monies in descending order of subsidy per trip. To make the two tables comparable, Muskogee County Transit's operating grant and ridership were reduced proportionally. As is evident, even with a lower allocation, the distribution in Table 8 results in 27,600 more trips that the distribution in Table 9.

Calculating the Average Cost per Trip

The subsidy per trip statistic includes both amortized capital expenses as well as annual operating subsidies. Sunk costs, i.e. previous expenditures, are not considered in the statistic. For example, Beaver City Transit received a capital grant to replace a van in FY 1994. The amortized value of the van does not appear in the FY 1995 subsidy per trip for Beaver City Transit. Since the capital grant has already been expended, and cannot realistically be recaptured, it is no longer relevant to state administrators. Requested capital grants in FY 1995, whether for replacement vehicles or expanding capacity, are relevant and are included.

Situations will arise in which states must decide whether to award a capital grant to replace a vehicle or allocate a higher operating subsidy to a competing operator. The decision rule in the recommended procedure would call for allocating money to the operator with the lowest subsidy per trip, with the amortized value of the replacement vehicle included in the ranking statistic. If the operator requesting only an operating grant had a lower subsidy per trip than the operator requesting the vehicle replacement grant, the money should go to the first operator. This could easily result in the second operator needing an even higher operating grant since older vehicles have higher operating costs. States should ask operators requesting capital grants to estimate their operating costs with and without the requested capital grant.

TABLE 7 Data Needed to Allocate Section 5311 Grants to Operators for FY 1995

	Without Capacity Increase				With Capacity Increase			
Operator	Forecast Trips[a]	Cost/Trip[b]	Operating Grant[c]	Capital Grant	Forecast Trips[d]	Cost/Trip[e]	Operating Grant	Capital Grant
BCT	14,043	0.805	11,310					
CAR	53,229	1.109	55,971	30,562				
MCT	83,942	0.978	82,097					
PEL	80,988	2.129	169,800	26,590	87,318	2.087	176,945	26,586
RED	109,856	1.827	190,999	96,547	161,884	2.063	321,146	32,183
SORTS	137,234	1.162	157,989	15,262				

SOURCE: Oklahoma Department of Transportation. NOTES: [a]Annualized data. Annual trips on systems expanding capacity reflects FY 1994 data. [b]Includes vehicle replacement costs amortized over ten years at zero percent interest. [c]For systems expanding capacity, data reflects FY 1994 actual operating grant awarded. Otherwise the amounts are actual FY 1995 awards. [d]FY 1995 actual number of trips. [e]Includes all capital and operating costs for continuation of existing service plus additional costs for expanding capacity. New and replacement vehicles amortized over ten years at zero percent interest. All dollar figures are Section 5311 share only. BCT = Beaver City Transit, CAR = Call a Ride Public Transit, MCT = Muskogee County Transit, PEL = Pelivan Transit, RED = Red River Public Transportation, SORTS = Southern Oklahoma Rural Transportation System.

TABLE 8 Allocations to Oklahoma Operators Using the Recommended Practice in FY 1995 (dollars)

Operator	Operating Grant	Replacement Vehicle Grant	Expansion Vehicle Grant	Total Award	Number of Trips
BCT	11,310			11,310	14,043
CAR	55,971	30,562		86,533	53,229
MCT	82,097			82,097	83,942
PEL	169,800	26,590		196,390	80,988
RED	321,146	96,547	32,183	449,876	161,884
SORTS	157,989	15,262		173,251	137,234
TOTALS	798,313	168,961	32,183	999,457	531,320

The third modification would substitute other measures of mobility for number of trips. The problem with using the number of trips as a mobility measure lies with the underlying assumption that the social benefit of a trip is the same no matter the length or duration of the trip, or the social circumstances of the trip maker. Alternative measures include passenger-miles of travel, passenger-hours of travel, per capita trips, and the ratio of trips to low income population. Different states judge the need for rural transit different ways, and all the previous performance measures can be found in actual state practice. There is compelling justification for each. The strongest arguments concern passenger-miles of travel. Substituting passenger-miles for the number of trips would favor operators in low density regions where trip lengths are longer and patronage lower. Whichever measure is used, the recommended procedure allows only one as the basis for allocation.

MULTIPLE GOAL ALLOCATION

States often establish minimum allocations to assure a minimum level of mobility. Minimum allocations are based on various measures with population being the most common. Other minimum allocation measures include number of operators and fleet size. The recommended procedure can be modified to incorporate a minimum mobility goal by creating a tier structure as practiced in South Carolina and Indiana. In a tier structure, states divide their Section 5311 monies into separate categories, one for each priority it desires to address. For example, a state could divide its money into two tiers with equal sums in each. A state would allocate one tier solely to maximize trips as described previously, and allocate the other on the basis of population to assure a minimum level of mobility.

Table 10 shows the allocation each of six Oklahoma operators would receive under this structure. As with Tables 8 and 9, Table 10 is based on an allocation of $1,000,000, and uses FY 1994 data to establish FY 1995 funding levels. The result reveals the basic problem with population based allocations, one noted by Karlaftis and Sinha[31], which is that operators can receive more money than they need or want. This is certainly the case with Beaver City Transit, which is awarded more than its entire request. Table 11 shows the allocations from Tables 8, 9 and 10 plus the actual FY 1995 allocation. Table 11 includes two tier based allocations to show the sensitivity of the result to changing the minimum allocation percentage.

Other tiers are also possible but not illustrated in this report. Examples include operating efficiency measured by the subsidy per revenue-mile of service; fiscal effort

---

[31]Karlaftis, Mathew, and Kumares Sinha (1997), *Performance Based Allocation in Indiana*, paper presented at the 96th Annual Meeting of the Transportation Research Board, Washington, January 1997.

measured by the ratio of locally generated revenue to total cost, or locally generated revenue per capita, or the ratio of locally generated revenue per capita to per capita income; and equalizing level of service measured by revenue-miles of service per capita or per lane-miles of roadway. All can be found in the literature or in practice.

CONCLUSION

Viable allocation processes must meet the four criteria described in Part III, namely: (1) the people who use the procedure and are affected by it must understand how the procedure works; (2) the procedure relies on easily obtained, reliable, and comparative data; (3) the procedure advances the state's rural transit goals; and (4) people feel the procedure is reasonably fair. Realistically, no allocation procedure will satisfy everyone. Consequently, the fourth criteria may not be attainable.

This research project examined many different allocation procedures and economic theories and recommends a method designed to maximize the number of trips by rural transit subject to a budget constraint. The recommended method is particularly sensitive to the intent of the Section 5311 program to improve the mobility of economically disadvantaged rural residents. The recommended procedure could also be modified to accommodate states wishing to achieve multiple goals, such as maximizing the number of trips and guaranteeing a minimum level of mobility. The recommended method incorporates the best practices currently in use by the states. The goal of maximizing trips comes from economic theory. It rests on several assumptions the most critical of which are that the need for rural transit is distributed proportional to population and that the principal users of rural public transportation are economically disadvantaged persons.

After studying allocation procedures for the past several years it is apparent that formulas will rarely fit all situations. The nine states which continue to adhere to formulas do so because formulas give the impression of impartiality, and therefore come closest to meeting the fourth criteria of fairness. However, in the end it is just an impression, as Texas discovered when it decided to abandon its formula in favor of a more flexible application process with a separate program of performance monitoring. Indiana has expended considerable effort to craft a fair formula, employing such techniques as peer grouping, tier structures, and performance measures, yet does not have a mechanism for incorporating new operators into the Section 5311 program or a remedy for allocations which can and do exceed the needs of individual operators. The formula may approach fairness for those operators already participating in the Section 5311 program but is certainly not fair to those communities desiring to initiate new systems.

TABLE 9 Allocations to Oklahoma Operators with Suboptimal Procedure in FY 1995 (dollars)

Operator	Operating Grant	Replacement Vehicle Grant	Expansion Vehicle Grant	Total Award	Number of Trips
BCT	11,310			11,310	14,043
CAR	55,971	30,562		86,533	53,229
MCT	48,909			48,909	50,008
PEL	176,945	26,590	26,586	230,121	87,318
RED	321,146	96,547	32,183	449,876	161,884
SORTS	157,989	15,262		173,251	137,234
TOTALS	772,270	168,961	58,769	1,000,000	503,716

TABLE 10 Allocations to Oklahoma Operators with a Two Tier System and Equal Amounts in each Tier in FY 1995 (dollars)

Operator	Tier I: Population	Tier II: Maximize Trips	Total Award
BCT	8,140	11,310	19,450
CAR	48,837	86,533	135,370
MCT	96,512	82,097	178,609
PEL	103,488	-	103,488
RED	98,837	146,809	245,646
SORTS	144,186	173,251	317,437
TOTALS	500,000	500,000	1,000,000

TABLE 11 Allocations to Oklahoma Operators Using Different Procedures in FY 1995 (dollars)

Operator	Maximize Trips	Suboptimal Allocation	Tier Based Allocation I[a]	Tier Based Allocation II[b]	Actual Award[c]
BCT	11,310	11,310	19,450	14,566	14,461
CAR	86,533	86,533	135,370	106,068	126,659
MCT	82,097	48,909	178,609	120,702	104,230
PEL	196,390	230,121	103,488	134,875	182,941
RED	449,876	449,876	245,646	392,864	374,077
SORTS	173,251	173,251	317,437	230,925	197,633
TOTALS	999,457	1,000,000	1,000,000	1,000,000	1,000,001

[a]Fifty percent allocated on the basis of population and fifty percent to maximize trips; [b]Twenty percent allocated by population and the remainder to maximize trips; [c]Adjusted to a total allocation of $1,000,000 for comparison purposes.

The procedure recommended in this report is exactly that, a procedure, not a formula. The procedure employs a decision rule in which capital and operating grants are awarded to operators in ascending order of their average subsidy per trip. The allocations resulting from the decision rule should be viewed as an initial solution, a first cut so to speak. Administrators should use this initial solution as a basis for further refinements.

The evidence suggests there is no quantitative substitute for the professional judgement of state administrators to recognize unique circumstances. However, the recommended procedure does simplify the allocation process in two ways. First, it reduces the problem to a zero sum game; an applicant can only receive more money if another receives less, thereby making the tradeoffs explicit. Second, it provides the administrator with a baseline allocation. The f inal solution can be determined hueristically.

Some states informally use a procedure similar to the one outlined, although the objective functions used to obtain an initial solution are often different than the maximum ridership objective proposed in this report. A summary of these procedures can be found in the 1984 AASHTO survey of state practices.[32]

Finally, it is important to remember that allocations are as much political as technical. Some state officials may wish to divorce themselves from the allocation process, but the survey and literature review suggest this desire is the exception rather than the rule. A potential model for the states to follow might be the process used by the Federal Transit Administration to award discretionary capital grants for new rail starts. In the rail program, the FTA ranks applicants according to a performance measure and makes recommendations to a decision making body; in FTA's case this is the Congress of the United States. States probably do not need to secure legislative approval of their allocations, but could use quasi-legislative bodies such as transportation commissions for this function.

---

[32]Task Force on Rural Public Transportation, *Rural and Specialized Transportation*, American Association of State Highway and Transportation Officials, 1984.

APPENDIX A

STATE SURVEY QUESTIONS

AND RESULTS

1. How are Section 5311 funds allocated to individual operators in your state?

2. Does your agency have criteria that communities must meet to be eligible to participate in the Section 5311 program?

3. What are the objectives of the Section 5311 subsidy program that your state attempts to achieve? If written, please send us a copy of your objectives.

4. Does your agency have criteria to evaluate the performance of Section 5311 operators in your state?

5. If Section 5311 subsidies were reduced or eliminated, what plans or policies would you implement to continue rural transportation service?

6. Where do you get local matching funds for the Section 5311 program?

7. How do you feel the Section 5311 program could be changed to improve transportation services in rural communities?

8. Have you surveyed operators participating in the Section 5311 program as a means of setting funding levels and determining the need for rural public transportation in your state?

9. How many Section 5311 operators do you have in your state?

10. What types of organizations providing transportation service in your state participate in the Section 5311 program?

APPENDIX B

STATE PARTICIPATION IN

SURVEY

State	Telephone Survey Only	State Management Plan	Other Written Documentation
Alabama		X	
Alaska			X
Arizona			X
Arkansas		X	
California	X		
Colorado	X		
Connecticut		X	
Delaware		X	
Florida		X	X
Georgia		X	
Hawaii		X	
Idaho			X
Illinois		X	X
Indiana		X	
Iowa		X	
Kansas			X
Kentucky	X		
Louisiana		X	
Maine		X	
Maryland		X	
Massachusetts			
Michigan	X		
Minnesota		X	X
Mississippi	X		
Missouri		X	X
Montana			X
Nebraska		X	
Nevada		X	
New Hampshire		X	
New Jersey		X	
New Mexico			X
New York		X	
North Carolina		X	
North Dakota		X	
Ohio		X	
Oklahoma		X	X
Oregon			X
Pennsylvania			X
Rhode Island		X	
South Carolina			X
South Dakota		X	
Tennessee		X	
Texas		X	
Utah			X
Vermont		X	
Virginia		X	
Washington			X
West Vergina		X	
Wisconsin		X	X
Wyoming		X	