BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Analysis Of The Allocation Formula For Federal Mass Transit Subsidies

The Federal Government grants funds to urban areas to subsidize mass transit operating expenses. These funds are allocated among areas on the basis of a congressionally determined formula.

This report develops criteria by which alternative factors that might be included in such a formula can be evaluated and then evaluates many potential factors according to these criteria. GAO suggests one possible formula that satisfies these criteria reasonably well. GAO also discusses the influence of the structure of the subsidy program on the extent to which transit service is financed through farebox revenues.

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COMPTROLLER GENERAL OF THE UNITED STATES
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To the President of the Senate and the
Speaker of the House of Representatives

This report analyzes the formula by which Congress allocates Federal assistance for mass transit operating expenses among urban areas. We have undertaken this review to assist the Congress in preparing future mass transit legislation.

Copies of this report are being sent to the Secretary of Transportation and the Chairmen of the relevant committees and subcommittees of the United States Senate and the House of Representatives.

Elmer B. Staats
Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

ANALYSIS OF THE ALLOCATION FORMULA FOR FEDERAL MASS TRANSIT SUBSIDIES

D I G E S T

The Congress has authorized Federal grants to urban areas to subsidize their mass transit operating expenses. Each area's share is determined by a formula. GAO has developed criteria by which various factors--for example, population or transit ridership--included in such a formula can be evaluated and has evaluated these factors according to these criteria.

Although no single factor satisfies all criteria, some are clearly unsatisfactory, and GAO has indicated the type of formula which satisfies the criteria reasonably well.

Also the way Federal operating assistance is distributed can influence local decisions about the type of transit service provided and the extent to which the service is financed through farebox revenues.

BACKGROUND

The Congress first authorized the use of Federal funds for urban mass transit operating assistance in 1974. The Surface Transportation Assistance Act of 1978 authorized more than $1.5 billion per year for this program for fiscal years 1979-82. The current formula allocates nearly all this money on the basis of population and population density.

EVALUATION CRITERIA

GAO has identified criteria by which potential allocation formulas can be evaluated:

--Inter-jurisdictional equity--Each area should receive an allocation appropriate to its relative need--however that need may be defined.

--Attainment of Federal program objectives--The formula should provide incentives for

transit operators to increase their shares of Federal assistance by actions that help attain Federal transit objectives.

--Creation and maintenance of incentives for efficiency--The factors in the formula should be ones that encourage efficient provision of service rather than reward transit operators with greater subsidies for inefficient behavior.

--Availability of data--Reliable measures of the variables in the formula should be available at a low cost.

Conflicts exist among these criteria. Although it is not possible to devise one unambiguously best formula, it is possible to describe the type of formula that best satisfies these criteria.

POTENTIAL FACTORS

GAO has evaluated many potential factors according to the criteria. They fall into four categories:

--Transit supply factors--Transit output (e.g., vehicle miles of service), transit input (e.g., number of vehicles), technological efficiency (e.g., vehicle-miles of service per employee), and transit availability (e.g., the percent of the population living within a specified distance of a transit route).

--Transit demand factors--Passengers and passenger miles.

--Joint transit supply and demand factors -

Use of provided service (e.g., riders per vehicle), cost efficiency of providing service (e.g., average cost per rider), and aggregate financial measures of the transit system (e.g., the size of the operating deficit).

--Urban-based factors--Population, population and employment density, density of commuting corridors, per capita income, age distribution of the population, and age of the city.

Several potential factors are clearly inferior, including:

--Transit input measures (except when funds are allocated specifically for input replacement).

--Ratio measures of transit output or consumption per unit (e.g., passenger-miles per employee).

--Total cost of providing service.

--Size of operating deficit.

COMBINING FACTORS INTO A FORMULA

GAO believes that a good formula should include at least one factor that assures that the largest shares go to urban areas with the greatest need and at least one that creates incentives for desirable responses by operators. One possible formula includes the following measures:

--Population.

--Population density.

--Revenue-seat-hours of service.

--Transit availability.

A formula based on the above factors is a reasonable way to allocate operating assistance because:

--Existing incentives for cost efficiency are maintained.

--Reliable data are generally available.

--The largest shares can be allocated to areas with the greatest need.

--Incentives are created to attain Federal program objectives.

--The formula is neutral with respect to the use of farebox revenues and State and

local subsidies to finance the non-federally-funded portion of transit costs.

USING SUBSIDIES TO FINANCE TRANSIT

Because the principle of using government funds in general and Federal revenues in particular to partially finance mass transit is well-established, GAO has not analyzed this principle in detail.

However, GAO believes that acceptance of this principle does not imply that all subsidy programs will lead to the benefits obtainable through proper implementation of Federal subsidies. The present program provides no assurance that the transit services subsidized will be the types of services for which economic efficiency arguments most imply the need for subsidies.

IMPACT OF FEDERAL ASSISTANCE ON USE OF FAREBOX REVENUES

The extent to which operators rely on farebox revenues to finance service can be affected by how Federal assistance is provided. The choice of certain factors, such as number of passengers, total revenue, or size of operating deficit, for inclusion in the allocation formula can bias local authorities' decisions toward greater or lesser reliance on farebox revenues. Requirements and limitations associated with the receipt of Federal assistance can also influence local fare policy.

MATTERS FOR CONGRESS

Current legislation authorizes operating assistance through fiscal year 1982. Before then the Congress will need to consider reauthorizing this program. GAO suggests that if the decision is made to continue the program, congressional committees examine alternative allocation formulas.

The Congress will also need to evaluate new Department of Transportation proposals for allocating bus replacement funds in 1981 and 1982.

GAO's analysis of the allocation formulas is an input to the congressional decisions concerning these issues.

Early consideration should be given to assure the existence of the necessary data to implement a formula of the type proposed by GAO. Since there is ample leadtime in determining a new formula, the Congress may wish to ask the Urban Mass Transportation Administration to develop cost estimates for obtaining more accurate measures of transit availability, a factor which GAO finds particularly useful in allocating operating assistance.

If the decision is made to use a formula with several transit-based as well as urban-based factors, the Congress must decide the appropriate weights given to each. GAO's analysis indicates that the greatest incentives for attaining Federal program objectives and providing service efficiently can be provided within the proposed formula by weighting revenue-seat-hours and transit availability most heavily.

AGENCY COMMENTS

The Department of Transportation generally agrees with GAO's analysis procedure. It believes that GAO's study is a valuable examination of the considerations involved in providing operating subsidies and that GAO's findings are, to a large extent, conceptually satisfying.

Its principal concerns relate to the practicality of obtaining data on revenue-seat-hours and transit availability in order to include these as factors in an allocation formula. On the basis of its experience, it feels that any factor used in such a formula must be extremely simple and require a minimum of data and computations for its formulation.

Tear Sheet

Contents

ABBREVIATIONS

DOT	Department of Transportation
FARE	Financial Accounting and Reporting Elements
GAO	General Accounting Office
MOE	maintenance of effort
NMTA Act	National Mass Transportation Act
STA Act	Surface Transportation Assistance Act
UMT Act	Urban Mass Transportation Act
UMTA	Urban Mass Transportation Administration

CHAPTER 1

INTRODUCTION

In the past 15 years, the Department of Transportation (DOT) has spent over $11 billion to help State and local governments finance urban mass transit. Originally Federal assistance was confined to capital grants, but in recent years it has included money to cover operating expenses as well. This report concerns how these operating subsidies are provided to local transit authorities.

Instead of relying on discretionary approval of grant applications, as is done under the capital program, DOT calculates each area's share of the operating assistance funds according to a congressionally approved formula. Many potential factors can be included in such a formula. The choice of factors is crucial both for determining each area's initial allocation and for creating incentives for attaining larger shares of future allocations. In addition, both the choice of factors and other requirements of the operating assistance program can influence the relative use of farebox revenues and State and local subsidies to finance the non-federally-funded portion of mass transit. This report concentrates on the incentives that assistance formulas create.

Chapter 2 reviews the legislative history of Federal mass transit assistance in order to provide background on the operating assistance program. Chapter 3 suggests criteria by which proposed allocation formulas can be evaluated and discusses potential conflicts among these criteria. Chapter 4 evaluates many proposed factors according to these criteria. Although we do not recommend one specific formula, our analysis enables us to identify some potential factors that are clearly inferior and to describe a type of formula that satisfies our criteria reasonably well. Chapter 5 shows that the arguments made in favor of Federal subsidies do not imply that all subsidy programs will lead to the efficiencies that are potentially available through subsidization. We also discuss the affect of Federal operating assistance on the extent to which local transit authorities rely on farebox revenues to finance transit service. Chapter 6 examines the extent to which acceptance of the incentives included in the formula suggested in chapter 4 can increase an urban area's share of the funds.

Although the Congress passed new legislation in the past session to continue the operating assistance program through

fiscal year 1982 and to alter the formula by which this assistance is allocated, we anticipate further reviews of these issues from time to time. This report is intended to help both DOT and congressional committees to prepare future mass transit legislation. In addition, our analysis will be useful to State transportation authorities who must decide how to allocate State funds among local transit systems.

CHAPTER 2

LEGISLATIVE BACKGROUND

The first legislation related to mass transit was passed in 1961, but Congress did not authorize the use of Federal funds to pay mass transit operating expenses until 1974. The Surface Transportation Assistance (STA) Act of 1978 modified the operating assistance program. A brief review of mass transit legislation helps to understand the current program.

A limited form of urban transport assistance was incorporated in the Housing and Urban Development Act of 1961. Under this act, only one loan of $3 million was made and $24.2 million was obligated for mass transit demonstration projects. The Federal share of each project was limited to two-thirds of the total cost.

URBAN MASS TRANSPORTATION ACT OF 1964

The Congress first passed a major bill committing Federal aid to urban mass transportation in 1964. In the decade before passage of this bill, 194 private transit companies had gone out of business. Many small and medium-sized cities no longer had bus service and others, including some large ones, were threatened with the loss of service. Federal assistance was seen to be necessary to preserve and improve existing services in order to reclaim riders who had switched from public to private transportation.

The Urban Mass Transportation (UMT) Act of 1964 continued the demonstration grant program but, more important, it also established a program of Federal capital expenditure grants to State and local governments. The UMT Act was passed largely to permit public takeovers of failing private systems. Its three purposes were

> "(1) to assist in the development of improved mass transportation facilities, equipment * * * (2) to encourage the planning and establishment of area-wide urban mass transportation systems * * * and (3) to provide assistance to State and local governments * * * in financing such systems * * **". 1/

The capital grant program authorized the Federal Government to provide matching grants to local governments to

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1/Public Law 88-365, section 2(b).

preserve, improve, and expand urban mass transportation systems. These grants could be used to help finance

> "the acquisition, construction, reconstruction, and improvement of facilities and equipment for use * * * in mass transportation service in urban areas * * **". 1/

However, no money could be used for operating expenses.

Although grants were limited to public bodies, the UMT Act provided for the participation of private companies "to the maximum extent feasible." Local authorities could use their Federal funds either to purchase private systems or to purchase vehicles for operation by private systems. The Federal share of those capital investments was limited to two-thirds of the net cost, to be matched by a one-third local government contribution. The net cost was defined as that portion of a project's cost which could not be financed from farebox revenues. "Thus, the grant program was explicitly designed to produce investments which the ordinary processes of the capital market would not produce." 2/

The Congress authorized relatively small amounts for the capital grant program of the 1964 UMT Act: $75 million for fiscal year 1965 and $150 million for each of 1966 and 1967. Later bills authorized $150 million for each of 1968 and 1969, $190 million for 1970, and $300 million for 1971. Actual appropriations for grants were less than the authorized amounts. There was also a limitation that no more than 12-1/2 percent of all capital grant funds could be appropriated to any individual State.

The UMT Act reflected an ambivalent attitude toward Federal intrusion into local transit decisionmaking. The existence of a unified urban transportation plan was a prerequisite for receiving Federal grants. In addition, air pollution standards had to be met and the interest of employees affected by Federal assistance had to be protected in ways approved by the Secretary of Labor. On the other hand, how-

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1/Public Law 88-365, section 3(a).

2/George W. Hilton, Federal Transit Subsidies, American Enterprise Institute, Washington, D.C., 1974, p. 7.

ever, the Federal Government was specifically prohibited from regulating

> "the mode of operation of any mass transportation system * * * or * * * the rates, fares, tolls, rentals, or other charges fixed or prescribed for such system by any local public or private transit agency." 1/

The urban mass transportation program was placed in the Department of Housing and Urban Development when it was created in 1965. DOT was created in 1966, and the Congress later established the Urban Mass Transportation Administration (UMTA) within DOT to assume responsibility for the program beginning July 1, 1968.

URBAN MASS TRANSPORTATION ACT OF 1970

By the late 1960s, many transit systems were publicly operated and the pressing need was for funds to maintain and expand services rather than to acquire them. There was widespread recognition that the existing mass transportation program was insufficient to fund major improvements in mass transit, particularly rail rapid transit. Major funding increases and an assurance of continued availability of Federal support were both needed, and these changes were incorporated into the Urban Mass Transportation Act of 1970.

The UMT Act of 1970 passed both the House and the Senate by overwhelming majorities, indicating substantial bipartisan support for the concept of Federal subsidies for urban mass transit. In this act, the Congress enunciated a commitment by the Federal Government to spend at least $10 billion during a 12-year period to solve the Nation's urban mass transportation problems. Of that amount, actual contract authority was given for grants totaling $3.1 billion during the first 5 years. With this act's passage, local authorities could now make their transit plans and apply for Federal capital grants with a reasonable expectation of continued availability of Federal support.

Federal subsidies for capital expenditures were intended to allow capital investment projects that could not be financed from farebox revenues. By 1970, many transit properties could no longer cover even their operating costs and the transit industry as a whole was running a substantial operating deficit. Many industry leaders favored repeal of

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1/Public Law 88-365, Section 9(f).

the prohibition against using Federal funds to pay transit operating expenses. Section 9 of the UMT Act of 1970 directed the Secretary of Transportation to conduct a study of the feasibility of providing Federal subsidies to help defray transit operating expenses and to report his findings and recommendations to the Congress within 1 year. In 1971 DOT issued its report, "Feasibility of Federal Assistance for Urban Mass Transportation Operating Costs," which recommended against Federal assistance for operating expenses.

Several major changes in the Federal role in financing urban mass transportation went into effect with the passage of the Federal-Aid Highway Act of 1973. This act authorized $3 billion in contract authority for the urban mass transportation capital grant program, raising the total available for capital grants to $6.1 billion. Also this act increased the share which the Federal Government would pay for capital expenditures from two-thirds to 80 percent of the project's net cost. Another portion of this act allowed, for the first time, use of highway funds for transit purposes when local and State authorities felt that their needs required a nonhighway public mass transit project. These funds could be used for, among other things, constructing exclusive bus lanes and fringe parking lots, constructing or improving fixed rail facilities, and purchasing buses or fixed rail rolling stock.

NATIONAL MASS TRANSPORTATION ASSISTANCE ACT OF 1974

In 1974 the Congress authorized, for the first time, Federal subsidies to pay transit operating expenses with the passage of the National Mass Transportation Assistance (NMTA) Act.

Opponents of Federal operating assistance had argued for many years that Federal subsidies should be restricted to capital grants. There were four major arguments to support this view: 1/

1/An additional argument sometimes made was that operating subsidies reward inefficiency with additional funds. This argument, however, assumes that subsidies will be allocated on the basis of transit systems' operating deficits so that an increase in deficit size will cause an increase in Federal assistance whereas, in fact, subsidies can be allocated on many bases.

1. The industry is capital poor. Major improvements in the transit system--modernization of existing rail rapid transit systems, construction of several new ones, replacement of obsolete buses--are needed to revive the industry. And since these needs require capital outlays, Federal assistance should be in the form of capital grants rather than operating assistance. 1/

2. Capital grants prevent transit unions from capturing most of the benefits of the Federal assistance in the form of higher wages or increased employment.

3. Restricting Federal assistance to capital grants limits the Federal Government's liability because the aid is delivered on a discontinuous project basis and can be reduced or ended when a program's goals are accomplished. Subsidies for operating expenses, on the other hand, are ongoing commitments; recipients begin to expect these payments as a matter of right.

4. Capital grants are highly visible means of showing Federal concern for mass transit problems.

By 1974, however, economists had shown these arguments to be largely invalid. If Federal subsidies are provided, limiting them to capital grants causes inefficiencies.

A model of optimal bus replacement decisions was developed to test the hypothesis that the industry was undercapitalized. No support for that hypothesis was found; instead, bus replacement decisions in Cleveland and Chicago were found to be very close to optimal. 2/ Restrictions limiting Federal assistance to capital grants provide incentives for local governments to inefficiently waste capital,

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1/Another point frequently made in conjunction with this argument is that local governments' action will not lead to these needed capital projects, either because local governments do not have the money to fund them or because local governments generally fail to provide for their long-term capital needs.

2/William B. Tye, "Economics of Urban Transit Capital Grants," in Price-Subsidy Issues in Urban Transportation, Highway Research Record No. 476, Washington, D.C., 1973, pp. 32 and 33.

such as by premature replacement of buses. With the Federal Government committed to paying 80 percent of the cost of a capital project, local authorities would tend to trade off operating expenses for capital expenses whenever an additional $1 dollar in capital costs would reduce operating expenses by 21 cents or more.

This incentive to overcapitalize the industry naturally led to a large increase in the demand for capital grant funds; rather than providing limited liability to the Federal Government, this program makes further demands for assistance seem inevitable.

Limitations of Federal assistance to capital grants provide no assurance that the assistance will lead to improved service rather than higher wages for transit workers. That argument ignored the fungibility, or interchangeability, of money. A subsidy for capital expenses reduces the cost of providing transit services. Operators could pass the benefit on to riders by reducing fares or increasing service. However, they could also maintain the same fares and service that would have existed without any Federal assistance and instead use the savings in capital costs to pay higher wages. The type of expenditure subsidized does not determine the ultimate beneficiary.

The visibility argument in behalf of capital grants is not an economic argument and is, therefore, not susceptible to economic analysis. However, whatever advantages arise due to visibility are purchased at the cost of wasteful use of capital that occurs when Federal assistance is limited to capital expenses. Furthermore, the reliance on capital grants for their visibility encourages installation of new facilities rather than achievement of program objectives, such as increased transit availability for transit dependent groups, as a measure of the effectiveness of Federal assistance.

As a result of the growing operating deficits of the industry 1/ and the increased awareness of the weakness of the arguments against Federal subsidies for operating assistance, the Congress amended the UMT Act to allow Federal assistance for operating expenses. The NMTA Act of 1974 created a new Section 5 in the UMT Act. Section 5(d) authorized using Federal funds for "the payment of operating expenses to improve or to continue such service by operation,

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1/A major reason in the growth of operating deficits during this period was the policy of operators not to increase fares enough to offset inflation.

lease, contract, or otherwise." 1/ Money authorized under section 5 can also be used for capital expenses, although in practice very little has been used in that way.

The Congress authorized nearly $4 billion for a 6-year period as section 5 subsidies, beginning with $300 million in fiscal year 1975 and increasing to $900 million in 1980. An important decision was made in determining that local authorities rather than riders would be the initial recipients of the subsidies. 2/ Therefore, it was necessary to decide how the funds would be allocated among urban areas. Administrative convenience suggested that each area's share be determined by a formula based on known factors; this reduced the burden on DOT that would arise in evaluating individual requests for funds from hundreds of operators. The formula approach also satisfied the political need to spread the funds among many areas while removing the appearance of political decisionmaking inherent in a discretionary grant program. In addition, under the formula approach, "grantsmanship" is not relevant in determining each area's share.

Once the Congress had decided to use a formula to allocate operating subsidies, it next had to decide which factors to include in it. Different combinations of factors would produce vastly different allocations. The two factors chosen were population and population density. Denser and more populous areas were felt to have greater need for assistance.

Algebraically the allocation formula is expressed as follows:

$$S_i = \frac{P_i}{\sum_{i=1}^{n} P_i} \times 1/2\ T + \frac{P_i \times D_i}{\sum_{i=1}^{n} (P_i \times D_i)} \times 1/2\ T$$

Where P_i = an urban area's population;

D_i = an urban area's population density, measured as persons per square mile;

1/Public Law 93-503, section 103(a).

2/An example of a user-side subsidy is the food stamp program. A similar transit stamp program could have been adopted to subsidize designated transit users.

$\sum_{i=1}^{n} P_i$ = the sum of all urban areas' populations;

$\sum_{i=1}^{n} (P_i \times D_i)$ = the sum of each urban area's population multiplied by its population density;

T = the total funds to be allocated; and

S_i = an urban area's share of the funds.

Congress might have chosen many other factors to allocate section 5 funds. The next chapter identifies criteria that can be used to evaluate potential formulas. Chapter 4, evaluates some factors which might be used in formulas according to our criteria.

The amended section 5 of the UMT Act limited the Federal share of the available funds to 50 percent of any urban area's transit operating deficit, regardless of the amount determined by the formula. This still left some discrepancy with capital expenses, for which the Federal share was 80 percent. However, the 50-percent limit was not a binding constraint for most major transit systems, although it was for many small ones (which generally did not receive capital grants).

An important provision of the amended section 5 was the "maintenance of effort" (MOE) requirement, which stated that

> "Federal funds * * * shall be supplementary to and not in substitution for the * * * State and local government funds * * * expended on the operation of mass transit service in the area involved * * *". 1/

The purpose of this requirement was to prevent State and local governments from simply replacing their own transit subsidies with Federal operating assistance. UMTA has interpreted the MOE provision to mean that any reduction by State and local governments in their subsidies requires a complete halt to Federal operating assistance, rather than a proportional reduction. Obviously an MOE requirement greatly influences local authorities' decisions about the relative shares of transit costs to be covered by farebox revenues and subsidies. This issue is discussed in chapter 5.

1/Public Law 93-503, section 103(a).

The NMTA Act of 1974 also extended and increased the section 3 so-called discretionary capital grant program. 1/ The Congress authorized expenditures of $7.325 billion for fiscal years 1975-80, nearly twice as much as was authorized for formula grants (operating subsidies). The amount for which contract authority existed and, therefore, could be used to fulfill obligations authorized in advance of appropriations was increased from $6.1 billion to $10.925 billion.

SURFACE TRANSPORTATION ASSISTANCE ACT OF 1978

Between 1974 and 1978, the Senate twice passed bills to amend the UMT Act, but neither became law. In the 94th Congress, the Senate passed the NMTA Act Amendments of 1975, but the House failed to act. Then in 1977 the Senate incorporated many of the features of that bill into the NMTA Act Amendments of 1977 and passed that bill. It provided new capital grant authority and additional funds for operating assistance, extended operating assistance to nonurbanized areas, and expanded Federal subsidies for commuter rail services. Only the sections dealing with commuter rail operating assistance were enacted into law.

However, in 1978 the Congress passed the STA Act of that year, which includes many changes in the Federal mass transit subsidy program. The STA Act of 1978 deals with both highways and mass transit. The mass transit portion of the act authorizes funds for section 5 formula grants through fiscal year 1982 and for section 3 discretionary capital grants through 1983.

The Senate version of this bill would have drastically altered the formula grant program, but the changes included in the final enacted bill are much less severe. Nonetheless, there are changes in the amounts authorized, the way in which Federal funds are to be allocated among urban areas, the ways these funds are to be used, and the MOE requirement.

The STA Act of 1978 authorizes vastly increased amounts for section 5 formula grants. These amounts range from $1.515 billion for 1979 to $1.765 billion for 1982. Part of this increase is due to switching funds for routine bus replacement from the discretionary capital grant program to the formula grant program.

1/Section 3 capital grants are referred to as discretionary because urban areas must submit applications for these funds and judgment is applied in choosing which projects will be funded.

The allocation formula still relies heavily on population and population density, but it is now more complicated. More than half the available funds, $850 million in 1979 and $900 million thereafter, will continue to be allocated by the formula set forth in the NMTA Act of 1974: half determined by population and half determined by population times population density. An additional $250 million per year will be allocated by these same factors but only after this amount has been first divided among size categories of urban areas; 85 percent will go to areas with more than 750,000 people and 15 percent will go to smaller areas. 1/ Local authorities have freedom to use both tiers of funds for operating or capital expenses, although in the past, formula grants have been used overwhelmingly for operating expenses.

In a major departure from past practice, the Congress has chosen to require that portions of an area's funds be spent in particular ways. Amounts ranging from $300 million in 1979 to $455 million in 1982 have been authorized solely for purchasing buses and related equipment and constructing bus-related facilities. The Senate version of the bill called for the bus replacement funds to be allocated by factors measuring the number of bus seat miles and the age of bus fleets. The rationale for this approach is that these factors reflect an area's need for bus replacement. However, the enacted legislation calls for bus replacement funds to be allocated by the standard population/population density formula for 1979 and 1980. The Secretary of Transportation is required to study alternative approaches for allocating bus replacement funds. The Congress will have an opportunity to consider this study before deciding how to allocate these funds in 1981 and beyond.

1/The purpose of dividing this "second tier" of funds such that 85 percent goes to urban areas with populations over 750,000 is to assure that the largest areas will receive greater allocations than if the population/population density formula had been applied to the entire $250 million. However, the difference is really fairly small. UMTA has calculated that 65 percent of the funds is allocated on a population/population density basis to areas with populations exceeding 1 million; therefore, a slightly larger percentage is allocated to areas with populations exceeding 750,000. Thus, allocating 85 percent to areas with population exceeding 750,000 adds less than $50 million to the total available annually to those areas.

The Congress has also included in the formula grant program funds for fixed guideway systems. 1/ The STA Act of 1978 authorizes from $115 million in 1979 to $160 million in 1982 for capital or operating assistance projects involving commuter rail or other fixed guideway systems. These funds will be allocated on the basis of each urban area's share of the Nation's commuter-rail-train-miles, commuter-rail-route-miles, and fixed-guideway-system-route-miles other than commuter-rail-route-miles. One-third will be allocated on the basis of each of these three factors; each area's share will equal the total being allocated by that factor multiplied by the ratio of that area's total to the national total for that factor. However, no urban area can receive more than 30 percent of the total allocated by any of these factors.

The allocation formula for fiscal year 1979 is summarized in table 1.

UMTA has not allocated fixed guideway funds for fiscal year 1979 due to legal technicalities concerning the applicability of this section of the formula for this year. 2/ The remainder of the funds nas been allocated, and the amounts going to the 20 urban areas with largest shares are listed in table 2. 3/

The STA Act of 1978 vastly alters the MOE requirement of the NMTA Act of 1974 for operating assistance. The Congress now asserts that its intent in making Federal assistance "* * * supplementary to and not in substitution for * * *

1/Fixed guideways refer to any public transportation facilities which use and occupy separate rights-of-way for the exclusive use of public transportation service.

2/GAO's decision in the matter of Rail Service Operating Payments Appropriation FY 1979-Applicable Allocation Formula, B-175155, July 25, 1979, was that UMTA is not required to allocate commuter rail operating payments for 1979 on the basis of the formula in the STA Act because these payments were not appropriated pursuant to the authorization in that Act. As a result of this decision, only the commuter rail services, and not other fixed guideway systems, have been funded thus far from funds previously appropriated.

3/Table 2 is based on UMTA calculations that of the $250 million authorized for 1979 for "second tier" funds, only $150 million has actually been appropriated.

local government funds * * *" is not that any failure by a local government to meet its MOE requirement should lead to a cessation of Federal assistance--the previous interpretation--but that such a failure should lead to a reduction in Federal assistance proportional to the shortcoming in local government assistance. Furthermore, the Congress has eased the requirement itself. If local authorities can demonstrate that they have reduced their operating costs without reducing their level of transit services, then they can reduce their local subsidies without failing to meet the MOE requirement. In addition, they are now free to reduce local subsidies and to offset these reductions by increased operating revenues arising from changes in fare structure. The MOE requirement will lapse in fiscal year 1982 if no further changes are made.

The Senate version of the STA Act of 1978 would have replaced the provision of the NMTA Act of 1974 that limited an area's Federal operating assistance to 50 percent of its operating deficit with a provision limiting the Federal share to one-third of total operating costs. However, this change was not included in the final version of the bill. Chapter 5 discusses the implications of this potential change, as well as the approved changes in the MOE requirement, on the relationship between governmental subsidies and farebox revenues in financing urban mass transit.

Table 1

Summary of Allocation Formula for Fiscal Year 1979 Section 5 Funds

Category of funds	Total to be allocated in fiscal year 1979	Factors used to allocate funds among urban areas	Items on which funds may be spent
First tier	$850 million	Population, population density	Any operating or capital expenses
Second tier	$250 million	Population, population density (note a)	Any operating or capital expenses
Bus replacement	$300 million	Population, population density	Purchases of buses and related equipment and construc- of bus related facilities
Fixed guideway	$115 million	Commuter-rail-train-miles, commuter-rail-route-miles, fixed-guideway-system-route-miles other than commuter-rail-route-miles	Operating expenses for commuter rail systems (note b)

a/Second tier funds are first apportioned such that 85 percent go to urban areas with more than 750,000 people and 15 percent go to smaller urban areas. Population and population density are used to allocate among areas in each size category.

b/These funds are limited to operating expenses for commuter rail systems in 1979 only. For the remainder of the time covered by the STA Act, these funds can be used for any capital or operating expenses for commuter rail or other fixed guideway systems.

Table 2

Twenty Largest Allocations of Fiscal Year 1979 Section 5 Funds (note a)

Urban Area	States	Fiscal year 1979 allocation (millions)
New York	New York, New Jersey	$236.6
Los Angeles-Long Beach	California	106.4
Chicago	Illinois, Indiana	85.0
Philadelphia	Pennsylvania, New Jersey	51.4
Detroit	Michigan	46.5
San Francisco-Oakland	California	34.3
Washington	District of Columbia, Virginia, Maryland	30.6
Boston	Massachusetts	29.0
St. Louis	Missouri, Illinois	20.9
Baltimore	Maryland	19.7
Cleveland	Ohio	18.9
Pittsburgh	Pennsylvania	18.0
Houston	Texas	16.4
Minneapolis-St. Paul	Minnesota	14.9
Miami	Florida	14.6
Buffalo	New York	13.5
San Juan	Puerto Rico	13.4
New Orleans	Louisiana	12.1
Seattle-Everett	Washington	11.9
San Diego	California	11.8

a/These allocations do not include funds to be allocated for fixed guideway system expenses.

CHAPTER 3

CRITERIA FOR EVALUATING ALLOCATION FORMULAS

Section 5 of the UMT Act authorizes using Federal funds to subsidize operating expenses of local transit operators. These funds are allocated among urban areas on the basis of a formula which determines each area's share.

The choice of factors for inclusion in the formula determines each area's share of the total appropriated for section 5. Some factors, such as measures of transit performance, may also create incentives for transit operators to alter the scope and type of services provided in order to increase their shares of future allocations.

Many possible factors can be used, either individually or jointly. The first step necessary to evaluate alternative specifications of the section 5 formula is to establish criteria by which these proposed formulas can be evaluated. Operating assistance subsidies are allocated annually. Therefore, the Congress, in evaluating these formulas, must consider the likely incentive effects as well as the initial allocation.

There is no universally accepted set of criteria for evaluating allocation formulas. However, after an extensive review of the transit subsidy literature, 1/ we have identified and concentrated on these four criteria which we believe capture the most commonly discussed issues: (1) interjurisdictional equity, (2) attainment of Federal program objectives, (3) creation and maintenance of incentives for efficiency, and (4) availability of necessary data. Other reasonable criteria may exist, but satisfaction of these four should ensure a satisfactory formula.

INTERJURISDICTIONAL EQUITY

Economists frequently define two components of equity. Horizontal equity requires that those in like situations be treated equally. Vertical equity requires that the burden and benefit be apportioned such that those most in need

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1/One good analysis of the criteria for evaluating transit allocation formulas is that presented by Walter Y. Oi ("The Federal Subsidy of Conventional Mass Transit," Policy Analysis, Vol. 1, No. 4, Fall 1975, pp. 613-658). We have used some of the ideas Oi has developed but have modified them in choosing our criteria.

receive the greatest benefit while those most able to pay bear the greatest burden. 1/

To use an equity criterion to evaluate allocation formulas, we must decide both the groups whose situations will be compared and the characteristics of the situations for which similarity is analyzed. We have selected urban areas rather than individuals as the groups to compare. That is, interjurisdictional equity is obtained when each area receives an "equitable" share. We have chosen this approach rather than a definition based on comparing individuals' income levels because decisions about how the funds will be used and which income classes will receive the greatest benefits are made mostly at the local level. To the extent that income redistribution is an objective of Federal operating subsidies that topic will be considered in the discussion of the second criterion.

Unfortunately there is no obvious way to determine each urban area's equitable share. There is no consensus about the variable which most accurately reflects an area's need for operating assistance. One possibility is the number of riders. In this view, the Congress can achieve both horizontal and vertical equity by making each area's share proportional to its share of total transit riders, creating an equal subsidy per rider. However, such a subsidy does not consider distances traveled per ride. Since longer trips are presumably more costly to provide than shorter ones, a subsidy based on passenger miles rather than number of passengers might be more equitable.

There are other measures besides passengers and passenger-miles for which an equity principle could be suggested to support that measure's inclusion in an allocation formula. Possibilities include, among others, equal subsidy per resident, per dollar of local expenditure on transit, per dollar of deficit, and per vehicle mile of service. The interjurisdictional equity criterion can be considered only in conjunction with attainment of Federal program objectives. That is, the variable which is compared to determine equity depends in part upon the objectives of Federal mass transit operating subsidies. Nonetheless, a satisfactory formula should in some way consider the relative need for assistance among areas.

1/Obviously many degrees of vertical equity are possible, and choosing one is a political decision.

ATTAINMENT OF FEDERAL PROGRAM OBJECTIVES

The allocation formula should further the attainment of the objectives of the operating assistance program. In part, this criterion can be affected by the allocation of funds among urban areas. For instance, if maintaining of rail transit were an objective, then this criterion could best be met by allocating large shares to areas with existing rail transit systems. At least some of these objectives, however, are likely to be broad enough that they can be satisfied in all or most areas. Therefore, the primary impact of the formula on this criterion lies in the incentives created. Variables based on measured transit characteristics can induce responses designed to increase transit systems' shares. Factors that induce responses which further Federal program objectives will satisfy this criterion.

To determine whether specific responses by local operators further Federal program objectives, it is necessary to clarify what these objectives are. In various mass transportation laws, the Congress has articulated its findings on the state of urban mass transportation and the need for Federal assistance to enable local governments to provide adequate service.

For instance, in 1964 the Congress found that "the deterioration or inadequate provision of urban transportation facilities" and the "intensification of traffic congestion" were jeopardizing "the satisfactory movement of people and goods" within urban areas. 1/ By 1970 the Congress found "the ability of all citizens to move quickly and at a reasonable cost" to be "an urgent national problem." 2/ In 1974 the Congress found "the maintenance of even minimal mass transportation" was becoming threatened and stated that "the termination of such service or the continued increase in its costs to the user is undesirable." 3/ Although the STA Act of 1978 contained no statement of findings, the Senate-passed version of that bill did. These findings were that there should be a "reaffirmation of the national commitment to the continued improvement of existing services and the development of additional services," that "the appeal and accessibility of public transportation as a viable alternative to excessive automobile

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1/Public Law 88-365, section 2(a).

2/Public Law 91-453, section 1.

3/Public Law 93-503, section 2.

use" must be broadened, and that there must be programs "to improve service to people who have particular need for effective public transportation." 1/

From these general findings we have identified specific actions that appear to further Federal program objectives. These include improvement in the quality of existing service, provision of additional service on existing routes, extensions of transit systems to make mass transit accessible to more people, and special efforts to improve accessibility to the handicapped. Quality improvements, of course, could take many forms, such as increased speed or comfort of travel.

The multiplicity of objectives and the potential conflicts among them create a problem in evaluating the effect of including a particular factor in an allocation formula. Responses to incentives designed to further one objective may simultaneously make the attainment of another objective less likely. For instance, introducing special facilities on buses to make them usable by the handicapped would increase mobility for that group. However, increases in boarding time due to use by the handicapped would increase total trip time by bus relative to cars and might reduce ridership by nonhandicapped persons.

CREATION AND MAINTENANCE OF INCENTIVES FOR EFFICIENCY

For a long time, many people believed that Federal capital grants might lead to improved mass transit service but that operating subsidies would only lead to higher costs of providing service. However, the adverse consequences--such as overcapitalization--of restricting Federal subsidies to capital grants have been thoroughly analyzed in recent years, and the arguments in favor of such a policy have been shown to be analytically unfounded. 2/ Economists generally believe that if Federal subsidies for mass transit are provided, then unrestricted grants that can be used for either capital or operating assistance are likely to prove the most efficient approach.

1/S. 2441, 95th Congress, section 101(a).

2/See, for instance, William B. Tye, "Economics of Urban Transit Capital Grants" in Price-Subsidy Issues in Urban Transportation, Highway Research Record No. 476, Washington, D.C., 1973, pp. 30-35.

Nonetheless, efficiency is a relevant criterion because of the potential incentive effects of the allocation formula. An ideal formula encourages efficiency rather than gives operators incentives to act inefficiently to increase their shares of future allocations. Such inefficiencies can occur both in choices of inputs and in provisions of service. Formulas in which allocations are based either on use of a particular input or on the size of the deficit seem particularly likely to promote inefficiencies. Similarly, formulas based on levels of service provided, without any consideration of demand, may lead to inefficiencies, such as running empty buses.

AVAILABILITY OF NECESSARY DATA

The Government needs reliable measures of the variables in the formula to accurately determine each urban area's share of the operating subsidies. Accurate data can be obtained quite inexpensively for some variables, particularly those that describe characteristics of the urban areas. The transit industry, however, has long been hampered by an absence of reliable data on transit performance measures. Acquisition of certain types of data may prove quite expensive.

Federal operating assistance for mass transit is allocated annually. Therefore, the Government's perspective on the question of data should be on a longrun basis. That is, the potential availability of reliable measures is more important than the current existence of the data.

Several types of defects may exist in the data. In some cases, such as ridership, it is widely believed that the data are not very accurate and that verification or auditing is not likely to improve the situation. Some information can be obtained only from surveys of riders. Although this approach may produce reasonably accurate data, the costs are likely to be high. These costs are a deadweight loss to society and reduce the benefits of the subsidy program. Another problem is that transit systems use various definitions for some variables. Data from one system may not be comparable with data from others.

The Congress has recognized the need for better data on transit performance. Section 15 of the UMT Act requires the Secretary of Transportation to "* * * accumulate public mass transportation financial and operating information by uniform categories and a uniform system of accounts and records." The project which will accomplish this end is known as FARE, Financial Accounting and Reporting Elements.

All transit systems must subscribe to FARE to be eligible for Federal operating assistance.

The FARE system will lead to the creation of a data base of transit performance measures far superior to that which has existed previously. Comparable data for at least some variables will be available, which will increase their attractiveness as factors on which to base allocation formulas. Since there is ample time before the need to reauthorize the operating assistance program, the Congress may wish to ask UMTA to develop cost estimates for acquisition of data on additional variables which satisfy the other criteria in order to use them also as factors in future formulas.

CONFLICTS AMONG CRITERIA

These four criteria are, we believe, a reasonable basis for evaluating factors to be used in an allocation formula. However, no factor is likely to exist that exactly satisfies all criteria. Attempts to satisfy one criterion may work directly contrary to another because of inherent conflicts among the criteria.

The Federal Government has introduced mass transit operating assistance into an environment in which there is great variance among urban areas with respect to both the scope and type of their transit systems and their fare policies. Some areas have extensive systems that cover much of these areas, while others offer only rudimentary service. In some areas deficits have been kept low by recovering most costs from riders, while in others a deliberate policy of large State and local subsidies (large deficits) has been adopted.

As a result, Federal operating subsidies can be used as either a reward or an incentive. The Congress can either reward urban areas that have spent a lot of their own money in developing extensive transit systems by giving them financial relief in the form of large Federal operating subsidies or, instead, subsidize the efforts of areas without extensive transit systems as an incentive to develop them. The reward approach recognizes past transit spending and allocates funds on the basis of existing conditions, while the incentive approach emphasizes provision of funds to expand beyond the current state.

The Congress can use transit performance measures to allocate operating assistance in order to induce responses in the form of increased or improved service. If each area's share were proportional to the number of vehicle-miles of

service, for instance, operators would have an incentive to expand their services. And if expansion of service is an objective of Federal policy, then encouraging such responses is consistent with satisfying that criterion.

However, a formula based on vehicle miles will allocate the largest shares to areas that already provide large amounts of transit service. The greatest potential for expanding service is likely to be in areas in which little service is currently provided. Although an attempt to induce expansion of service may be desirable, only limited funds would be available, at least in the short run, to offset operating expenses in those areas that choose to expand their service, thereby lessening the chances of obtaining the objective.

If, instead, the Congress used vehicle-miles to allocate operating assistance but gave the largest shares to areas with few vehicle-miles, more of the funds would go to areas in which there was the greatest potential to increase service. However, the incentive effects would be intolerable; urban areas could keep their shares high by continuing to provide little service. Equity principles, such as equal subsidy per rider or per passenger mile, also imply rewarding areas with widespread service, even if such action directs the bulk of the funds away from those areas with the greatest potential to increase service.

There is no way to entirely resolve this conflict. The negative incentive effects of rewarding low levels of service --or some other measure--suggest that to the extent the attainment of Federal program objectives is a relevant criterion, formulas should be structured to encourage movement toward those objectives, even if initially this implies that the largest shares will go to areas already meeting them. One potentially successful resolution would be for the Congress to use the improvement in an area's performance as the basis for determining its share. This approach focuses attention on the additional service provided and creates incentives to expand service in all urban areas. However, in comparing improvements among areas, the Congress will need to consider the different levels of service from which the areas are beginning.

Potential for conflict also exists between the criteria of attaining Federal program objectives and creating and maintaining incentives for efficiency. Attempts to induce local transit decisions that further Federal objectives may simultaneously induce economically inefficient behavior. Objectives of mass transit assistance are frequently phrased as increases in the level of service, such as increased

vehicle-miles. If the objective is to increase the level of service and the Congress uses vehicle-miles to allocate the funds, operators will have an incentive to attain this objective by expanding their service. Operators, however, may inefficiently choose to expand their service on high speed routes even if demand considerations suggest expansion elsewhere, because at higher speeds more vehicle-miles could be obtained per vehicle in a given time.

Attempts to increase their shares of Federal operating subsidies by actions that help attain Federal objectives may also cause inefficient combinations of inputs in providing transit service. To increase the number of vehicle-miles, operators might be biased toward acquiring smaller vehicles and using them more frequently. If an objective of efficient use of resources is measured in terms of output per unit of a specified input--such as passenger miles or revenues per employee--then there is a bias away from that input, which may produce an inefficient combination of inputs.

Finally there is potential for conflict between the attainment of Federal program objectives and the widely held belief in local autonomy.

Local authorities likely are most familiar with their own transit needs, and the Congress has generally allowed them to decide about the type and scope of services offered. However, it is improbable that all uses to which local authorities would put Federal funds would be steps toward Federal objectives. The Congress can create incentives for local decisions to be consistent with Federal objectives by using measures of transit performance characteristics important to the Federal Government as the basis for determining each area's share of the funds.

Despite these conflicts, a formula must be chosen. The next chapter, analyzes factors that might be included in this formula. Although it is not possible to devise one best formula, we can eliminate some factors from consideration and describe the type of formula that best satisfies our criteria.

CHAPTER 4

ALTERNATIVE SPECIFICATIONS OF ALLOCATION FORMULAS

There are many factors which the Congress could use, singly or jointly, to allocate mass transit operating assistance among urban areas. The choice of factors will determine both each area's current allocation and the incentives presented to transit authorities to behave in ways which will increase their share of future allocations. We will evaluate potential formulas according to the criteria established in chapter 3.

Our discussion is quite lengthy because of the many factors we have analyzed. We have, however, limited our analysis to measures that have been considered at some time as potential factors. We have included some clearly inferior measures because we feel it is important to show why they should not be included in allocation formulas.

We have divided the factors under consideration into four categories. The first three are measures of various characteristics of each urban area's transit system. Variables related to the transit service provided are in the first category, while those that measure the amount of transit consumed are in the second. The first category includes measures of (1) transit output (e.g., vehicle miles of service), (2) transit input (e.g., number of vehicles), (3) technological efficiency with which inputs are turned into outputs (e.g., vehicle miles of service per employee), and (4) transit availability (e.g., the percent of population living within a specified distance of a transit route). Ridership and passenger-miles are examples of variables in the second category.

The third category of transit-related factors consists of measures for which the values depend upon both the transit service provided and the amount consumed. This category includes measures of (1) the use of the provided service (e.g., riders per vehicle) and (2) the cost efficiency of providing transit (e.g., the average cost per rider), as well as (3) aggregate financial measures of the transit system (e.g., the size of the operating deficit).

Characteristics of urban areas that are not measures of the transit system fall into the fourth category. These potential factors are frequently called urban-based factors and include measures of population, density, and income, as well as other features.

The Congress could use a transit-based formula, an urban-based formula, or one based jointly on transit and nontransit characteristics. In a transit-based or jointly based formula, factors from any or all of the three categories of transit characteristics could be used. The major difference between transit-based and urban-based factors--apart from the effect on the initial allocation--is that local transit authorities usually have at least partial control over the values of transit-based factors, but not over urban-based ones. Therefore, a transit-based formula could create incentives for local authorities to alter one or more aspects of their systems, while an urban-based formula would not. We will examine this distinction further in evaluating the potential factors.

TRANSIT SUPPLY FACTORS

Several types of measures are included in this category. Perhaps the most intuitively appealing are those that are measures of output, the amount of service provided.

Transit output

In order to allocate operating assistance such that each urban area's share equals its share of transit output, it is necessary to decide how output will be measured. Either the number of vehicles or the number of seats can measure the nature of service provided. And either the number of miles traveled or the number of hours during which the vehicles or the seats are used in revenue service can measure the extent of service provided. Therefore, four potential measures of transit output are vehicle-miles, seat-miles, revenue-vehicle-hours and revenue-seat-hours. 1/

Allocations based on output imply equal subsidies per unit of service provided. That is, each area's cost of providing service would be reduced by the same amount per unit provided. Such a formula would not satisfy equity criteria based on principles of providing equal assistance to all riders or to all residents of urban areas since each area's share would not depend on either usage of the transit system or population. However, this type of formula is consistent with the view that the largest Federal subsidies should be granted to those areas that have chosen to provide the most service.

1/The word "revenue" is used in front of "vehicle" and "seat hours" to indicate that we are measuring the number of hours in which the vehicles and seats are operated for revenue service.

Local authorities can increase their shares of future allocations based on output by increasing their service. Although expanded service by itself will not necessarily lead to attainment of all Federal program objectives, it is a necessary element. To the extent, however, that attainment of objectives requires increases in particular types of service, a subsidy based strictly on total output is too broad to guarantee appropriate responses. A framework in which transit output is differentially weighted according to a prescribed scale would help to generate responses aimed at attaining narrower objectives than an expansion of total transit service.

The encouragement of increased transit output risks the introduction of service for which there is little or no demand because an urban area's share of the available funds from a subsidy based on output does not depend on ridership. Local transit authorities would have incentives to provide as many miles or hours of service as possible with their fleet of vehicles. This might cause them to increase their service on long high-speed routes, such as suburban-downtown express routes, and decrease service on shorter, slower, intracity routes. In the extreme, operators could increase their subsidies even by operating vehicles at times and places which attracted no riders. 1/ However, the Congress could avoid this type of inefficiency, without resorting to a subsidy based on ridership, by stipulating that a specified percentage of a vehicle's seats must be occupied during a portion of each run for that run to count as part of the area's transit output. The determination of the appropriate percentage, of course, is a subjective matter, but might be influenced by such things as the minimum load factor beyond which a bus is more energy efficient than an automobile with a single occupant.

Although a subsidy based on transit output provides incentives for increased output, it is neutral with respect to the cost efficiency with which a given level of output is produced. Since the subsidy is not based on costs, there is no incentive for inefficient production of transit service. On the other hand, reductions in the cost of providing that service will not lead to increased subsidies. However, if the level of inputs is considered fixed, then a subsidy based on output encourages technological efficiency in the use of inputs, which produces more output and subsequently increases the area's share of funds.

1/This is a serious concern because the incremental cost of operating a vehicle at an off-peak hour is frequently quite low.

Data availability would not likely be a major problem in implementing a formula based on transit output. The number of vehicle miles or revenue vehicle hours could generally be calculated from published schedules. The costs of monitoring and enforcing accuracy would be small relative to those necessary to monitor ridership because there would be only a small number of vehicles relative to the number of passengers. Furthermore, no work would be required by drivers to collect the necessary data. 1/ For seat-miles or revenue-seat-hours, the data costs would be only slightly higher. The number of seats on each vehicle as well as the distance traveled and the time in revenue use would be have to be verified.

The similarities among the four measures of transit output outweigh the differences and, therefore, no one output measure is far superior to the others. Measures of seats are slightly preferable to measures of vehicles because they allow for differentiation based on vehicle size. 2/ Other things being equal, larger vehicles represent greater output. In addition, riders purchase seats on vehicles rather than vehicles themselves. Of course, the use of seat measures might lead transit operators to use large buses when smaller ones would provide sufficient capacity. However, this implies only that the use of output measures might lead to excess transit output, not that seat-miles or revenue-seat-hours are inferior output measures. Some passengers stand on crowded vehicles, so the number of seats understates the carrying capacity of vehicles. But this is only a minor concern because there is not likely to be great variance among vehicles in the relative proportion of seats and standing spaces. 3/ Revenue-seat-hours has a small advantage over seat-miles in that the former is not influenced by the speed of travel and is, therefore, probably the best measure of transit output.

1/If a minimum load factor is required, then data availability is a significant problem because verification of the percentage of seats occupied is difficult to obtain.

2/Two vehicles of vastly different sizes traveling the same route would travel the same number of vehicle miles. On the other hand, equal numbers of seat miles could be generated by one vehicle with 2x seats or two vehicles each with x seats traveling the same route. The latter example seems to more closely represent equal levels of transit output.

3/If there is significant variance in this proportion, it might be more accurate to measure carrying capacity rather than seats, but that is a more subjective and less readily verifiable figure.

Transit input

An alternate measure of transit supply is the amount of inputs used in providing transit service. The Congress could base each urban area's share of the funds on, for example, the number of transit employees, the number or age of transit vehicles, or the number of miles of fixed guideways. These variables, like those for transit output, are used to represent the size of an area's transit system. To the extent that there is a correspondence between inputs and output, allocations based on inputs are also consistent with the view that the largest Federal subsidies should be granted to those areas which provide extensive service.

An allocation based on the use of a particular input would create incentives to increase use of that input. To some degree, there is substitutability among inputs in providing transit service. Although the Federal subsidy does not lower the price of any input, the availability of increased assistance for using more of a specified input reduces the effective cost of that input relative to others. Therefore, this type of subsidy will bias operators' choices away from the most economically efficient combination of inputs and toward greater use of the input upon which subsidy allocations are based.

In general, the direct objectives of Federal mass transit operating assistance are not an expansion of transit inputs. Allocation formulas that create different types of incentives are likely to be more effective in attaining those objectives. However, if an objective is to increase a specific type of service, then a subsidy based on an input heavily used in that type of service might be effective in attaining the objective. This is particularly relevant in the case of rapid transit on fixed guideways, for which an incentive to expand fixed guideways might lead to greater service of this type. Nonetheless, there is partial substitutability among inputs, and in areas that already have fixed guideways, increased service can be provided by using more vehicles on the existing mileage as well as by increasing the mileage.

In reauthorizing the operating assistance program in 1978, the Congress mandated that specified portions of each urban area's funds be spent for both bus replacement and fixed guideway systems. If money is authorized solely for replacing buses or some other input, then a strong equity argument can be made in behalf of using the size and age of an area's bus fleet to determine that area's share of this portion of the funds because the greatest need for bus replacement funds occurs in those urban areas with large,

old bus fleets. However, even if equity considerations suggest that old buses imply a need for funds to replace them, this does not imply that limits should be placed on how local authorities can spend their Federal funds. Flexibility by local authorities in the use of Federal assistance should be encouraged.

A formula which allocates subsidies on the basis of transit output is neutral with respect to the technological efficiency with which inputs are combined to produce a given level of output. There is no incentive to be either more efficient or less efficient than before the subsidy. However, an allocation based on inputs creates incentives for inefficiency because an increase in the amounts of inputs used to produce a given level of output would lead to an increase in an urban area's Federal subsidy.

One criterion by which subsidies based on input score well is data availability. There are few conceptual or measurement difficulties in obtaining data on the number and age of transit vehicles or the number of miles of fixed guideways. This data is also easily auditable as well as comparable among transit systems. Employment data may present a conceptual problem due to part-time workers. However, this can be handled by calculating the number of fulltime equivalent workers.

Technological efficiency

Instead of allocating subsidies on the basis of the amount of transit service supplied--as measured by either outputs or inputs--the Congress could determine each area's share by the technological efficiency with which inputs are turned into outputs. Potential factors for this type of formula include measures of output--vehicle-miles, seat-miles, revenue-vehicle-hours, revenue-seat-hours--per employee; vehicle-miles or revenue-vehicle-hours per vehicle; seat-miles or revenue-seat-hours per seat, etc.

The rationale for this type of formula is that it would provide incentives for more efficiency in providing service. Operators would be able to increase their shares of the funds by increasing their technological efficiency. One way in which this might happen is by providing increased service with the same amount of inputs. However, increases in technological efficiency might also be accompanied by reductions in output. Therefore, operators' responses to this type of formula may not aid in the attainment of Federal objectives related to increased provision and availability of mass transit.

Furthermore, to the extent that there is substitutability among inputs, subsidies based on the efficiency with which one particular input is used might bias operators' choices away from the most efficient combination of inputs. In this case, operators could increase their subsidies by substituting other inputs for the one used in the formula.

There are no strong equity considerations in favor of this type of formula. Certainly this formula does not provide equal subsidies per resident or per transit rider. And unlike other transport supply formulas, one based on efficient use of inputs does not necessarily provide the largest subsidies to those areas that are supplying large amounts of transit service. The most technologically efficient areas could be ones with either large or small transit systems. Finally, although the availability of data is not a severe hindrance to this type of formula, the data requirements are somewhat greater than for transit output or transit input formulas because information on both inputs and outputs would be necessary.

Transit availability

Finally another aspect of transit supply that is potentially applicable to allocating Federal mass transit assistance is the availability of service to residents. That is, this approach considers whether the service is supplied in a way that enables most residents to use it.

Conceptual and practical problems must be solved in measuring availability.

The major conceptual problem is the definition of "availability." The usually proposed measure of availability is the percentage of residents who live within a specified distance, such as one-fourth mile, of a transit route. However, this is a very crude measure that neglects several important considerations, such as the frequency of service and the potential destinations to which one can ride. A more refined measure would value these features in comparing transit availability among urban areas.

On a practical level data limitations are a serious concern in applying even the most theoretically sound measure of availability. Transit schedule information is readily available and generally reliable. Therefore, it is possible to determine which parts of an urban area lie within a specified distance of transit routes. And it is also possible to determine the frequency of service in specific sections and the potential destinations to which one can ride. However,

the data base of the population available from the census is not disaggregated by distance from the nearest transit route, and it is not possible to accurately measure the number of residents of each section that has been defined by distance from transit route, frequency of service, and potential destinations. Nor is it possible to accurately determine the number of employment sites within each section defined as above, although accessibility to such sites may be an important component of transit availability. Nonetheless, census data are sufficient to allow reasonable approximations in many cases, and the potential errors in measurement must be balanced against the other attributes of this type of factor. The Congress may wish to ask UMTA to develop estimates of the cost of acquiring more accurate data on transit availability.

There is great potential to create desirable incentives by using this allocation factor. Assuring the availability of mass transit to as many urban residents as possible is an objective of Federal operating assistance. By allocating funds on the basis of transit availability, the Congress can provide incentives to operators to increase the percentage of their areas' residents to whom service is available. And by differentially weighting different types of availability in calculating an area's value of this measure, the Congress can create incentives aimed at very specific objectives. For instance, if service availability for low income and elderly people is considered particularly important, availability to these groups can be weighted heavily in measuring overall availability. This will provide strong incentives for operators to provide service that is available to these groups. Similarly, if the availability of transit service to suburban employment locations is heavily weighted, the likely response by operators is increased service to those areas. The incentives from this type of formula contrast with those from a formula based on transit output, in which case any increase in output could increase an area's share of Federal assistance, regardless of where the service was provided.

With respect to interjurisdictional equity, a formula based on transit availability is clearly not consistent with principles calling for equal subsidies per rider or per resident. Satisfaction of those equity criteria requires formulas based on ridership and population, respectively, and no formula based on transit supply factors will meet these goals. Nor does this type of formula allocate the largest shares to those areas that might be perceived as most in need by virtue of their having chosen to provide the greatest amount of service, although an urban area could increase its share by increasing the availability of its

service. Instead, small urban areas with transit systems that are extensive within their own areas but small in comparison with many large cities' systems might receive the largest shares although they do not seem to be the most needy. 1/ On the other hand, there may be a bias in favor of high density urban areas because the greater the density, the greater the percent of residents for whom service can be made available with a transit system of a specified size.

Transit availability measures resemble transit output measures in that they do not bias local authorities' decisions about the way in which inputs are combined to produce transit service. Increases in cost unaccompanied by increases in availability do not lead to greater subsidies. On the other hand, greater efficiency in providing the same level of availability does not lead to greater subsidies either, although increased efficiency that allows the provision of greater availability with the same level of inputs does lead to greater subsidies.

TRANSIT DEMAND FACTORS

These measure the amount of transit services consumed, which might be a more important consideration in allocating Federal assistance than the amount of transit services supplied.

As was the case for transit supply factors, it is necessary to define measures of transit consumption. There are two basic measures, passengers and passenger-miles, which differ in many respects: theoretical justification, measurability, resulting distribution of funds, and incentives created for transit operators.

The theoretical question is whether the number of people who ride mass transit or the total distance they travel is the best measure of the amount of mass transit consumed. That is, do users of the system consume rides or do they consume transportation across a specified distance? At first glance it seems that x riders each traveling 2y miles consume more transit than x riders each traveling only y miles, which suggests that passenger-miles is the better measure. However, it is less clear which of the following, if either, represents

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1/ If availability were measured as the number of residents for whom service was available, rather than the percent, then this factor would be likely to provide greater assistance to the largest urban areas.

greater transit consumption: 2x riders each traveling y miles or x riders each traveling 2y miles. So, we conclude that in theory either measure is potentially useful in an allocation formula, and we will evaluate both according to our criteria.

Equity arguments exist in favor of both passengers and passenger-miles as factors to allocate Federal mass transit assistance. If the Congress wants to provide operating assistance such that each area receives an amount that can be used to subsidize all riders equally, then the number of passengers is the appropriate measure. However, if the Congress is more concerned with aiding those areas most in need rather than aiding all riders equally, then passenger-miles might be a better measure because of the likely greater cost of transporting riders longer distances.

The availability of data necessary to use passengers or passenger-miles as factors in a formula poses serious problems. Existing data on ridership is widely believed to be unreliable and not comparable among transit systems. 1/ There are both definitional and operational difficulties in measuring transit consumption variables. Consistent definitions of these variables are required. At present, some ambiguous areas include whether or not charter passengers and free riders should be counted and whether or not each segment of trips by riders who transfer should be counted separately.

Even if all transit operators defined ridership in the same way, the operational costs of accurately measuring the numbers of passengers and passenger-miles might be very high. Nonuniform pricing prevents a simple determination of ridership from farebox revenues. Bus drivers could possibly maintain a count of passengers, but only at the cost of reducing speed. An audit of this data would be far more costly than a similar audit of transit supply factors. Besides, vehicle operators could not count passengers on rail transit lines with multiple entry points. Nor could operators on either

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1/One major reason for the lack of comparability of ridership data is the different ways in which transfers are counted as passengers. The comparability problem should be solved, or at least greatly lessened, in a few years, when the effect of FARE, Financial Accounting and Reporting Elements, can be seen. This project will lead to a uniform system of accounts and records. However, there still will be operational difficulties in measuring transit consumption.

type of mass transit accurately count the number of passenger-miles, although the sale of distance-based tokens and tickets might allow an approximation.

A formula based on transit consumption may provide large incentives for transit operators to increase their systems' passengers or passenger-miles. Many responses to these incentives which local authorities might employ to increase their shares of the funds would simultaneously help attain the Federal program objectives outlined in chapter 3. These attempts to attract more riders include improvements in the quality and expansion of the scope of the services.

Increases in Federal assistance, of course, are only one objective of local authorities. Quality improvements and route expansion will increase transit systems' revenues with this type of formula through both additional farebox revenues from the extra passengers and additional Federal assistance. These activities, however, are not costless, and the additional Federal funds might not fully offset added costs that may exceed additional farebox revenues. In this case local governments would need to increase their own subsidies to acquire more Federal funds. The extent of this increase, if any, would depend upon the cost of improved and expanded transit, the responsiveness of ridership to improved and additional service, and the amount of additional Federal funds obtainable for a specified increase in ridership.

Local authorities might make other responses that are not as clearly consistent with Federal transit objectives. For instance, they might reallocate their resources to increase their vehicle-miles on high density routes while reducing them on low-density routes. Also, they might increase ridership by reducing fares (thereby increasing deficits and local subsidies). A low fare policy might be either good or bad, but the bias of a formula based on transit consumption measures should be recognized. The relationship between the allocation of Federal assistance and the relative use of farebox revenues and subsidies to pay for mass transit is discussed in chapter 5.

An allocation formula based on transit consumption mostly avoids creating incentives for inefficiency. Increases in costs unaccompanied by increases in passengers or passenger-miles will not result in larger Federal subsidies. There is no bias toward or against the use of any particular input in providing transit service. Operators have incentives to provide service that people want, unlike the case of a formula using transit output measures. With a formula based on transit consumption, local authorities are less likely to provide

unused service for the sole purpose of increasing Federal subsidies. On the other hand, they are also less likely to risk providing new service in areas for which ridership is expected to be small initially, although it may increase in the future. If Federal subsidies are based on passenger-miles, rather than passengers, there may be a bias toward providing long-distance service.

JOINT TRANSIT SUPPLY AND DEMAND FACTORS

Some measures of mass transit depend upon both the service provided and its consumption. One type of factor in this category measures the extent to which the service provided is used. These factors are expressed as ratios of a measure of transit consumption to a measure of transit output or input, such as passengers per revenue vehicle hour or per employee. A second type of factor measures the cost efficiency of providing the service consumed, such as average cost per passenger-mile. And a third type of factor measures an aggregate financial statistic, such as total revenue or total deficit.

Use of services provided

For the most part, the defense for using measures of use of the transit services provided to allocate Federal subsidies must rely on the incentives likely to be created by such a formula. The potential factors do not measure the transit intensiveness of urban areas, so their use in allocation formulas does not imply that equity based on providing the largest subsidies to those areas with the largest transit systems will be achieved. Nor does this method of allocation satisfy equity principles based on equal subsidies per rider or per resident. Also there are no advantages with respect to data availability; not only must the difficulties of obtaining accurate data on transit consumption measures be overcome, but whatever problems exist in measuring transit inputs and outputs must also be handled.

On the surface, it appears that a formula based on use of the service provided creates incentives for desirable responses. If passengers per employee were a factor in the formula, an area's share of the funds would rise if the same number of passengers used mass transit while the operators reduced the number of employees. Similarly, if passengers per seat-mile were a factor in the formula, an area's share would rise if operators provided the same amount of service but more people chose to ride. The first result suggests greater efficiency, while the second would be consistent

with the attainment of Federal transit objectives if, for instance, the increased ridership were due to quality improvements in the service.

However, the incentives for both the maintenance of efficiency and the attainment of Federal objectives are not so straightforward. In any ratio measure, changes in the value can arise from changes in the numerator, the denominator, or both. Instead of improving the quality of their service to attract more riders, operators might reduce their service, eliminating routes in which the number of passengers per seat-mile is below the systemwide average or reducing the number of seat-miles by using fewer or smaller vehicles on popular routes. Because there are costs involved in attempting to increase ridership and potential savings from reducing or eliminating service, there is a strong likelihood that that approach would be taken to gain greater Federal subsidies. The Congress could, however, mandate that an urban area could increase its share only if an increase in passengers per seat-mile were accompanied by an increase in the number of passengers. Such a provision might reduce the negative incentive effects of this type of formula.

Increases in transit output and usage and decreases in the operating deficits of transit properties are, to a considerable degree, opposing aims. Although the results of an allocation formula based on a ratio of transit consumption to transit output or input may be decreases in service, this may lead to a reduced deficit. For instance, operators would be unlikely to expand service by creating routes for which there would likely be few riders. Adding such service might increase ridership slightly, but at a significant cost. Whether or not small increases in ridership attained in this way warrant large expenditures of public funds--State and local as well as Federal--depends upon the price one is willing to pay to attain the objective of increased service.

The impact on the efficiency of input combinations of using this type of factor depends upon whether the specific factor is a ratio of transit consumption to transit output or transit input. If the factor is a ratio of transit consumption to transit output, then operators retain their incentive to supply transit service as efficiently as possible. However, ratios of consumption to input bias operators away from use of that input. If, for instance, each area's share is determined by the number of passengers per vehicle, to the extent that there is substitutability among inputs, operators would have an incentive to attract the same number of passengers by using fewer vehicles and more of other inputs, such as employees (i.e., by using each vehicle more hours per day).

Cost efficiency

In many ways measures of the cost efficiency of providing the transit service consumed, such as average cost per passenger-mile, are similar to measures of the ratio of transit consumption to transit output or input. Since these potential factors measure cost efficiency rather than size, their use in allocation formulas will not result in those urban areas with the largest transit systems receiving the largest shares of Federal assistance. This type of formula will not satisfy equity principles of equal subsidy per rider or per resident either. In addition, there will be difficulties in implementing the formula due to the problems inherent in obtaining reliable data on transit consumption. So the case for this type of factor must rest on the incentives it creates for maintaining efficiency and attaining Federal objectives.

A formula based on the cost efficiency of providing the service consumed creates strong incentives for operators to combine inputs optimally. Efficiency in day-to-day operations will be directly rewarded by increased Federal operating assistance. Operators will have incentives to provide service that residents will use. However, this may lead to a reduction in total transit service, particularly on low density routes. In this conflict between cost efficiency and increased service and usage, the optimal dividing line will depend upon one's view of the benefits to society of increased transit use.

Allocating Federal assistance on the basis of cost efficiency of providing the service consumed is not a good method to remove the burden of heavy transit deficits from those urban areas currently under severe financial strain. In fact, a strict application of this approach might result in some areas with small deficits receiving subsidies that exceed their deficits, while those with large deficits might receive only a small fraction of their deficits. This could be avoided by limiting each area's subsidy to a given percentage of its deficit. But such a limitation would intensify the incentive that already exists with this type of formula to maintain a low fare policy. Chapter 5 discusses the implications on fare policy of alternative allocation mechanisms.

Aggregate financial measures

Three aggregate financial measures can be used to allocate Federal operating assistance: total revenue, total costs, and total deficit. Total revenue depends upon both the amount of service consumed and the fares charged.

Similarly, total cost depends upon both the amount of service and the efficiency with which it is provided. The relationship between total revenue and total cost and resulting deficit or surplus depends upon all these matters.

In most respects total revenue is superior to total cost as an allocation factor. Revenue data are readily available and auditable. These figures are more accurate than data on transit consumption. 1/ Cost data are also readily available. At present there are difficulties in comparing cost data among transit properties because of differences in accounting practices and local conditions, such as wage rates. However, the Congress can impose uniform accounting standards and adjust for regional wage differentials, and in the long run data availability should not be a serious concern in measuring total cost either.

Total revenue also has some merit on the basis of equity. An allocation proportional to total revenue implies that the largest shares of Federal assistance will go to those areas in which riders are willing to pay the most of their own money for mass transit. This is similar in equity effects to an allocation based on ridership, except that instead of reducing the cost to local authorities in all areas by an equal amount per rider, this method reduces the cost by an equal amount per dollar of revenue collected from riders. That is, regardless of location, each additional dollar of revenue yields an equal increase in Federal operating subsidy. No corresponding equity principle exists for total cost because there is no direct relationship between the cost of providing service and the willingness of riders to pay for it. To the extent that costs are correlated with output, the use of total cost allocates the largest shares to the most transit intensive areas. But the danger is that greater costs might mean only greater waste. This type of equity could be better achieved by a subsidy based directly on transit output.

The superiority of total revenue to total cost as am allocation factor is mainly a result of the incentives that the use of these factors are likely to create. The use of total cost to determine an area's share of the funds removes incentives for cost efficiency and rewards wasteful actions.

1/Total revenue is typically not proportional to the number of passengers because fares are differentiated on the basis of time of travel, length of trip, age of passenger, and other factors.

Increases in transit service that add to both total cost and total revenue will be rewarded by increased shares of Federal funds regardless of which measure is used to allocate the funds. But if total cost is used, these increased shares will result even if the increased costs are due to increased expense of providing the same level of service. A formula based on total revenue is neutral with respect to the efficient combination of inputs; one based on total cost is biased toward inefficiency. Furthermore, even if both types of formulas lead to increased transit output, a formula based on total revenue creates greater incentive to provide the type of service desired by residents since each area's share depends on the amount which people are willing to spend to consume transit service.

Total revenue depends upon both the amount of service consumed and the fares charged to each user. Clearly the use of this factor in an allocation formula has significant implications for operators' fare policies and the distribution of non-Federal funding of mass transit between farebox revenues and State and local subsidies. These implications are discussed in chapter 5.

Much of the initial impetus for Federal assistance for mass transit was due to the growing deficits in a few cities with extensive transit systems and the failure of many privately owned transit systems to continue to be profitable. It was widely believed that the preservation of mass transit was at least very desirable, if not essential; that the heavy burden of deficits might cause some cities to eliminate mass transit; and that Federal subsidies were necessary to assure that mass transit continued without bankrupting cities.

A logical way to allocate Federal operating assistance to accomplish the objectives of reducing the burden of deficits and ensuring the continuation of mass transit is to use a formula that bases each urban area's share on the size of its transit deficit. In this way the Federal funds go to those areas in which deficits are high and the elimination of service is a serious threat. However, there are other reasons that suggest that the size of the deficit is not an ideal allocation factor.

It is hard to justify on equity grounds allocating Federal subsidies on the basis of deficit size. The deficit may seem to measure an area's need for assistance. However, deficit size is the result of many factors, including fare policy and cost efficiency as well as the amount of service supplied and consumed. If two areas provide identical transit

systems but only one charges riders a fare, then the other will certainly have a larger deficit, but that does not imply that equity requires that it receive a larger Federal subsidy. The incentives for fare policy of a formula based on deficit size are opposite of those for a formula based on total revenue. A detailed discussion can be found in chapter 5.

A formula based on deficit size, like one based on costs, destroys incentives for cost efficiency and rewards increases in costs with larger shares of Federal subsidies, even if those increased costs do not lead to increased transit output. The assurance of greater subsidies will encourage operators to expand their service even if it will be unprofitable; there is no incentive to provide the type of service that people will consume.

A formula based on deficit size, even more than some others, hinders attempts to reward improvement of transit service to specific groups. It may be difficult to determine transit consumption, for instance, of specific groups in order to weight their consumption more heavily than others' to encourage expansion of service directed at them. But it would be far harder to determine the size of the deficit attributable to specific groups because of problems in allocating joint costs. Apart from that type of problem, however, data availability is not a serious concern. Deficit figures can be readily computed from data on total revenues and total costs, and this data is generally available and auditable.

URBAN-BASED FACTORS

Unlike the potential factors we have discussed so far, urban-based factors do not measure characteristics of an area's transit system. At present, and in the past, the Congress has used measures of population and population density to allocate Federal operating assistance. Other urban-based factors include age distribution of the population, per capita income of the residents, employment density, density of commuting corridors, and age of the city.

The major difference between transit-based and urban based factors is that formulas composed of urban-based factors do not create incentives to alter existing transit systems. In evaluating these factors, therefore, we will be concerned only with their impact on the initial allocation of funds; no incentives are created for operators to attempt to increase their future allocations.

Since some transit-based formulas create incentives for inefficiency, the absence of incentive effects should not be automatically interpreted as a drawback of urban-based formulas. However, there is little room for furthering the attainment of specific Federal program objectives, except to the extent that attainment of these objectives requires the allocation of funds to particular urban areas. That is, the desire to provide maximum flexibility to local authorities to use their Federal assistance as they see fit is supported, even if their actions do not further Federal mass transit objectives.

There is no consensus about whether characteristics of transit systems or characteristics of urban areas themselves are more relevant in determining an equitable allocation of funds. The case in favor of urban-based factors rests to a considerable degree on their ability to equitably allocate the funds. There is no obvious way of determining the relative deservedness of urban areas in receiving the funds, but some variables differentiate areas in ways that suggest varying transit needs.

Population is the primary factor in current and past formulas. A formula based on population implies equal subsidies per resident. The equity of this formula relies on an assumption that there are no differences among people that imply different needs for Federal mass transit assistance. However, nontransit characteristics of urban areas besides population suggest either that some people are more deserving of subsidy or that some areas have greater needs for developing and continuing extensive transit systems.

Income, age distribution, and number of handicapped people are characteristics that might be used to determine each area's share. One possible interpretation is that equity implies helping those most in need rather than providing equal subsidies per resident. Poor, old, young, and handicapped people are frequently described as "transit captives" because of their lack of access to automobiles. Therefore, areas with particularly large proportions of people in these categories might have a greater need to provide transit service and therefore might be more deserving of Federal

subsidies. This type of equity can be achieved by including the number of people in these groups in the formula. 1/

The second urban-based factor that has been used to allocate Federal mass transit operating assistance is population density. The justification for use of this variable is that denser urban areas have greater transit needs because of the relative efficiency of mass transit over cars where people are clustered together. But population density considers only how closely together people live. Inasmuch as most peak-period transit trips are journeys to work, employment density is also important. Most conventional mass transit travels on fixed prescheduled routes. Therefore, the density of specific corridors on which people are likely to travel between home and work is a better measure of the relative need for and advantage of transit than either residential or employment location density alone.

Another potential measure of an urban area's transit needs is the age of the center city. Those cities that reached their approximate current sizes before 1920 tend to have downtowns very ill-suited for large-scale automobile use. As a result, these cities generally have more extensive transit systems than those that have grown more recently. Therefore, this factor might be used in an allocation formula to direct Federal funds toward areas most reliant on mass transit, although the same effect could probably be obtained through use of transit-related factors.

The availability of data is generally superior for urban-based factors than for transit-based ones, particularly transit consumption measures. Census data are readily available for measures of population and population density, although employment density data may be costly to acquire; income data are available elsewhere. This information is usually accurate and comparable among urban areas. Data for the density of commuting corridors may not already exist everywhere, but such information could be obtained and

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1/In practice, there may not be substantial variations in the proportions of young, old, or handicapped people among urban areas. If not, then a formula based on the number of people in these groups would result in substantially the same allocation as a formula based on population. Also it is questionable whether reliable data on numbers of handicapped people are available, or even attainable. There are greater variations in the proportions of poor people.

approximations to these data exist as measures of the number of people commuting from suburb to center city and vice versa.

PRESENT FORMULA

The present formula relies heavily on urban-based factors, although serious consideration was given in 1978 to greater use of transit-based factors, particularly for funds for bus replacement. Both the first and second tier of unrestricted funds are allocated on the basis of population and population density. Half is allocated by population and half by population times population density, although the second tier funds are first divided according to area size before individual allocations are made. The Congress chose to allocate bus replacement funds on the same basis, although the Senate version of the 1978 STA Act called for using bus fleet age and bus-seat-miles. Transit based factors are used to allocate only the funds for fixed guideway expenses. The factors used are transit supply factors: commuter-rail-train-miles, commuter-rail-route-miles, and fixed-guideway-system-route-miles. 1/

COMBINING FACTORS INTO A FORMULA

A good allocation formula should direct Federal funds to those urban areas with the greatest need, encourage efficiency in providing transit service, and provide incentives for creation of a transit system consistent with Federal objectives. In addition, reliable data to implement such a system should be available at low cost. None of the factors we have analyzed satisfies ideally these four criteria. Therefore, a formula that combines two or more factors is necessary to satisfy these criteria in part.

Some factors are clearly inferior; their inclusion is likely to lead to unsatisfactory results. For instance, measures of transit inputs bias transit operators' choices toward these inputs on which allocations are based without providing any benefits not available through the use of transit output and/or transit consumption measures, unless these input measures are being used to allocate funds solely for input replacement. Similarly ratio measures of transit output or consumption per unit of transit input bias choices away from use of the specified input. The total cost of providing service is a notably poor factor for a formula

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1/A more complete discussion of the current formula can be found in chapter 2.

because of the incentives to provide service inefficiently. And deficit size is also an inferior factor because although a formula based on deficit size would help accomplish the objective of reducing local deficits, there would be incentives to maintain as large a gap between total costs and locally supplied revenues (fares plus subsidies) as possible.

A good formula should include from among the remaining factors at least one that assures that the largest shares of the funds go to those urban areas with the greatest need and at least one likely to create incentives for desirable responses by operators. Because the size and density of an area as well as its current transit system and usage seem important in determining each area's equitable share, more than one factor is needed to meet the interjurisdictional equity criterion. A factor that measures transit output or consumption will create incentives for the expansion of transit output or consumption as well as allocate current Federal subsidies to transit intensive areas. Additional transit-related factors can both create incentives to provide the type of transit service consistent with Federal objectives and maintain incentives to provide transit service efficiently.

One possible formula includes the following measures: population, population density, revenue seat hours, and transit availability. Population and population density can be combined into one factor by multiplying the two measures together (PD). Then each urban area's share of the funds allocated by PD equals the area's value of PD divided by the sum of all areas' values, times the amount to be allocated by PD. Similarly each area's annual revenue-seat-hours of

service divided by the sum of all areas' revenue-seat-hours and then multiplied by the total amount allocated by this factor equals each area's share of that amount. 1/

There is no exactly comparable way to allocate among areas the total to be allocated by the transit availability factor, because transit availability is measured as the percent of the population rather than the number of people with available transit service. However, allocating to each area an amount equal to the total to be allocated by this factor multiplied by the ratio of the percent with available transit divided by the sum of these percents produces a roughly similar distribution. That is, an area in which

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1/These can be expressed mathematically as follows:

$$S_{PD_i} = \frac{P_i \times D_i}{\sum_{i=1}^{n} (P_i \times D_i)} \times S_{PD} \qquad S_{T_i} = \frac{RSH_i}{\sum_{i=1}^{n} RSH_i} \times S_T$$

P_i, D_i, and RSH_i are the population, population density, and revenue-seat-hours of service, respectively, of an individual urban area.

$\sum_{i=1}^{n}(P_i \times D_i)$ and $\sum_{i=1}^{n} RSH_i$ are, respectively, the summation of all urban areas' values of population times population density and revenue-seat-hours of service. S_{PD} and S_T are the total amounts to be allocated by the population times population density and revenue-seat-miles of transit service factors, respectively; and S_{PDi} and S_{Ti} are each urban area's share of S_{PD} and S_T, respectively.

twice as many people have available transit, as compared with another, will receive twice as large a share. 1/

Any determination of the relative amounts of the total available Federal operating assistance to be allocated by each of the three factors is subjective and must be made politically. A relatively larger amount to be allocated according to population times population density suggests greater concern for the equity of the distribution of funds as determined by the size and density of the area and less for the potential incentives from a transit based formula. A relatively larger amount to be allocated according to revenue-seat-hours of service implies that interjurisdictional equity requires a consideration of the existing transit intensiveness of urban areas and provides greater incentives for operators to expand their service. The Congress can provide greater incentives for the attainment of Federal program objectives, at the potential risk of providing only small subsidies for some large urban areas, by allocating a relatively larger share according to the transit availability factor.

Several features of a formula based on population times population density, revenue-seat-miles, and transit availability suggest that this formula or one similar is a reasonable way to allocate Federal mass transit assistance.

1/This can be expressed mathematically as follows:

$$S_{A_i} = \frac{A_i/P_i}{\sum_{i=1}^{n} A_i/P_i} \times S_A$$

A_i/P_i is the percent of people in an urban area with available transit service, expressed as a ratio of the number of people in an urban area with available service, A_i, divided by the total number of people in that urban area, P_i; $\sum_{i=1}^{n} \frac{A_i}{P_i}$ is the summation of the value of A_i/P_i for all urban areas; S_A is the total amount to be allocated by the transit availability factor; and S_{A_i} is each urban area's share of S_A.

1. Existing incentives for cost efficiency are maintained. Since the transit-related factors are based on transit output and availability, local authorities cannot increase their shares of Federal funds by providing service inefficiently, although there may be a bias toward excess capacity.

2. Reliable data are generally available. Census data exist to measure population and population density. Transit output data are usually more reliable, easier to calculate, and easier to verify than transit consumption measures, such as passenger-miles. Transit availability is harder to measure with the existing state of the art, but reasonable approximations can most likely be obtained when exact measurement is not possible. The advantages of using transit availability will most likely offset any distortions caused by measurement error. The Congress may wish to ask UMTA to estimate the cost of obtaining more accurate measures of transit availability.

3. The largest shares of the available funds can be allocated to those places with the greatest need. A drawback in emphasizing ratio measures, such as measures of cost efficiency, is that the largest shares would go to areas with the most efficient transit systems, even if these areas were small. The inclusion of population times population density weights the formula in favor of large, compact areas in which extensive transit service is likely to be particularly important. This is reinforced by the inclusion of revenue seat hours, which commits the Federal Government to assisting those areas that have chosen or will choose to provide extensive service.

4. Incentives are created for operators to increase their service in ways consistent with Federal program objectives. Although local authorities have the freedom to design their own systems, they can receive the greatest increases in their shares of funds by providing increased service that increases transit availability. And by carefully measuring availability to emphasize availability to particular groups, such as the young, old, poor and handicapped, the Congress can provide strong incentives to improve the service for these transit dependent people.

5. The formula is neutral with respect to fare policy. Many potential factors, particularly those which measure transit consumption, encourage local authorities to adopt a low fare policy in order to attract more riders. If total revenue were a factor in the formula, there might be a bias toward either raising or lowering fares, depending on the responsiveness of ridership to fare changes. But neither the number of revenue-seat-hours nor the availability of service would be influenced by a change in the proportion of costs covered by farebox revenues.

CHAPTER 5

SUBSIDIES AND USER CHARGES IN FINANCING MASS TRANSIT

Until recent years most mass transit service in the United States was provided by private companies. However, most transit service is now provided by the public sector. Therefore, public decisions must be made about how this service will be financed. Currently most transit service is financed jointly by farebox revenues and taxes collected by State and local governments and the Federal Government.

This chapter briefly considers the basis for subsidizing mass transit with tax revenue. The use of government funds in general and Federal revenues in particular to cover part of the costs of providing transit service is well-established, and we will not analyze that question in detail. However, acceptance of the rationale for Federal transit subsidies does not imply that all subsidy programs will lead to the benefits obtainable through proper use of Federal subsidies. We will consider the types of subsidies justifiable on economic grounds. And we will analyze the impact of the way in which Federal mass transit operating assistance is provided on the relative use of farebox revenues and State and local government subsidies for providing the balance of the funding.

USE OF NONFAREBOX REVENUES FOR MASS TRANSIT FINANCING

For many years transit was a profitable industry in the United States. However, in the 1950s and 1960s many transit systems were experiencing financial difficulties and were taken over by local governments. Rising incomes, expanded highway networks, and suburbanization of both population and employment all contributed to ridership declines and subsequent deficits. But public policy decisions concerning fares and service levels were also important. Transit companies typically enjoyed an exclusive franchise in all or a portion of an area, but were not free to adjust fares or service. This inability to respond to changes in demand weakened transit companies' ability to offset the long-term trend of declining ridership.

Many communities had to decide between subsidization of mass transit and loss of service. Between 1955 and 1973, 163 transit companies became publicly owned; 102 of these changeovers occurred after 1964. Once transit became a publicly provided service, there was no longer any need to

have a rate structure designed to produce enough farebox revenues to cover all costs, or even all operating costs. And, in fact, the operating ratio, the ratio of farebox revenues to operating costs, has declined from 0.90 in 1970 to 0.57 in 1975 as local authorities have adopted low fare policies.

Low fare policies have necessitated the use of funds collected from taxpayers, rather than riders, to pay part of the costs of providing service. Many reasons have been suggested for charging riders less than the full cost of providing transit service. These can be grouped into five categories: 1/

1. External benefits--Riders should not be required to pay the full costs of providing transit service because some of the benefits accrue to others. Therefore, the amount which riders are willing to pay for any given level of service understates the community's true willingness to pay and subsidies are required to assure that the economically efficient level of service is provided.

2. Increasing returns to scale--Mass transit is an industry in which the average cost of providing a unit of output declines as the amount of output produced increases. Therefore, a price equal to average cost exceeds marginal cost, thus violating the pricing rule necessary for an optimal allocation of resources. A price equal to marginal cost, however, means that total revenues are less than total cost, so subsidies are needed.

3. Parallel subsidies--Drivers in general, and peak-period center city-oriented drivers in particular, receive government subsidies which distort travelers' decisions. A parallel subsidy for transit is necessary to restore equality between the ratio of the prices of mass transit and automobile use and the ratio of their costs so that travelers can make efficient modal choice decisions.

1/The justifications presented in each category are those given by proponents of transit subsidies. In listing them we do not mean to imply our endorsement.

4. Income redistribution--Many riders have low incomes. A low fare policy redistributes income away from those whose taxes are raised to subsidize mass transit and toward riders.

5. Government responsibility to transit dependents--This reason combines aspects of the others. The essence of this argument is that government policies have biased travelers' choices toward automobile use with the result that transit dependent groups for whom the automobile is not a feasible option are not by themselves capable of providing effective demand for high quality transit service. Since government is responsible for reducing the level of service available to them by encouraging those who can to use automobiles, government has the responsibility to subsidize mass transit to preserve these persons' mobility.

The first three reasons refer to efficiency issues, while the last two relate to equity. Although people have varying perceptions of an equitable distribution of income, available information suggests that pricing transit service below cost is not an effective way to redistribute income from rich to poor. This is because transit riders as a group are not notably poor. The distribution of all riders according to household income is very similar to the distribution of all households according to household income. 1/ Transit subsidies would be more effective in redistributing income if the fare reductions possible due to the subsidies were restricted to those types of service heavily used by low income people or to those people traveling on all mass transit who are identified as low income. But even in this case, the extent to which income redistribution is obtained will also depend on the incidence of the taxes raised to finance mass transit subsidies.

Little can be said about the argument that government has a responsibility to assure transit access for those unable to use automobiles because of government actions that diverted many potential transit users to automobiles. Support for this argument depends upon both an assumption that government has significantly biased travelers' choices toward automobiles and an equity judgment that government should now assist those adversely affected by others' responses

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1/This is based on national totals and may not be true in all urban areas.

to prior government decisions. Government has certainly provided incentives for automobile use, but the magnitude of the bias introduced is not readily calculable.

The equity arguments all have some merit. Although many of the external benefits frequently cited from increased mass transit use are probably not obtainable, it does seem likely that landowners along fixed guideway transit routes benefit considerably. For instance, downtown landowners probably benefited greatly from the decision to operate Washington's subway system on Saturdays. Therefore, some type of subsidy for subway riders appears justified because of external benefits, although not necessarily the subsidy program currently in existence. 1/

Similar conclusions can be reached about the increasing returns to scale and parallel subsidy arguments. Increasing returns to scale exist for some, but not all, types of transit service. Subsidies on certain routes and at certain times of day might offset the allocational distortions due to large subsidies for certain categories of automobile users.

The present Federal operating assistance program emphasizes autonomy for local authorities in deciding how to use the funds. As a result, the Federal Government has no control over the pricing policy used by local authorities and the types of service subsidized. There is no assurance that the transit service subsidized will be the same types of service for which the reasons discussed above most imply the need for subsidies.

For instance, the primary beneficiaries of highway subsidies are peak-period center-city-oriented drivers for whom capacity has been built. Therefore, the parallel subsidy argument primarily justifies subsidies for transit

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1/An extreme statement of the external benefits argument is that the benefits of mass transit are so diffuse and difficult to assign that mass transit should be treated as a public good and financed entirely from taxes. However, this seems implausible since a significant portion of the benefits certainly accrue to riders. And once this is accepted, the pure public good notion breaks down because the exclusion principle clearly applies: People who choose not to pay to ride mass transit can be excluded from receiving at least the portion of the benefits that goes to riders.

service that would compete with automobiles for these travelers. Studies have found that for most types of transit service, prices equal to marginal cost will generate sufficient revenues to cover operating costs. Only on bus or rail rapid transit with such a low density of passenger demand that intervals between scheduled vehicles are more than 30 or 40 minutes will the increasing returns to scale argument justify operating subsidies. 1/ And income redistribution arguments justify either subsidies only for transit service widely used by low income people or subsidies given directly to low income riders for use on any type of transit service.

The existence of external benefits is a justification for subsidies likely to apply to more types of transit service. However, to the extent that the nonrider beneficiaries can be identified, this justification implies that the taxes raised to finance mass transit should be collected from those who benefit from transit service.

IMPACT OF FEDERAL OPERATING ASSISTANCE ON NON-FEDERAL REVENUE SOURCES

Although Federal operating assistance covers only a fraction of the cost of providing mass transit, this money is very important to State and local authorities because it reduces the pressure on State and local residents to finance transit service through farebox revenues and State and local taxes. Therefore, in choosing an appropriate balance between farebox revenues and State and local subsidies, transit operators will be sensitive to any impact of this decision on their share of Federal funds.

One way in which the Congress can influence local decisions about the extent to which user charges should be used to finance mass transit is through the choice of factors for inclusion in the subsidy allocation formula. Several potential transit-based factors are such that their inclusion in the formula would likely create incentives to raise or lower fares in order to increase an area's share of the funds.

1/José A. Gómez-Ibáñez, "Assessing the Arguments for Urban Transit Operating Subisidies," in Transit Operating Subsidies, Highway Research Record No. 573, Washington, D.C., 1976, p. 8.

Transit consumption measures, such as the number of passengers or the number of passenger-miles they travel, are frequently suggested as factors on which urban areas' shares can be based. If passengers or passenger-miles were included in the formula, operators would be likely to increase the number of passengers or the average distance each travels. One way in which operators can increase ridership is by reducing fares. So the use of transit consumption measures in operating assistance formulas biases local authorities' choices toward increased reliance on State and local subsidies and reduced reliance on farebox revenues to cover the non-federally funded portion of transit costs. 1/ In addition, if the factor in the formula is passenger-miles, then riders that travel long distances are worth more in terms of Federal assistance than those who travel short distances. Therefore, operators might choose flat fares and a liberal transfer policy to attract more long distance riders.

Any transit-based ratio measure using a transit consumption measure will be similarly influenced by fare policy. For instance, if passengers per vehicle mile were used in a formula, operators would have an incentive to adopt a low fare policy in order to maximize ridership.

Total revenue and total deficit are two other transit-based measures that would be heavily affected by fare policy. Total revenue merits some consideration in a formula because it measures the amount which riders are willing to pay.

1/Fare reductions might decrease farebox revenues more than they increase Federal assistance, thereby necessitating larger State and local government subsidies. Whether or not this would happen depends upon both the responsiveness of ridership to fare reductions and the increase in Federal assistance generated by a specified ridership increase. The evidence suggests that local authorities are already willing to partially subsidize transit service. The possibility of obtaining additional Federal assistance from lowering fares and increasing this subsidy biases local authorities further in this direction.

Most operators do not now set fares at revenue-maximizing levels. 1/ However, if each area's share were proportional to its total farebox revenues, then operators would have a strong incentive to set fares at revenue-maximizing levels. Since studies have found little responsiveness of transit demand to changes in price, at prevailing fare levels, an attempt to increase farebox revenues implies an increase in fare levels. So, the Congress can encourage greater use of farebox revenues to pay for mass transit by including total revenue as a factor in the allocation formula.

The incentive effects for fare policy are exactly opposite if each area's share is determined by the size of its transit deficit. The lower the fares are, the larger the deficit. This is true both because each rider is paying less per trip and because the low fares attract additional riders, which increase the costs of providing service. In theory, operators could even increase the size of their deficit beyond that which would exist at a zero price by charging a negative price (i.e., paying people to ride transit). This is an additional reason that deficit size is not a good transit-based factor to include in an allocation formula.

The Congress can also influence local authorities' decisions about the use of user charges to finance mass transit through the maintenance of effort requirement. In the 1974 legislation that originated the operating assistance program, the Congress included a stiff MOE requirement, which mandated that State and local governments must maintain their existing levels of transit subsidies in order for an urban area to be eligible to receive Federal operating assistance. The purpose of this requirement was to prevent State and local authorities from simply substituting Federal funds for their own without increasing the total spent on transit (and, presumably, the quantity or quality of service).

However, this requirement also significantly affected the share of transit costs to be financed through farebox revenues. As long as the total of farebox revenues and

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1/Many studies have shown that a 1-percent increase in fare causes a smaller than 1-percent decrease in ridership (i.e., transit demand is price inelastic). Therefore, raising fares increases farebox revenues. A good summary of evidence on transit elasticities is in an article by Michael A. Kemp ("Some Evidence of Transit Demand Elasticities," Transportation, Vol. 2, 1973, pp. 25-52).

State and local transit subsidies did not change, operators were prevented by the potential loss of Federal operating assistance from increasing the share of costs covered by user charges. In addition, the MOE requirement weakened the incentive to improve cost efficiency because a reduction in the operating deficit--and therefore a reduction in State and local subsidies--would have led to a loss of Federal operating assistance.

In 1978 the Congress passed the Surface Transportation Assistance Act. The MOE requirement in that bill was substantially eased. State and local authorities can now substitute farebox revenues for subsidies without threatening their Federal operating assistance, thus providing flexibility in determining the optimal share of transit costs to be recovered from riders. Also the new MOE requirement allows operators to reduce their operating costs and therefore their deficits and their subsidy levels without sacrificing Federal operating assistance, as long as they can show that the level of service has not been reduced. Furthermore, the MOE requirement will lapse in fiscal year 1982.

Federal operating assistance for any urban area is limited to 50 percent of its transit operating deficit. This limit imposes some discipline on local authorities in that any cost increase not matched by an increase in farebox revenues will be at most only partially funded by increased Federal assistance. On the other hand, however, for those areas constrained by the 50 percent limit, there is a clear bias against substituting farebox revenues for State and local subsidies, because a reduction in the deficit will cause a reduction in Federal operating assistance.

The Senate-passed version of the 1978 STA Act would have changed the limitation of funds from 50 percent of the operating deficit to one-third of total operating costs. However, this change was not included in the final version of the bill. If this change had become law, the bias against farebox revenues would have been eliminated because the maximum amount an area could receive would then depend on the amount that an area spent on transit, regardless of the distribution between farebox revenues and State and local subsidies. The drawback, however, is that for urban areas receiving the maximum Federal assistance of one-third of operating costs, any reduction in transit costs would cause a reduction in Federal operating assistance. With the present limit, a reduction in transit costs accompanied by a decrease in fares and farebox revenues that left the deficit unchanged would not lead to a loss of Federal operating assistance. So although the 50-percent limit biases financing decisions

away from use of farebox revenues, it does tend to encourage efficiency in providing transit service somewhat better than a limit of one-third of operating costs.

CHAPTER 6

IMPLICATIONS OF ALTERING ALLOCATION FORMULA

Current legislation authorizes Federal mass transit operating assistance through fiscal year 1982. Before then the Congress will need to consider refunding this program. We anticipate that if the decision is made to continue this program, congressional committees will examine alternative specifications of the formula used to allocate these funds among urban areas. This report's analysis of subsidy allocation formulas will be helpful in choosing an appropriate formula. 1/

Although we have not recommended any specific formula, we have identified some clearly inferior factors, suggested how some of the remaining factors might be combined into a formula that satisfies our criteria, and presented one possible formula of this type. This formula includes both transit-based and urban-based factors. Therefore, the question of adequacy of transit data becomes relevant. We have not excluded from consideration potential factors for which adequate data are not currently available because we believe that the Government should take a longrun view toward the question of data availability.

Congressionally mandated reporting requirements have greatly enhanced the data base on transit measures. However, accurate data do not currently exist for one measure which we believe to be very useful in creating appropriate incentives for local transit operators: transit availability. Although reasonable approximations of this measure are probably obtainable now, the Congress may wish to ask UMTA to develop estimates of the cost of acquiring more accurate data, so that if it is then felt desirable and cost effective

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1/Actually the STA Act of 1978 provides a formula by which the bus replacement portion of the funds should be allocated only for the first 2 fiscal years, 1979 and 1980. The Secretary of Transportation is required to study alternative approaches for allocating bus replacement funds in 1981 and 1982 and to report the study results to the Congress. We have concentrated on the allocation formula as a whole and have not dealt with the question of an appropriate formula for bus replacement other than to note that factors such as bus-seat-miles and the age of bus fleets may reflect the need for bus replacement.

to obtain these data, there will still be time to do so before the date of reauthorization of the operating assistance program.

In deciding whether to alter the current formula, the Congress will no doubt be concerned with the implications and consequences of any such change. Chapter 5 identifies several arguments to support our suggestion that a formula based on population, population density, revenue-seat-hours, and transit availability is reasonable. Some good features of this formula, such as maintaining both incentives for cost efficiency and neutrality toward fare policy, are also features of the current population/population density formula but might be lost if the Congress adopted a formula including some of the inferior factors we have discussed.

ADVANTAGES OF PROPOSED FORMULA (COMPARED WITH PRESENT)

One major advantage of our proposed type of formula is that it includes factors that provide incentives for operators to increase their transit service in ways consistent with the attainment of Federal program objectives. The current formula provides no such incentives because it includes only urban-based factors which cannot be affected by local transit decisions; therefore, it fails to satisfy one of our criteria.

A second advantage is that in the proposed formula more characteristics are used to determine which urban areas have the greatest need for Federal operating assistance. Although there is no precise way to determine the equity of an allocation formula, we believe that equity is improved by including some measure of transit intensiveness. Among urban areas of comparable size and density, those that provide greater amounts of service have greater needs for Federal operating assistance. In addition, of course, the possibility of receiving larger shares of the funds provides an incentive for local authorities to expand their service.

POTENTIAL CHANGES IN URBAN AREAS' SHARES

An urban area's share depends upon its values of the factors included in the formula relative to those of other areas. Therefore, a specific area's share of the total might

increase or decrease after the adoption of a new formula. 1/ The direction of change depends upon whether that area's values relative to other areas' values for the additional factors included in the formula are higher or lower than that area's population and population density relative to other areas'. In general, any formula that includes a transit output or transit consumption factor will provide larger shares to areas heavily reliant on mass transportation than will a strictly urban-based formula. In practice, of course, there is already a fairly high correlation between transit intensiveness and population and population density. The inclusion of revenue-seat-hours as a factor, therefore, may not have a major influence on most urban areas, although those few areas that provide exceptionally large amounts of transit service would benefit.

"Transit availability" is generally defined as the percentage of people who reside within a specified distance from transit routes. Chapter 4 indicates how this measure can be refined to weight more heavily the availability of transit for those groups whose access to mass transit is of particular concern. Since this measure is expressed as a percent of potential availability, high values of transit availability can occur in both large and small urban areas. Areas that provide widespread service relative to their sizes will benefit from including this factor in the formula, regardless of their actual sizes.

The extent to which the initial allocation of funds under an alternate formula will differ from that which exists with the current formula will depend upon the relative weights retained by population and population density in the alternate formula. Clearly the greater the weights retained by those two factors, the closer the allocation will resemble that which exists with the current formula. Since our proposed formula is a combination of factors designed to simultaneously satisfy several criteria at least partially, there is no economic way to determine appropriate weights for the several

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1/Although some urban areas' shares may decrease upon the adoption of a new formula, the Congress can avoid reducing the number of dollars received by any area by increasing the appropriation for the program and allocating only the additional amount by factors other than population and population density. This was done when the formula was slightly modified in 1978.

factors. Instead it is a political decision which the Congress should decide on the basis of its view of the relative importance of the allocation formula criteria and the appropriate determination of equity.

A determination that providing large amounts of transit service is an equity justification for receiving a large share of Federal assistance implies a relatively large proportion of the funds should be allocated on the basis of revenue-seat-hours. Although the inclusion of both revenue-seat-hours and transit availability provide incentives to operators, it is the transit availability factor that most encourages the attainment of Federal program objectives. This is because transit availability can be measured such that incentives exist for specific desired improvements rather than just overall expansion of service. There is also a combined effect of the two transit-based factors. The greatest increases in subsidies can be attained by extending transit availability through providing new revenue-seat-hours of transit service in previously unserved areas (rather than by reallocating existing service to provide expanded coverage).

There is a direct tradeoff between providing these incentives and assuring an equitable allocation because high transit availability may not be correlated with large populations or extensive transit systems. The greater the concern with attaining Federal program objectives, the larger the proportion of funds the Congress should allocate on the basis of transit availability.

EXTENT OF INCENTIVES IN PROPOSED FORMULA

Since desirable incentive effects are a major benefit of altering the allocation formula, it is necessary to examine the extent to which acceptance of these incentives can increase an urban area's share of the funds. This, of course, depends in part upon the proportion of funds to be allocated by those factors that create incentives. The extent to which values of the incentive-creating factors vary among urban areas is also important. If there is little potential variation, there is little incentive.

For a particular urban area, the values of these measures at the time they are included in the formula are also important. Since the purpose of including transit-based factors is to provide incentives for local authorities to increase their values of these measures, the largest initial shares will go to those areas that already have high values. So the incentives for improvement exist mainly in those

areas with low initial values of the transit-based factors included in the formula. This is particularly true for transit availability, because that variable has a natural upper bound: availability cannot exceed 100 percent. In fact, urban areas with high initial transit availability might experience declining shares of the total as other areas increase their transit availability, but this is a necessary concomitant of providing incentives for improvement.

Additionally an increase in an area's allocation due to a response to an incentive created by the formula may seem large or small depending on that area's initial allocation. For instance, an increase of a given number of revenue-seat-hours will, with the proposed formula, lead to the same dollar value increase in Federal assistance, regardless of the area in which this increase in service occurs. However, as a percent increase in assistance, this value will be greater in urban areas that previously provided only low levels of service.

NUMERICAL EXAMPLE

We have constructed an example which shows the amount of increase in Federal assistance available to a hypothetical urban area that increases its revenue-seat-hours and transit availability from specified levels. At the current funding level for formula grants, if the money were distributed equally among areas, each would receive about $5 million per year. In fact, of course, since the funds are allocated on the basis of population and population density, there is great variance among areas with respect to their current allocations. New York City and its suburbs receive more than $200 million, while many small urban areas receive less than $1 million.

If, for example, one quarter of the available funds were allocated on the basis of revenue-seat-hours, then an area that provided the same number of revenue-seat-hours as the average per urban area would receive about $1.25 million on the basis of this factor. A 10-percent increase in revenue-seat-hours by an area would lead to a nearly 10-percent

increase in Federal assistance. 1/ This amounts to $125 thousand for an urban area with revenue-seat-hours initially equal to the average per urban area. Similarly the incentive for a 50-percent increase in revenue-seat-hours is a $625 thousand increase in Federal assistance. A larger or smaller incentive could be provided by allocating a larger or smaller share of the funds on the basis of revenue-seat-hours. 2/

This analysis is based on the assumption that other urban areas are not simultaneously changing their number of revenue seat hours. If all areas increased their revenue-seat-hours by 10 percent, none would receive a larger share. However, this does not imply that there is no incentive to increase service, because if any area did not match other areas' increases, then its share would fall.

For urban areas providing a much greater than average amount of revenue seat hours, a 10 or 50 percent increase in its revenue seat hours will lead to a greater amount of additional Federal assistance. In the current formula, eight areas each receive 2 percent or more of the total funds. With the continued assumption that one quarter of Federal assistance is allocated on the basis of revenue-seat-hours, an urban area which provided 2 percent of the Nation's revenue-seat-hours would receive about $6.5 million on the basis of this factor. For this area, a 10-percent increase in revenue-seat-hours would increase Federal assistance by $650 thousand and a 50-percent increase in revenue-seat-hours would increase Federal assistance by $3.25 million.

1/The share received by an urban area is determined by the ratio of its revenue-seat-hours divided by the sum of all areas' revenue-seat-hours. So a 10-percent increase in the numerator also causes a small increase in the denominator. The smaller the urban area's share, the smaller the effect on the denominator. Even if this area provides 1 percent of the Nation's revenue-seat-hours of transit, a 10 percent increase causes only a 0.1-percent increase in the sum of all areas' revenue-seat-hours.

2/In making these, and subsequent, calculations in this formula, we are assuming that the value of one factor remains unchanged while the value for the other increases. In fact, of course, increases in revenue-seat-hours could be accompanied by increases in transit availability, which would mean increases in Federal assistance beyond those calculated here.

There is an additional complication in calculating the size of the incentive to expand transit availability, because there is no clearcut way to determine each area's share of the total transit availability for urban residents. Since transit availability is measured as the percent of residents for whom transit is available--however this is defined--a summation of these values for all areas does not represent a measure of total transit availability in quite the same way that a summation of all areas' revenue-seat-hours represents total revenue-seat-hours of transit service. 1/

As a result, there is no unequivocal scale that determines the extent by which one urban area exceeds another in transit availabilty. Nonetheless, the scale used is important in determining the amount by which an area can increase its share of Federal assistance by increasing the availability of its service.

Probably the simplest scale is to calculate each area's share by dividing its percentage of availability by a summation of all areas' percentages of availability. Although this denominator does not actually represent the total amount of availability in all areas--a concept not suitable to measurement--it does have the property that one area with twice as high a value for transit availabiity as compared with another will receive twice as large a share.

The distribution of values for population and revenue-seat-hours among urban areas is very skewed; the largest values are several orders of magnitude larger than average. But the distribution of values for a transit availability measure calculated as described here almost certainly will be much less skewed. An area with 90-percent availability would warrant a share only three times as large as an area with 30 percent availability. This narrow distribution partially reduces the incentive-creating effect of using transit availability as a factor.

If, for example, one quarter of the available funds were to be allocated on the basis of transit availability, then an urban area with transit availability equal to the average for all urban areas would receive about $1.25 million per year on the basis of this factor. If that average were 50 percent, then an area initially at that level that raised its

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1/If transit service were measured as the number of residents for whom service was available, rather than the percent, then this problem would not arise.

level of transit availability to 75 percent would receive an additional $612.5 thousand per year. For an area receiving relatively small allocations on the basis of population, population density, and revenue-seat-hours, this increment might make a substantial difference so that the incentive to increase transit availability will quite likely be large. But this incentive will be smaller in large urban areas. The Congress may wish to consider whether a different scaling of transit availability that provides larger incentives for large areas is more desirable. Additionally the Congress will need to decide the appropriate weight to place on transit availability in the allocation formula. A weight larger than one quarter will increase the incentive for areas of all sizes to increase their transit availability.

AGENCY COMMENTS

The Department of Transportation generally agreed with our analysis procedure. It felt that our study was a valuable examination of the considerations involved in providing operating subsidies and that the factors included in the proposed formula represented a good combination for the purposes of achieving the desired effects of an operating subsidy and reducing the conflicts between the criteria. DOT believed, however, that although our results were conceptually satisfying, there were substantial practical problems in obtaining the data necessary to include revenue-seat-hours and transit availability in an allocation formula. It maintained that any factor used in such a formula must be extremely simple and require a minimum of data and computations for its formulation.

DOT said that it was not wise to predicate changes in the formula on the assumption that the necessary but currently unavailable data would somehow come into existence. We also recognize that a formula cannot be implemented before the necessary data are available, but we do not believe that this implies limiting our consideration to formulas for which data currently exist. We feel that there is ample lead-time before the need to reauthorize the operating assistance program for the Congress to consider asking UMTA to develop cost estimates of obtaining reliable data for theoretically useful factors, such as transit availability and revenue-seat-hours. In particular, we believe that DOT has overstated the difficulty of obtaining data on revenue-seat-hours. Its view is based on the fact that current records do not always indicate which bus was operated on which route on each day. However, the necessary information is only the size of the bus, rather than the specific bus, operated on each route. As long as the size does not vary or the transit system uses

vehicles of only a few different sizes, these data may not be costly to obtain.

DOT contended that we had dismissed transit input measures as suitable factors because we had not considered the structure of the formula. DOT believes that since the current formula allocates a portion of the available funds solely for bus replacement, an allocation based on an input factor, such as the number of vehicles of a certain age, is a logical approach. We agree (see p. 30) that a strong equity argument can be made in behalf of allocating bus replacement funds on the basis of the size and age of bus fleets. However, we also believe that even if the presence of large numbers of old buses implies a need for funds to replace them, this does not imply that limits should be placed on how local authorities can spend their Federal assistance. Furthermore, we believe that for funds to which no spending limit is attached, transit input factors are a notably inferior way by which funds might be allocated both because their use in an allocation formula would bias transit operators choices toward inefficiently excessive use of that input and because, in general, the expansion of transit inputs is not an objective of Federal mass transit assistance.

Finally DOT said that we had selected population, population density, revenue-seat-hours, and transit availability as the factors that best satisfied the criteria established in chapter 3. None of these factors by itself ideally satisfies our four criteria. They were selected jointly to form one possible formula that would include factors that both assure that the largest shares of the Federal operating assistance go to those urban areas with the greatest need and provide incentives for desirable responses by operators. Other formulas might also accomplish those ends.

APPENDIX I

OFFICE OF THE SECRETARY OF TRANSPORTATION

WASHINGTON, D.C. 20590

ASSISTANT SECRETARY
FOR ADMINISTRATION

Mr. Henry Eschwege
Director
Community and Economic
Development Division
U. S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Eschwege:

We have enclosed two copies of the Department of Transporation's (DOT) reply to the General Accounting Office (GAO) report, "Analysis Of Allocation Formula For Federal Mass Transit Subsides."

DOT generally agrees with the analysis procedure utilized by the GAO in their study.

If we can further assist you, please let us know.

Sincerely,

Edward W. Scott, Jr.

Enclosure

APPENDIX I

DEPARTMENT OF TRANSPORTATION REPLY TO GAO DRAFT REPORT PAD-79-47 ON "ANALYSIS OF ALLOCATION FORMULA FOR FEDERAL MASS TRANSIT SUBSIDIES"

SUMMARY OF GAO FINDINGS AND RECOMMENDATIONS

The General Accounting Office performed an analysis of potential factors for use in the apportionment formula of UMTA's Section 5 formula grant program. Four categories of factors were considered:

- .measures of transit supply (e.g., vehicle miles, numbers of vehicles, vehicle seat hours)
- .measures of transit demand and usage (e.g., passengers, passenger miles)
- .measures of joint transit supply and usage (e.g., riders per vehicle)
- .urban-based factors (e.g., population, population density)

These factors were examined against four evaluation criteria:

- .interjurisdictional equity
- .attainment of Federal program objectives
- .avoidance of incentives for inefficiency
- .availability of data

From this process, GAO selected four factors that it considered best satisfied the criteria. These factors were population, population density, revenue seat hours of transit service, and transit availability.

The GAO report is intended as advisory material for the Congress in future development of the Section 5 formula. As such, it did not contain specific recommendations for UMTA actions. It also did not recommend a structure of the Section 5 formula in terms of relative weights of the four factors recommended for inclusion in the formula, or a partitioning of the Section 5 funds in terms of eligibility of usage.

DEPARTMENT OF TRANSPORTATION POSITION

DOT generally agrees with the analysis procedure utilized by the GAO in their study. It constitutes a valuable examination of the considerations involved in the provision of operating subsidies. The process of evaluating the various potential factors against the four criteria resulted in

the selection of four of these factors that, from a philosophical standpoint, represent a good combination for the purposes of achieving the desired effects of an operating subsidy and reducing the conflicts between the criteria. The concerns expressed in the report, the criteria utilized, the factors considered, and the conclusions reached mirror, in many respects, the process DOT has recently gone through during the legislative development of the Surface Transportation Assistance Act of 1978. The results of the GAO are, to a large extent, conceptually satisfying.

From a practical standpoint, however, DOT disagrees with the GAO view of the desirability of two of the recommended factors: bus revenue seat hours, and transit availability. Our primary objection to these factors is the lack of data available for their determination.

DOT has observed, during previous and current efforts at collecting transit data from the urbanized areas, that the record-keeping practices, and the capabilities for using these records to calculate various quantities, vary significantly from one transit operator to another. Based upon our experience to date, any factor that is to be successfully employed in the Section 5 formula must of necessity be extremely simple and require a minimum of data and computations for its formulation.

The factor, bus revenue seat hours, which the GAO recommends, requires data on which bus operated on which route on each day, or on the actual amount of time spent in revenue service by each bus. These data are often not available under current record-keeping practices.

The other factor, transit availability, was not defined in the GAO report. Thus, the actual mathematical specification would be left to others if it were adopted. Any conceivable measure of transit availability appears to involve enormous data collection and computational problems and expenses. For a precise determination of transit availability, the data itself does not currently exist and could be obtained only with great difficulty and expense.

The GAO report stated that a long range view of data availability should be adopted in considering future development of the Section 5 formula, and that current situations should not inhibit plans for such development. DOT feels, however, that in reality it is not wise to predicate changes in the formula on the assumption that the necessary but currently unavailable data will somehow come into existence.

Another shortcoming of the GAO report is that it only recommends factors to be included in the formula, and does not consider the actual structure of the formula. This has led the GAO to the dismissal of transit input factors, such as fleet size, as suitable factors. However, the current Section 5 formula is divided into several sections or "tiers," with amounts apportioned to the urbanized areas under each tier being dependent upon differing factors, and the allowable uses of the funds under each

APPENDIX I

tier differing. One of these tiers is intended to provide funds for the replacement of worn-out buses, and the apportionment of these funds according to an input factor such as the number of vehicles of a certain age is a very logical approach.

UMTA has discussed these concerns and issues with the GAO staff that prepared the report. During the course of this discussion, GAO acknowledged that some of these practical difficulties could be of greater magnitude than they had previously envisioned.

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