

high-demand sections. Other, less traditional approaches may be appropriate, such as timed transfer or pulse systems, private-sector service contracting, or substitution of paratransit services for fixed-route services in areas of very low demand. To the extent that the public transit system seeks to assist the low-income person dependent on transit, the feasibility of user-side subsidies should be reviewed.

Finally, a better match between demand and service is necessary if urban mobility is to be improved and if public transit is to remain viable within urban areas. To achieve this match requires a clear definition of the purpose of public transit subsidies. In order to define that purpose and to measure the extent to which the purpose is being ad-

ressed, public transit authorities must be aware of existing subsidy disparities between areas and types of services within the urban area.

REFERENCES

1. R. Cervero, M. Wachs, R. Berlin, and R. Gephart. Efficiency and Equity Implications of Alternative Transit Fare Policies. Univ. of California, Los Angeles, 1980.
2. R. Johnson. Park and Ride Survey. SCRTRD Marketing Research, Los Angeles, Feb. 1981.

Publication of this paper sponsored by Committee on Public Transportation Planning and Development.

Formula for Allocation of WMATA Metrorail Subsidy Requirement

R. WAYNE THOMPSON AND ROBERT A. PICKETT

Many major U.S. metropolitan areas struggle with the problem of how to distribute the cost of providing government services among participating political jurisdictions. Because transit service is provided by local or state governments, quasipublic authorities, and private operators, it has increasingly required direct financial assistance in order to meet its operating costs in the past decade. This subsidy requirement has given rise to the same sharing problem that characterizes other regional activities. An obvious way to determine a jurisdiction's share of total transit subsidy is to examine the difference between the passenger revenue collected in that jurisdiction and the operating cost incurred in the same jurisdiction. Experience indicates, however, that this approach, while equitable, is fraught with practical problems. An alternative approach, adopted by the Washington Metropolitan Area Transit Authority for application to the Metrorail system, has combined simplicity and stability with ease of administration to produce a formula that distributes only the system subsidy, not costs and revenues. This formula relies on measurements of relative benefits derived from operation of the rail transit system, focusing on jurisdictional population and density, number of stations in each jurisdiction, and number of riders from each jurisdiction. The technique has been successfully applied in each of the past four years, a noteworthy accomplishment given the widely divergent fiscal policies of the District of Columbia, the two states, the four counties, and the three municipalities that constitute the Washington, D.C., transit zone. The technique is transferable to other locations and may be applicable to other government activities.

The legislation that created the interstate compact organization known as the Washington Metropolitan Area Transit Authority (WMATA) was signed into law by President Johnson in 1966. The original purpose of the Authority was to construct the Washington, D.C., regional rail rapid transit system known as Metrorail. Since that time, some 37 miles of heavy rail lines have been built and placed in operation, including 40 stations and two large storage and maintenance facilities. The system is scheduled for completion in 1990 and will include 101 service miles and 82 stations.

Following the 1972 acquisition by WMATA of the region's private bus companies, it became apparent that the Authority would not only construct the Metro system but would also operate it. The area's local governing bodies were soon to discover that this new transit operating responsibility would carry with it some very difficult problems of inter-jurisdictional coordination and agreement. One of

the greatest of these has been the policy and process for handling the steadily mounting operating deficits of the transit system.

It is the purpose of this paper to explain the method selected by the WMATA Board of Directors for determining the financial responsibility of each local political jurisdiction with respect to the Metrorail operating deficit.

METRO RAIL OPERATING ASSISTANCE REQUIREMENT

The WMATA transit zone is composed of eight local political jurisdictions: Montgomery and Prince Georges Counties in Maryland; Arlington County, Fairfax County, the City of Alexandria, the City of Falls Church, and Fairfax City in Virginia; and the District of Columbia. Figure 1 shows these jurisdictions, along with the adopted 101-mile Metrorail system.

Since the beginning of WMATA transit operations in 1972, the Board of Directors has attempted to keep passenger fares as low as possible subject to local fiscal constraints. The fare structures that have been instituted on Metrorail since its inception have provided enough revenue to cover only about half the cost of operating the system. The remaining half has been provided by subsidies--financial contributions received from sources other than passenger fares--the responsibility for which has been shared by the local political jurisdictions and the federal government. Table 1 gives this "operating assistance" requirement for each of three consecutive fiscal years, FY 1978 to FY 1980. This paper focuses on the jurisdictional distribution of the Metrorail subsidy requirement (line 3 in Table 1) only.

METRO RAIL SUBSIDY ALLOCATION PROBLEM

Given the above stated operating assistance requirements, one is led logically to the question of the extent to which each local jurisdiction is obligated to support the Metrorail system out of its general

Figure 1. WMATA transit zone.

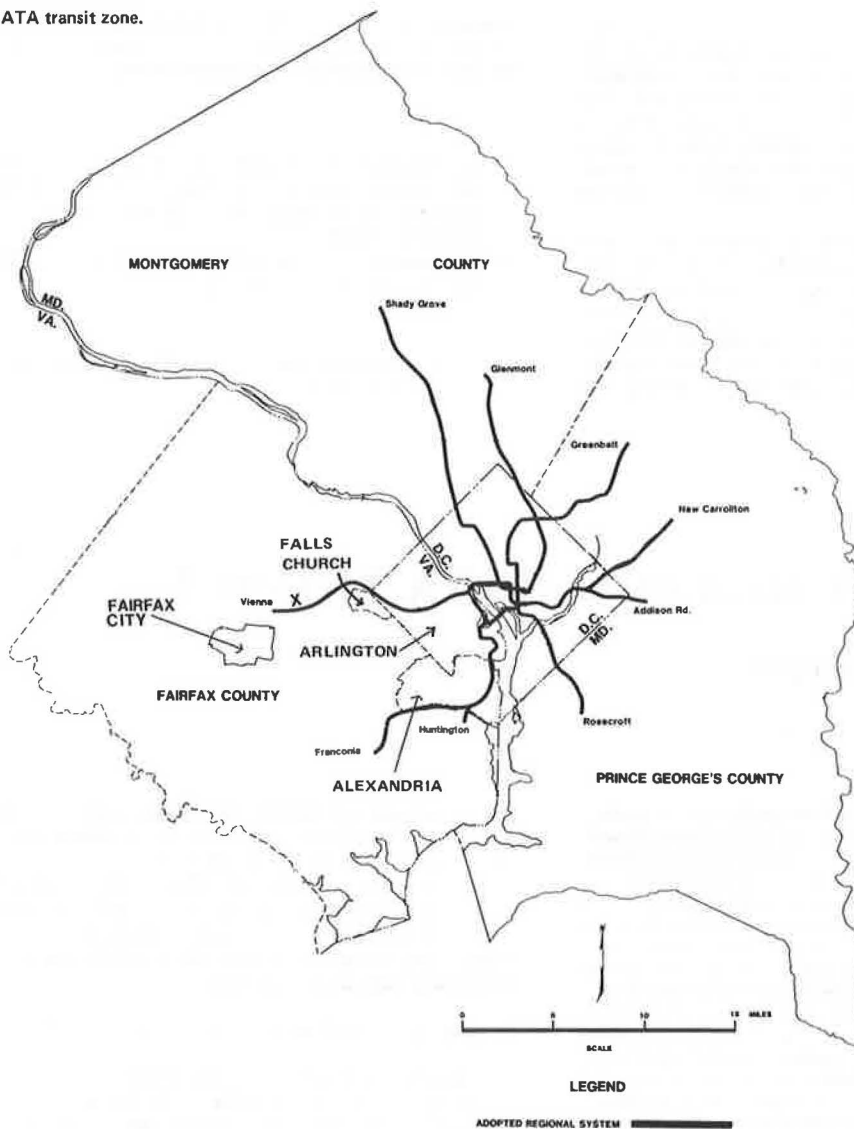


Table 1. WMATA transit operating assistance: FY 1978 to FY 1980.

Line No.	Item	Amount (\$000 000s)		
		FY 1978	FY 1979	FY 1980
	Metro-rail			
1	Operating cost	34.7	53.9	74.1
2	Operating revenue	15.4	32.2	45.1
3	Balance (subsidy)	19.3	21.7	29.0
	Metrobus			
4	Operating cost	120.8	129.0	160.0
5	Operating revenue	59.2	55.7	70.9
6	Balance (subsidy)	61.9	73.3	89.1
	Subsidy requirement			
7	Total (bus and rail)	80.9	95.0	118.1
8	Federal share ^a	17.8	23.7	25.7
9	Local share	63.1	71.3	92.4

^aSection 5 of the Urban Mass Transportation Act of 1964, as amended.

tax revenues. In other words, what proportion of the total Metro-rail subsidy does each jurisdiction owe, and how is that proportion determined? The Authority and its constituent governing bodies have labored long and hard to answer this question to everyone's satisfaction. One may never find the perfect solution and, regardless of what method is

used to distribute the subsidy requirement in any given year, the process is always subject to annual review and revision in subsequent years. This fact notwithstanding, however, the WMATA solution has remained remarkably stable and consistent since it was first implemented.

CRITERIA

Initial efforts to develop a Metro-rail subsidy allocation system were guided by a collective desire to adhere to certain criteria. These criteria were never formally adopted but were expressed informally by various participants in the decisionmaking process. They provided that any agreed-on solution should meet the following criteria:

1. It should be equitable. Each jurisdiction's share of the subsidy should bear a logical relation to the degree to which that jurisdiction participates in, or benefits from, the operation of Metro-rail.
2. It should be sound and easily verified.
3. It should be stable and predictable.
4. It should be simple.
5. It should be clear. In order for the solution

to be well accepted and used, it must be clear to all participants how each element impacts their share of the subsidy as well as how each element reflects their actual participation in Metrorail operations.

6. It should be easy to administer.

7. It should be regional in focus. This may well be the criterion that has carried the greatest weight in holding together the sometimes fragile consensus on this issue among the local jurisdictions. A regional focus has been made possible by the existence of a regional mileage-based fare structure and a regionally uniform service policy. If service or fares were to be adjusted on a jurisdictional basis, then the whole range of cost and revenue issues would come into play in this subsidy allocation process and each jurisdiction would be making claims and disputing results based on purely parochial interests.

APPROACHES TO THE SOLUTION

Transit operating agencies in several U.S. metropolitan regions have had to grapple with the subsidy allocation problem in much the same way that WMATA has. In each case, however, the circumstances vary sufficiently to make each approach to the solution of this problem unique to the particular region and system to which it is applied.

On the other hand, it may be possible to categorize all such solutions into two groups: the cost/revenue approach, and what, for want of a better term, we will call the "relative-benefits" formula approach. The WMATA Board examined possibilities in each of these two categories.

The cost/revenue approach would seem to be the most obvious solution and indeed is used at present to distribute the Authority's Metrobus operating subsidy requirement among the local jurisdictions. In terms of the seven criteria cited previously, there are both advantages and disadvantages associated with this method in its application to Metrorail.

The assignment of costs and revenues separately to each jurisdiction based on the amount of service provided in that locale, as a means of determining subsidy obligations, is unquestionably equitable since, under this scheme, a jurisdiction gets exactly what it pays for. The data, although factual and sound, exhibit one major deficiency: They are sometimes difficult to obtain and to maintain in an up-to-date form. Obstacles have recently been encountered along this line in allocating Metrobus costs and revenues. Furthermore, small changes in a given cost component, such as fuel price, can affect one jurisdiction more than others and leave doubts as to the stability and predictability of this method.

Because of these drawbacks, the cost/revenue approach was felt to be too complicated and unstable to apply to Metrorail. It would certainly be very difficult to administer, as the Metrobus experience has amply demonstrated. The most severe shortcoming of this approach, however, is that it fosters a parochial solution to cost control and is therefore the antithesis of a regional focus. Since the Metrorail system is not divisible (as is Metrobus) on a jurisdictional basis, separate jurisdictional management actions cannot be applied. On the contrary, management policies such as headways and car consists must be applied uniformly by line, irrespective of jurisdiction. It follows, therefore, that cost, revenue, and resultant subsidy should also be shared regionally rather than on a jurisdictional dollar-per-unit-consumed basis.

RELATIVE-BENEFITS FORMULA CONCEPT

The WMATA Board clearly voiced its desire to adhere to the seven criteria, particularly the concept of a regional focus (1, p. 2):

The Board's Allocation Committees have discussed and investigated many different Rail Formulae over the past few years. The (Board) feels that it is time for a fresh approach which embraces simplicity, regionalism, and a concept which recognizes that an effective public transportation system impacts arewide community life and represents a total regional enhancement.

From this policy then arose the relative-benefits concept for allocating the deficit itself rather than distributing costs and revenues separately (1):

The (Board) very early in its deliberations concentrated on an "aggregate deficit" approach rather than a revenue-cost formula...and primary emphasis was placed on attempting to allocate Metrorail subsidy requirements on the basis of relative benefits.

Once a formula was established, the Metrorail operating assistance requirement could then be distributed among the jurisdictions in amounts equal to the total benefit received by each jurisdiction relative to all others in the system.

ADOPTED RELATIVE-BENEFITS FORMULA

The Authority's participating local governments were able to identify three main categories of benefit that would lend themselves to formula application:

1. Indirect benefits to the general public in terms of improved quality of life,
2. Benefits that accrue to a jurisdiction by virtue of having one or more Metrorail stations located within its boundaries, and
3. Direct benefits to the users of the system.

It was concluded that the proportion of total ridership residing in each jurisdiction would be designated as the measure of user benefit to determine each jurisdiction's share of that component of the formula. In other words, the greater the number of riders from each jurisdiction, the greater (it is assumed) is that jurisdiction's benefit.

In the same vein, it is assumed that the greater the population of a jurisdiction, especially in urbanized areas, the more that jurisdiction benefits from the improved quality of life brought about by the operation of rail rapid transit in the region. In this sense, all citizens benefit, whether they be users or nonusers of the system, and the denser the residential land use, the greater is the benefit. It was decided, therefore, that census information on population and population density should somehow be included in the formula to reflect this fact.

Last, it was decided that benefit should be assigned to a jurisdiction in direct relation to the number of stations in operation within its boundaries. In this case, some jurisdictions receive no benefit at all, and their subsidy requirements are commensurately lower. In areas where stations are located, the jurisdiction benefits through enhanced development potential and the stimulation of economic activity, both of which create an enlarged tax base. In addition to this financial benefit, the citizens of a jurisdiction in which a station is located enjoy an obvious advantage in terms of system accessibility.

On May 19, 1977, the WMATA Board of Directors adopted a formula to distribute the Metrorail subsidy that encompasses the three elements outlined above: population/population density, assigned stations, and passengers' residence. The adoption resolution specified that the subsidy requirement would be allocated among the WMATA signatories as follows:

1. One-third on the basis of the relative number of stations in operation in each signatory,
2. One-third on the basis of a weighted average of urbanized-area population and population weighted density by using approved 1976 population estimates, and
3. One-third on the basis of the relative number of Metrorail passengers who reside in each signatory, as determined by direct survey.

These three elements are examined in detail below.

APPLICATION OF ADOPTED FORMULA

The remainder of this paper deals with the application and performance of the adopted formula, focusing on FY 1980 for reference purposes. The final proportional distribution of the Metrorail subsidy is actually the average of the three elemental distributions (i.e., each element counts as one-third of the total). Table 2 gives the percentage

figures developed for FY 1980, demonstrating the average of the three elements (2). The actual subsidy dollar amount for FY 1980 was distributed among the eight jurisdictions based on the average percentages, as shown in the right-hand column of this table (3). Table 2 is now used as a reference to examine the derivation of each element.

Population and Population Density

Generally speaking, the element of population and population density is based on U.S. Census of Population data and therefore remains fairly fixed over time, given the fact that such information is produced only once every 10 years. Some interim projections of population are made locally, however, and the percentages given in Table 2 are based on an estimate of 1976 population made by the Metropolitan Washington Council of Governments (MWCOC).

Two separate census items make up this element: (a) population of the urbanized area and (b) land area of the urbanized area. These two items are combined in Table 3 to produce the desired percentage distribution.

One will notice that a two-step process is used in the derivation of the final percentages for Maryland and Virginia. This is a result of the language used in the adopted resolution, which stresses distribution of the subsidy by "signatory", i.e., those units of government constitutionally

Table 2. Distribution of FY 1980 Metrorail subsidy requirement.

Jurisdiction	Distribution (%)					Dollar Amount (\$)
	Population/ Population Density	Assigned Stations	Passengers' Residence	Final (average) Distribution		
District of Columbia	39.81	67.12	32.96	46.63		13 524 671
Montgomery County	15.26	2.92	15.02	11.07		3 210 768
Prince Georges County	19.61	8.75	19.49	15.95		4 626 174
Arlington	5.59	21.21	14.36	13.72		3 979 380
Alexandria	4.51	0.00	5.84	3.45		1 000 646
Fairfax County	14.26	0.00	11.52	8.59		2 491 463
Falls Church	0.34	0.00	0.61	0.31		89 913
Fairfax City	0.62	0.00	0.20	0.28		81 212
Total						29 004 227

Note: Data based on final distribution of FY 1980 Metrorail subsidy requirement (2) and WMATA FY 1980 audited financial statements (3).

Table 3. Determination of population/population density element.

Jurisdiction	Urbanized- Area Population ^a	Land Area ^b (km ²)	Population Density (persons/km ²)	Population Weighted Density (000 000s)	Distribution (%)			Percentage of Total
					Population	Population Weighted Density	Avg	
District of Columbia	721 800	170.6	4231	3053.9	28.002	51.613	39.807 ^c	
Maryland	1 074 296	694.7	1546	1660.9	41.676	28.071	34.874	
Virginia	781 618	508.3	1538	1202.1	30.322	20.316	25.319	
Total	2 577 714	1373.6			100	100	100	
Subjurisdictional split								
Maryland								
Montgomery County	494 076	350.8	1408	695.7	45.991	41.547	43.769	15.264 ^c
Prince Georges County	580 220	343.9	1687	978.8	54.009	58.543	56.231	19.610 ^c
Total	1 074 296	694.7			100	100	100	34.874
Virginia								
Arlington	152 000	72.2	2105	320.0	19.447	24.737	22.092	5.594 ^c
Alexandria	107 400	40.8	2632	282.7	13.741	21.854	17.798	4.506 ^c
Fairfax County	490 663	373.0	1315	645.2	62.775	49.876	56.325	14.261 ^c
Falls Church	10 000	5.6	1786	17.9	1.279	1.384	1.332	0.337 ^c
Fairfax City	21 555	16.7	1291	27.8	2.758	2.149	2.453	0.621 ^c
Total	781 618	508.3			100	100	100	25.319

Note: Data based on unpublished WMATA financial records.

^aMWCOC estimate for 1976.

^bConverted from square miles as defined by 1970 Census of Population.

^cPercentages that make up population/population density element of formula (Table 2).

empowered to enter into the Authority compact agreement--the District of Columbia, the State of Maryland, and the Commonwealth of Virginia. The percentages were therefore first derived on an aggregate basis and then "suballocated" to the separate jurisdictions.

A precedent has been set for the use of this overall procedure in that it is similar to that used by the Urban Mass Transportation Administration for the distribution of its Section 5 Federal Operating Assistance Grants.

Following Table 3 from left to right, the procedure is as follows:

1. Column 2 and column 3 give the population and land area of the urbanized area (sources as indicated). It should be noted that in Montgomery, Prince Georges, and Fairfax Counties, the population of the urbanized area is less than the total population of those jurisdictions because a certain portion of each lies outside the urbanized area.

2. Column 4 is the population (column 2) divided by the land area (column 3) of each jurisdiction. This yields the density in residents per square kilometer.

3. Column 5 is the population (column 2) multiplied by the density (column 4) to yield population weighted density.

4. Column 6 is the percentage distribution of population (column 2).

5. Column 7 is the percentage distribution of population weighted density (column 5).

6. Column 8 is the average of the distribution of population (column 6) and the distribution of population weighted density (column 7).

Again, the Maryland and Virginia average percentages are further distributed in the lower half of the table. The figures that finally make up this element of the formula are footnoted. These are the figures appearing in Table 2.

Assigned Stations

The second element of the formula, assigned stations, is included to reflect the benefit that accrues to a jurisdiction as a result of having one or more stations in operation within its boundaries. The jurisdictional location of those stations in operation in FY 1980 can be broken down as follows. In phases 1 through 3, the following stations became operational:

1. District of Columbia--Rhode Island Avenue, Union Station, Judiciary Square, Gallery Place, Metro Center, Farragut North, Dupont Circle, Stadium-Armory, Potomac Avenue, Eastern Market, Capitol

Table 5. Jurisdiction of residence: results of phase 4 passenger survey.

Jurisdiction	No. of Passengers	Proportion of Transit Zone (%)	Proportion of All Riders (%)
District of Columbia	89 077	31.98	29.17
Montgomery County	42 055	15.10	13.77
Prince Georges County	52 378	18.80	17.15
Arlington	43 042	15.45	14.09
Alexandria	15 798	5.67	5.17
Fairfax County	33 791	12.13	11.06
Falls Church	1 866	0.67	0.61
Fairfax City	549	0.20	0.18
Total transit zone	278 556	100.00	91.20
Other			
Howard County	1 409		0.46
Anne Arundel County	3 203		1.05
Charles County	535		0.18
Prince William County	1 996		0.65
Loudoun County	570		0.19
Outside Washington metropolitan area	19 147		6.27
Total	26 860		8.80
All riders	305 416		100.00

South, Federal Center Southwest, L'Enfant Plaza, Smithsonian, Federal Triangle, McPherson Square, Farragut West, Foggy Bottom, Brookland, Fort Totten, Takoma, Minnesota Avenue, and Deanwood;

2. Arlington County--Rosslyn, Pentagon, Pentagon City, Crystal City, and National Airport (Arlington Cemetery station is excluded);

3. Montgomery County--Silver Spring; and

4. Prince Georges County--Cheverly, Landover, and New Carrollton.

In phase 4, four additional Arlington County stations became operational: Court House, Clarendon, Virginia Square, and Ballston.

Thus, the cumulative totals of stations in operation in FY 1980, by construction phase, are as follows:

Phase	District of Columbia	Arlington County	Montgomery County	Prince Georges County
1-3	23	5	1	3
4		4	1	
Total	23	9	1	3

Obviously, only four jurisdictions have stations assigned to them; the other four do not. As was pointed out in Table 2, the effect of this station "assignment" is to lay a heavier subsidy burden on those jurisdictions in which Metrorail operates. The City of Alexandria and Fairfax County will eventually join the other Washington jurisdictions in sharing a portion of this subsidy allocation element.

In FY 1980, phase 4 of the Metrorail construction

Table 4. FY 1980 weighted distribution of assigned stations.

Jurisdiction	Phase 3				Phase 4				Combined Final Distribution (%)
	No. of Stations	Distribution (%)	Pro Rata Weight	Weighted Distribution (%)	No. of Stations	Distribution (%)	Pro Rata Weight	Weighted Distribution (%)	
District of Columbia	23	71.88	0.4034	29.00	23	63.89	0.5966	38.12	67.12
Montgomery County	1	3.12	0.4034	1.26	1	2.78	0.5966	1.66	2.92
Prince Georges County	3	9.38	0.4034	3.78	3	8.33	0.5966	4.97	8.75
Arlington	5	15.62	0.4034	6.30	9	25.00	0.5966	14.91	21.21
Alexandria	0	-	-	-	0	-	-	-	-
Fairfax County	0	-	-	-	0	-	-	-	-
Falls Church	0	-	-	-	0	-	-	-	-
Fairfax City	0	-	-	-	0	-	-	-	-
Total	32	100.00	0.4034	40.34	36	100.00	0.5966	59.66	100.00

program was completed, and four new stations were placed into service on December 1, 1979, all in Arlington County. However, since Arlington did not have use of these four stations for the full year, the assigned-stations element was prorated. The method used to accomplish this pro rata distribution was to weight each operating phase according to the number of days it was in service during the fiscal year. In effect, this procedure converts the distribution from a phase-specific basis to a fiscal-year basis. The following table (2) gives the pro rata weights for Metrorail phases 3 and 4 as calculated for FY 1980:

Construction Phase	Month	Operating Days	
		No.	Percent
3	July	26	
	August	27	
	September	30	
	October	31	
	November	30	
Total		144	40.34
4	December	31	
	January	31	
	February	29	
	March	31	
	April	30	
	May	31	
	June	30	
Total		213	59.66
Total		357	100.00

(It should be noted that Sunday service began September 2, 1979; thereafter, the system has operated 365 days/year. Phase 4 opened December 1, 1979.)

Table 4 gives the percentage distribution of assigned stations, the application of the pro rata weights, and the resultant final distribution of this element as reflected back in Table 2. In this case, the present distribution for each phase is

Table 6. Unweighted jurisdiction of residence by phase: percentage distribution of passengers.

Jurisdiction	Proportion of Passengers (%)			
	Phase 2 ^a	Phase 2A ^b	Phase 3 ^c	Phase 4 ^d
District of Columbia	32.52	32.17	34.41	31.98
Montgomery County	6.76	16.12	14.90	15.10
Prince Georges County	16.66	16.93	20.50	18.80
Arlington	17.51	14.65	12.73	15.45
Alexandria	7.79	6.54	6.11	5.67
Fairfax County	14.79	12.65	10.62	12.13
Falls Church	0.63	0.68	0.53	0.67
Fairfax City	0.35	0.26	0.21	0.20
Total	100.00	100.00	100.00	100.00

^a November 1977. ^b May 1978. ^c May 1979. ^d April-May 1980.

Table 8. FY 1980 weighted distribution of passenger jurisdiction of residence.

Jurisdiction	Phase 3			Phase 4			Combined Final Distribution (%)
	Distribution (%)	Pro Rata Weight	Weighted Distribution (%)	Distribution (%)	Pro Rata Weight	Weighted Distribution (%)	
District of Columbia	34.40	0.4034	13.88	31.98	0.5966	19.08	32.96
Montgomery County	14.90	0.4034	6.01	15.10	0.5966	9.01	15.02
Prince Georges County	20.50	0.4034	8.27	18.80	0.5966	11.22	19.49
Arlington	12.73	0.4034	5.14	15.45	0.5966	9.22	14.36
Alexandria	6.11	0.4034	2.46	5.67	0.5966	3.38	5.84
Fairfax County	10.62	0.4034	4.28	12.13	0.5966	7.24	11.52
Falls Church	0.53	0.4034	0.21	0.67	0.5966	0.40	0.61
Fairfax City	0.21	0.4034	0.08	0.20	0.5966	0.12	0.20
Total	100.00		40.33	100.00		59.67	100.00

multiplied by the pro rata weight, which yields the weighted distribution. The weighted distributions are then added together to produce the combined final distribution for the entire element.

Passenger Residence

The third and final element of the formula is passenger jurisdiction of residence, selected for inclusion to reflect direct user benefits. This element is determined by a direct sample survey conducted following the opening of each operating phase.

Table 5 displays the results of the phase 4 passenger survey (conducted in April and May 1980), which show how the percentage distribution for transit-zone residents is developed. Tables 6 and 7 (2) present the results of the last four surveys for comparison purposes. The desirability of the jurisdiction of residence element in terms of the stability criteria is amply evident here, and as the system grows the changes resulting from the addition of each phase will diminish.

Again, as with the assigned-stations element, passenger residence must be prorated according to the number of days during the year that each phase was in service. In FY 1980, phases 3 and 4 were in operation and the pro rata weights calculated earlier were applied to this element as well.

Table 8 gives the percentage distribution by phase, the application of the pro rata weights as explained above, and the weighted and combined final distributions. Figure 2 shows a flow diagram of the steps used in the formula to derive the final subsidy percentages by jurisdiction.

OVERALL FORMULA PERFORMANCE

Table 9 summarizes the first three years of the use of the formula, revealing the simplicity and stability over time that characterize this allocation method. As discussed above, the population/population density element is fixed for the period shown. As the system has grown, the assigned-stations

Table 7. Unweighted jurisdiction of residence by phase: daily passenger volumes.

Category	Passengers per Day			
	Phase 2 ^a	Phase 2A ^b	Phase 3 ^c	Phase 4 ^d
Transit-zone residents	125 462	171 042	239 833	278 556
Nonresidents	8 977	14 991	30 047	26 860
Total	134 439	186 033	259 880	305 416

^a November 1977. ^b May 1978. ^c May 1979. ^d April-May 1980.

Figure 2. Flow diagram of Metrorail subsidy allocation formula.

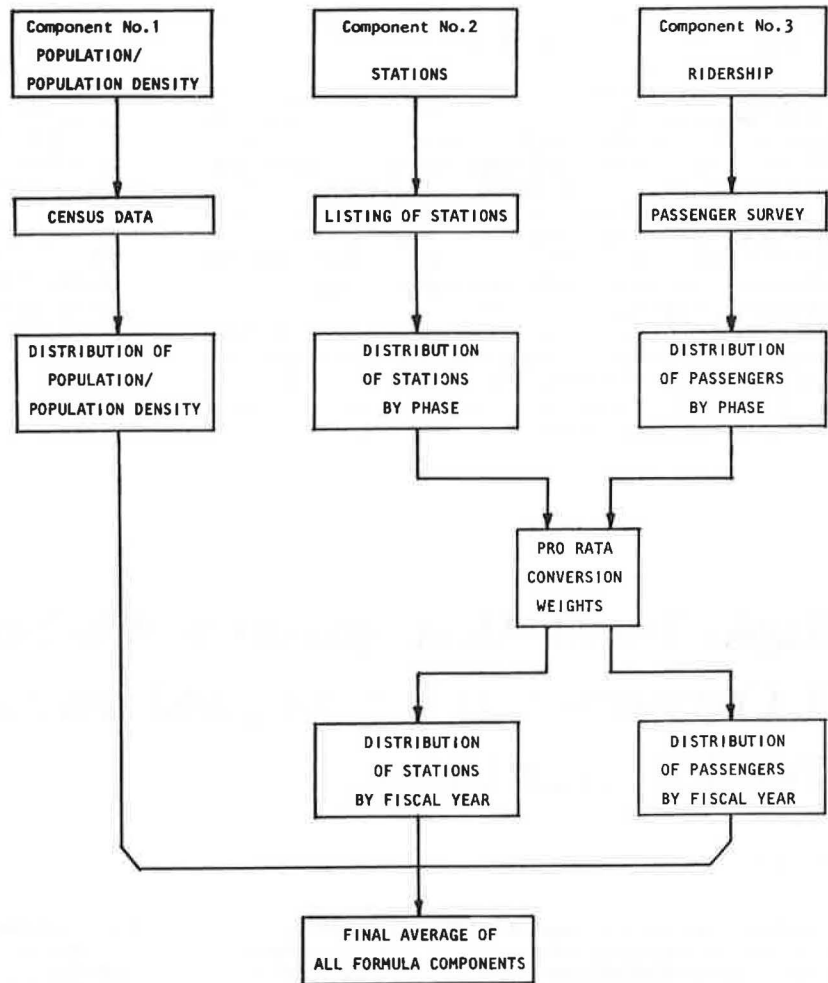


Table 9. Summary of first three years of use of Metrorail subsidy allocation formula.

Jurisdiction	Distribution (%)											
	FY 1978 ^a				FY 1979 ^b				FY 1980 ^c			
	Population/ Population Density	Assigned Stations	Passenger Residence	Final Distribu- tion	Population/ Population Density	Assigned Stations	Passenger Residence	Final Distribu- tion	Population/ Population Density	Assigned Stations	Passenger Residence	Final Distribu- tion
District of Columbia	39.81	78.06	34.15	50.68	39.81	74.00	33.61	49.15	39.81	67.12	32.96	46.63
Montgomery County	15.26	1.51	10.57	9.11	15.26	3.33	15.34	11.31	15.26	2.92	15.02	11.07
Prince Georges County	19.61	-	16.77	12.13	19.61	6.00	19.21	14.94	19.61	8.75	19.49	15.95
Arlington	5.59	20.43	16.34	14.11	5.59	16.67	13.42	11.89	5.59	21.21	14.36	13.72
Alexandria	4.51	-	7.28	3.93	4.51	-	6.26	3.59	4.51	-	5.84	3.45
Fairfax County	14.26	-	13.92	9.39	14.26	-	11.35	8.53	14.26	-	11.52	8.59
Falls Church	0.34	-	0.65	0.33	0.34	-	0.58	0.30	0.34	-	0.61	0.31
Fairfax City	0.62	-	0.32	0.32	0.62	-	0.23	0.29	0.62	-	0.20	0.28
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

^aFinal distribution, phases 2 and 2A.

^bFinal distribution, phases 2A and 3.

^cFinal distribution, phases 3 and 4.

element has shifted accordingly. Likewise, jurisdiction of residence has changed each year but in smooth and predictable ways.

PROSPECTS FOR THE FUTURE

In spite of the superiority of this type of relative-benefits approach over the most viable alternative (cost/revenue allocation), there is not 100

percent satisfaction with each of the individual elements. In suburban jurisdictions, the share of each element is rising and this is placing increasing demands on local budgets. Preliminary figures from the 1980 Census show significant increases in suburban population; as construction continues, the Metrorail system reaches farther into those same areas with more stations, increasing their share of the assigned-stations element of the formula.

Influenced by these two events, the suburban share of total ridership is also climbing.

Governing bodies, of course, tend to look critically at any factor that has adverse impacts on their budgets. Recently, several alterations have been sought in the WMATA formula. Some suburban jurisdictions have supported replacing passenger residence with whatever measure is adopted by Congress for distribution of Section 5 funds. There have also been discussions of using only population or only ridership to distribute the subsidy, and the relative utility of the cost/revenue approach is reexamined with some regularity.

In spite of all these attempts at alteration, however, the present approach has withstood the tests of time and critical review. It has been found to be the best method yet devised to fulfill the seven criteria listed at the outset.

REFERENCES

1. Recommendations of Revenue and Operations and Subsidy Allocation Committee on Formula to Allocate Metrorail Subsidy Requirements. Washington Metropolitan Area Transit Authority, Washington, DC, Memorandum, 1977.
2. R.W. Thompson. Final Distribution of the FY 1980 Metrorail Subsidy Requirement. Washington Metropolitan Area Transit Authority, Washington, DC, Memorandum, 1980.
3. Audited Financial Statements and Other Financial Information, Washington Metropolitan Area Transit Authority. Ernst and Whinney, Washington, DC,

Publication of this paper sponsored by Committee on Public Transportation Planning and Development.

Rapid Transit Development in Medium-Sized Urban Areas: A Comparison of Planning and Decisionmaking in Two Canadian Cities

PETER P. BELOBABA

Several North American urban areas with populations of 500 000 to 1.5 million are in the midst of rapid transit development programs. Although the systems being considered are smaller in scale than the rapid transit systems of larger metropolitan areas, their effect on the transportation systems and land use patterns of the smaller cities may prove to be much more significant. Detailed technical analyses of the many impacts of alternative modes, routes, and staging scenarios thus have a major role to play in the decisions to be made with respect to rapid transit development in such cities. Nontechnical factors, however, such as the characteristics of the political environment and the planning process undertaken in a particular city, can have just as great an influence on the rapid transit system ultimately implemented. The rapid transit planning processes undertaken in Calgary, Alberta, and Ottawa, Ontario, are compared to illustrate this balance between technical analyses and nontechnical factors. From the initial decision to proceed with a rapid transit program through the decisions made with respect to route alignments and mode selection, the analysis methods used and the decisionmaking processes followed in the two cities differ significantly. In both cases, however, nontechnical influences proved to be extremely important in creating two very different rapid transit solutions to similar transportation problems.

Costly experiences with the development of heavy rail rapid transit systems in a number of North American cities, together with recent funding cutbacks, have forced both planners and decisionmakers to reevaluate plans for extensive regional rail systems. Several medium-sized urban areas that once hoped to build heavy rail systems are now considering or undertaking the development of less costly rapid transit projects, financed through alternative means. The most notable U.S. example is the San Diego light rail line. In Canada, several cities with metropolitan area populations of 0.5 million to 1 million are also committed to the development of light rail or busway rapid transit systems. Although these Canadian cities are smaller than the U.S. cities that are considering rapid transit development, and although there are significant political and institutional differences, many of the decisions made and the processes followed in planning

these systems are nevertheless comparable to those in medium-sized U.S. cities faced with similar transportation problems.

This paper examines three major decisions made in planning rapid transit projects in Calgary, Alberta, and Ottawa, Ontario: the initial decision to undertake a rapid transit development program, the selection of specific route alignments and profiles, and the selection of one particular mode over another. A comparative approach is used to identify the differing objectives of the two programs, the technical analyses completed, and the influences of political considerations and the planning process itself on the ultimate project outcomes in the two cities. Strikingly different planning environments and design processes suggest a number of conclusions as to the importance of technical evaluations in relation to nontechnical factors in determining the type of rapid transit system developed.

The rapid transit projects in the two cities differ substantially in terms of the mode selected and the types of route alignment to be used. In Calgary, an 8-mile light rail transit (LRT) line, located primarily along a railroad right-of-way and leading to a downtown transit mall, opened in May 1981. Planning for rapid transit in Ottawa has been under way for more than a decade, with the result that work will soon begin on the construction of a system of "transitways", exclusive rights-of-way to be used by articulated buses feeding the downtown area.

The discussion in this paper generally follows the rapid transit planning and decisionmaking sequence followed in the two cities. A brief description of the characteristics of each city is provided, and the transportation planning background relevant to each case is summarized. Separate sections of the paper are then devoted to the initial