percent do not. Reasons for selecting a gasoline station are as follows:

Reason	Percent
Price	41
Near home	26
Good service	15
On way to shopping	3
Other	6
No response	21

Of 600 respondents, 80 percent knew gasoline prices exactly and 20 percent could not remember them. Respondents who inform themselves about gasoline prices in their communities do so with the following frequency:

Frequency	Percent
Regularly	13
Occasionally	18
Only in passing	36
Hardly ever	32

Nevertheless, the expenditures for operating the car account for only 40 percent of the costs involved in using cars. And the perception of other expenditures is even worse than that for operating costs, for instance, the perception of repair costs, which account for 19 percent of the car budget, and the perception of fixed costs, which account for 27 percent of the car budget. The depreciation in the value of the car, which accounts for an average of 14 percent of the yearly car budget, is usually either partly or totally repressed.

The assumption that radical increases in operating costs for cars would lead people to be more aware of car-related costs could not be justified in this study, with the exception of the purchase price of the cars.

Nevertheless, as inaccurate as the perception of the car budget might be, car-related costs are still comparatively well accounted for in the household budget in contrast to other categories of expenditure.

A detailed study (11) of total household budgets showed that there were even worse errors in the perception of the total expenditures for the household. In Munich, for instance, only 2 percent of all households kept a regular account of their expenditures and only every sixth household (18 percent) could precisely account for income and expenditures. Approximately every fourth household (23 percent) knew precisely what they spent for at least some categories of items, whereas 38 percent of the households could more or less correctly reconstruct their household budgets--with some effort. Every fifth household (21 percent) could do no more than roughly estimate its expenditures, even with great effort.

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A Decade of Change for Mass Transit

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The transit industry in the United States was transformed during the decade of the 1970s. This transformation consisted of changes in institutional structure; changes in the amount, type, and location of transit service; and changes in cost levels and in the means by which costs were financed. The purpose of this paper is to examine the nature and extent of these changes, with particular emphasis on changes in levels of service, costs, and financing. Variations in these trends among different transit systems are highlighted, and causes of the variations are analyzed by a range of statistical methods. Although the econometric results are not entirely conclusive, they suggest that various aspects of the current transit program may encourage cost escalation and thus hamper the effectiveness of government subsidies to transit.

The transit industry in the United States underwent a revolution during the decade of the 1970s. Unlike most other industries, however, the transit revolution resulted not from technological change but rather from shifts in public policy. The most important aspects of transit's transformation were changes in the institutional framework of the industry, accompanied by a broadening of the perceived objectives of transit; changes in the amount, type, and location of transit service; and changes in the costs of transit and in the means by which these costs were financed. The purpose of this paper is to examine the nature and extent of these changes with particular emphasis on changes in levels of service, costs, and financing. Variations in these trends among different transit systems are highlighted, and causes of the variations are analyzed by a range of statistical methods.

NATIONWIDE TRENDS

There were significant differences among cities along virtually every dimension of change in mass transit during the 1970s. Nevertheless, an examination of nationwide aggregate trends is useful for identifying the most important, overall shifts in the industry. The changes focused on here are institutional changes, service-level changes, and changes in costs and financing.

Changes in Institutional Framework

Changes in the institutional structure of the transit industry during the 1970s represented the culmination of trends that had been initiated in the 1960s. In both decades, the proportion of the industry that was publicly owned increased substantially. The percentage of public systems increased from 5 to 15 percent between 1960 and 1970 and from 15 to 55 percent between 1970 and 1980. Moreover, this increasing number of public systems provided a larger and larger proportion of the nation's transit service: from 36 percent of total vehicle miles in 1960 to 68 percent in 1970 and 93 percent in 1980 (1, p. 43). Thus, transit in the United States has been transformed from a primarily privately owned industry to one that is now overwhelmingly public. Related to this development, consolidated metropolitanwide transit agencies have become increasingly common. Although such regional authorities have enhanced the possibilities for comprehensive planning, service coordination, pooling of overhead costs, and regionwide financing, they have eliminated most competition within the industry. Some observers blame public ownership and lack of competition for the rapidly rising costs and subsidy requirements of transit during the 1970s, which are documented in subsequent sections of this paper (2, pp. 42-49; 3, pp. 109-113).

Increasingly viewed as a public service to be provided by local government agencies, transit has been run less and less to maximize profits or even to minimize losses. Rather, transit operators have been charged with the responsibility for achieving a wide range of social, economic, and environmental goals such as pollution abatement, congestion reduction, energy conservation, central-city revitalization, traffic safety, and improved mobility for the poor, the elderly, and the handicapped (4, pp. 171-203; 5, pp. 1-12, 32-36). Political considerations have supplanted market competition as the guiding force for determining service policies, fare structures, and operating procedures. In some instances, the resulting political bargains may have led to inefficiency. For example, suburban portions of regional transit districts have received additional service in return for their political support and financial contributions to regional systems (6). Unfortunately, these suburban services have usually been either lightly patronized (as with bus routes) or extremely expensive to run (as with commuter rail) and in both cases have entailed large operating subsidies per passenger (7).

Finally, public ownership and government subsidization have been accompanied by numerous regulations, many of which have accelerated cost increases. These include the Section 504 regulations of the Rehabilitation Act of 1973, which mandate full accessibility of transit vehicles and stations for elderly and handicapped users; Section 13(c) of the Urban Mass Transportation Act of 1964 and the Davis-Bacon Act, which have increased the power of transit labor unions; Section 401 of the Surface Transportation Assistance Act of 1978, which requires that transit vehicles and other capital equipment be manufactured in the United States; and a host of environmental regulations (5, pp. 31-46, 80-134).

Changes in Service Level

In light of the dramatic changes in the institutional structure of the U.S. transit industry, it is somewhat surprising to see how little the overall level of transit service changed from 1970 to 1980. According to the American Public Transit Association (APTA) (1, p. 58), total vehicle miles of operation (excluding commuter rail) grew from 1.9 billion to 2.1 billion, an increase of only 11 percent. There was much variation among transit modes, however. For example, vehicle miles of trolley coach service decreased 61 percent, vehicle miles of streetcar service decreased 42 percent, and vehicle miles of rail rapid transit service decreased 6 percent (in spite of new systems in San Francisco and Oakland, Washington, and Atlanta). The overall increase in service was due solely to the 19 percent expansion of bus operations. Changes in ridership roughly paralleled these changes in service levels. Trolley coach passengers declined 45 percent, streetcar passengers declined 53 percent, and rail rapid transit passengers declined 10 percent. In contrast, bus ridership increased 18 percent (1, p. 55).

The allocation of transit service within metropolitan areas also changed. Although statistics on this shift are not shown here, various studies indicate that an increasing proportion of transit service is being provided in relatively low density, suburban portions of urban areas (2, pp. 279-284; 6, pp. 548-549; 8, p. 23). As transit routes have been extended in an attempt to capture the patronage of an ever more suburbanized population, service frequencies have been reduced in central-city areas. This shift in service policy has been partly responsible for the decreasing load factors and increasing trip lengths on transit over the decade of the 1970s.

Although transit service has been decentralized within urban areas, it has become ever more concentrated during peak commutation hours. In 50 large U.S. cities, for example, the average ratio of peak-hour to midday buses in service increased from 1.80 in 1960 to 2.07 in 1980 (9, p. 49; 10, pp. C2-C27). Peaking has been even greater for rail rapid transit. For the seven U.S. systems that reported these data, the ratio of peak to midday cars in service averaged 2.98 in 1980 (10, pp. D2-D5). As the degree of peaking has increased, so has the extent to which transit vehicles, capital infrastructure, and transit workers are underutilized during off-peak hours. This has exacerbated the decline in the industry's productivity and has contributed to the escalation of transit costs.

Changes in Costs and Subsidies

Of all the changes in U.S. transit, the burgeoning of transit costs and subsidies has surely been the most dramatic trend. As shown in Table 1 (1, 11), total operating expenses have skyrocketed for all modes of transit. Between 1970 and 1980, total costs increased 387 percent for bus and streetcar service, 138 percent for rail rapid transit, and 228 percent for commuter rail service. Of course, these

Table 1. Trends in U.S. transit operations and finances, 1970-1980.

Statistic	Bus and Streetcar 1970	Bus and Streetcar 1975	Bus and Streetcar 1980	Rail Rapid Transit 1970	Rail Rapid Transit 1975	Rail Rapid Transit 1980	Commuter Rail 1970	Commuter Rail 1975	Commuter Rail 1980
Operating expense[a] ($ millions)	1,303	2,500	5,049	613	1,085	1,458	297	571	973
Operating revenue ($ millions)	1,323	1,483	1,957	384	491	717	188	283	436
Operating deficit ($ millions)	-20	1,017	3,092	229	593	741	109	288	537
Operating revenue/operating expense	1.02	0.59	0.39	0.63	0.45	0.49	0.63	0.50	0.45
Vehicle miles (millions)	1,476	1,567	1,710	407	423	385	N.A.	N.A.	164
Cost per vehicle mile ($)	0.88	1.60	2.95	1.51	2.57	3.79	N.A.	N.A.	5.83
Revenue passengers[b] (millions)	4,358	4,245	4,926	1,574	1,388	1,420	295	260	285
Cost per passenger ($)	0.30	0.59	1.02	0.39	0.78	1.03	1.01	2.20	3.41
Average fare[c] ($)	0.30	0.35	0.40	0.24	0.35	0.50	0.64	1.09	1.53
Operating subsidy per passenger ($)	0.00	0.24	0.62	0.15	0.43	0.52	0.37	1.11	1.88

Note: N.A. = not available.
[a]Excluding depreciation.
[b]Also defined as linked passenger trips.
[c]Average fare was calculated as the ratio of passenger revenue divided by revenue passengers, excluding transfer passengers.

Table 2. Trends in transit subsidies by level of government, 1970-1980.

Type of Subsidy	1970 Amount ($ millions)	1970 Percent of Total	1975 Amount ($ millions)	1975 Percent of Total	1980 Amount ($ millions)	1980 Percent of Total
Operating						
Federal	0	0	408	21	1324	30
State	30	9	549	29	992	23
Local	288	91	944	50	2062	47
Total	318		1901		4378	
Capital						
Federal	133	67	1287	80	2787	81[b]
State and local[a]	67	33	322	20	647	19
Total	200		1609		3434	
Operating and capital						
Federal	133	26	1695	48	4111	53
State and local	385	74	1815	52	3701	47
Total	518		3510		7812	

Note: Commuter rail as well as rapid transit, streetcars, trolley buses, and motor buses are included in these statistics. The capital subsidy amounts do not include the special Congressional appropriations for the Washington subway system.
[a]The state and local portion of capital subsidy financing was estimated on the basis of statutory matching rates for different segments of the transit capital program.
[b]The overall federal matching rate for capital subsidies in 1980 exceeded 80 percent due to the 85 percent matching rate on Interstate transfer funds.

figures do not control for changes in the amount of service provided, so they could be misleading. Operating costs per vehicle mile also increased rapidly, however: 235 percent for bus and streetcar and 151 percent for rail rapid transit. Due to declining load factors on all modes, cost escalation is calculated to be slightly greater on a per-passenger basis: a 240 percent increase in operating cost per bus and streetcar passenger, a 164 percent increase in cost per rail rapid transit passenger, and a 235 percent increase in cost per commuter rail passenger.

Growth in Operating Deficits

Perhaps the most striking trend in these operating and financial statistics is the sharply increased unprofitability of bus and streetcar services relative to rail rapid transit and commuter rail. In 1970, bus services in the United States were actually profitable in aggregate, whereas rapid transit and commuter rail covered less than two-thirds of their operating costs from passenger fares. By 1980, bus services covered only 39 percent of their operating costs from the farebox, a lower percentage than either of the other modes. This reversal stems both from the rapid increase in bus costs--as noted above--and the much slower increase in bus fares relative to fares on other transit modes. Between 1970 and 1980, average bus fares rose only 33 percent, whereas rapid transit fares rose 108 percent and commuter rail fares 139 percent. The resulting increase in operating subsidy per bus rider was $0.62 compared with a $0.37 increase in subsidy per rapid transit passenger. The increase in subsidy per commuter rail passenger was even larger ($1.24), which arises from the greater average length of commuter rail trips.

The sudden escalation of operating deficits from bus service has been attributed to two factors (2, pp. xxxiii-xxxiv). First, federal operating subsidies per rider have been larger for all-bus systems in low-density urban areas than for multimodal systems in dense urban areas. Because the Section 5 subsidy allocation formula is based primarily on population and population density instead of ridership, transit-oriented cities with rail systems received substantially less subsidy than they would have if the formula had distributed funds strictly in proportion to ridership. Second, most rail rapid transit service is located in urban areas whose state and local governments have experienced the most severe budget crises. The greater scarcity of federal as well as state and local government operating subsidy funds in cities with rail transit has led to larger fare increases and service cutbacks.

Growth of Government Subsidies

The overall increase in government subsidies to mass transit from 1970 to 1980 is depicted in Table 2 (1,11,12), which also disaggregates subsidies by level of government and by operating versus capital purposes. The total operating and capital subsidy to transit in the United States multiplied by more than 15-fold over the decade, from $0.5 billion to $7.8 billion. The rate of increase was greater for capital subsidies than for operating subsidies

(17-fold versus 14-fold), but operating subsidies nevertheless exceeded capital subsidies in 1980, accounting for 56 percent of the total subsidy.

Another notable trend in Table 2 is the increased federal role in transit finance. Growing from $0.1 billion in 1970 to $4.1 billion in 1980, federal assistance rose from 26 to 53 percent of the total subsidy. Finally, one important trend not shown in the table is the increasingly widespread use of regionwide taxes earmarked for transit. Virtually no major city had adopted this financing mechanism by 1970--primarily due to the much smaller need then for transit subsidies. By 1980, however, 15 of the 26 largest U.S. metropolitan areas relied primarily on earmarked transit taxes for the local share of subsidy financing (11). Gortmaker, in a paper in this Record, states that of 101 cities surveyed by the U.S. Conference of Mayors in 1980, 46 percent had either state or local taxes dedicated for transit, and 21 percent had plans for implementing such taxes by 1982.

Impacts of Subsidies

In many ways, these nationwide trends in the transit industry have been disappointing. Some might argue that the 11-fold increase in transit subsidies from 1970 to 1980 has simply inflated costs instead of providing more, better, or cheaper service for transit users. There may be some validity to this viewpoint in light of the mere 11 percent increase in vehicle miles of service provided and the even smaller, 6 percent increase in ridership. Declining productivity and increased unit costs may have been partly responsible for the suprisingly small impacts of subsidies on output and use levels. Operating costs per vehicle mile increased 205 percent for the industry as a whole over the decade, and operating costs per passenger increased 222 percent (1, pp. 47, 58). Even controlling for the 112 percent general rate of inflation in the economy, these increases were substantial; in constant, inflation-adjusted dollars, costs per vehicle mile and per passenger increased 44 percent and 52 percent, respectively. At the same time, output per transit worker declined 18.4 percent, from 13 600 miles per employee in 1970 to only 11 067 miles per employee in 1980 (1, pp. 58, 66). This decrease in labor productivity was detrimental to transit budgets--especially in conjunction with rapid increases in salaries and fringe benefits--because labor costs typically account for 70-80 percent of total operating costs (6, p. 544).

Capital costs in the transit industry have also increased rapidly. For example, construction costs for the new Washington, D.C., subway system have averaged about $90 million/mile, almost the same as the $89 million/mile cost of the new Atlanta subway (13,14). In contrast, San Francisco's Bay Area Rapid Transit (BART) system, which was built in the late 1960s, cost $23 million/mile, roughly a fourth as much (15). Similarly, the capital cost of purchasing a new bus increased more than fivefold between 1970 and 1981--from less than $30 000 per bus to more than $150 000 per bus (16).

Because costs have increased so much, transit subsidies have not produced substantially more transit service to the nation. Until recently, however, they have been successful in keeping down fares. From 1970 to 1980, the average fare for the transit industry as a whole rose only 36 percent, from $0.28 per linked trip (including transfer charges) to $0.38 per linked trip (1, p. 60). Given the 112 percent general rate of inflation in the United States over this period, the real transit fare (in inflation-adjusted, constant dollars) actually fell by 34 percent. This decline in real transit fares--in conjunction with an increase in automobile user costs over the same decade--makes the small increase in transit ridership all the more puzzling.

Incentives for Cost Escalation

There is good reason to question whether the very design of the transit subsidy program is responsible for small ridership gains and rapidly increasing costs. Shifting the transit tax burden to the federal level of government has sharply reduced the proportion of transit costs directly relevant to local transit decisionmakers. As a result, when weighing the costs and benefits of proposed capital projects, for example, local officials have an incentive to consider only the small, local share of costs and thus may decide to undertake projects whose benefits fall far short of total costs yet exceed local costs. Similarly, urban areas receiving relatively generous federal operating assistance (50 percent in many cases) have initiated or maintained highly unprofitable routes and types of services that local officials probably would not have been willing to support on their own.

This impact of federal involvement has been compounded by the adoption in numerous areas of state and local taxes earmarked for transit. Most such taxing arrangements automatically yield a growing tax revenue stream over time even if statutory rates remain constant. This also has reduced the need for local transit authorities to eliminate highly unprofitable services, to bargain for moderate labor wage settlements, and to increase the productivity of their operations. Finally, none of the federal or local subsidy programs have made funding levels contingent on performance standards, cost control, ridership gains, or the achievement of social, environmental, or economic goals. Only a few states have begun to tie subsidy payments to performance indicators, but even these have set aside only a small fraction of the total state subsidy to reward efficient systems.

Determining the nature and extent of the subsidy program's impact on transit costs and performance during the 1970s is essential to improving the program. Subsequent sections of this paper examine the variation among cities in the changes in costs, service levels, and ridership from 1970 to 1979 and seek to identify the cause of the variations and, in particular, the degree to which differences in institutional and financial arrangements can explain the variation.

VARIATIONS AMONG CITIES IN TRANSIT TRENDS

Although most transit systems have conformed to the general directions of the nationwide aggregate trends documented above, there have been significant differences among cities in the magnitude of financial and operating changes over the decade. To examine variations among cities, this section reports changes in key variables for each of 34 individual bus systems. The difficulty of obtaining consistent data for the entire decade accounts for the small size of the sample. As a whole, however, the group represents a cross section of the industry. The sample systems cover virtually the entire spectrum of size and type of system, type of urban area, geographic location, cost and service level, fare policy, and perhaps most importantly, institutional structure and subsidy financing arrangement.

The data used for the analysis were derived from four sources: Transit Operating Reports for 1970, 1975, and 1979 compiled for each system by APTA,

Table 3. Trends in operations and finances of 34 bus systems, 1970-1979.

Bus System	Fleet Size (1979)	Change in Operating Cost ($/bus hour)	Ratio of Operating Subsidy to Operating Cost		Change in Subsidy per Passenger[a] (cents)	Change in Average Fare[a,b] (cents)	Change in Vehicle Hours (%)	Change in Total Riders[a] (%)	Change in Riders per Bus Hour[a]
			1970	1979					
Los Angeles	2604	+21	0.04	0.57	+35	+2	+61	+84	+6
New York	2500	+19	0.00	0.37	+28	+17	-11	-16	-3
Chicago	2420	+31	0.00	0.48	+24	-4	-34	+32	+43
Philadelphia	1552	+15	0.02	0.39	+17	+7	-10	+2	+6
Minneapolis[c]	1069	+15	0.00	0.67	+36	-6	+49	+62	+4
St. Louis	1058	+20	0.00	0.77	+64	-23	+12	+47	+8
Cleveland	1011	+21	0.00	0.74	+46	-12	-13	+13	+11
Baltimore[c]	969	+14	0.00	0.46	+26	+7	+22	+3	-8
Atlanta	921	+16	0.00	0.76	+51	-9	+44	+33	-3
Miami	654	+15	0.00	0.53	+35	+9	+36	+21	-4
Denver	631	+21	0.00	0.80	+95	-10	+215	+185	-3
Portland (OR)	540	+19	0.18	0.70	+67	+2	+124	+123	0
Buffalo	538	+14	0.00	0.43	+26	+13	-23	-43	-14
New Orleans[c,d]	493	+15	0.22	0.51	+14	+7	-7	-15	-7
Dallas	456	+13	0.00	0.36	+22	+13	+2	-7	-3
Norfolk[c]	282	+15	0.00	0.56	+43	+10	-1	-21	-8
Louisville[c]	247	+15	0.00	0.73	+54	-7	+22	-1	-7
Sacramento	233	+19	0.33	0.77	+77	+3	+87	+73	-2
Omaha	232	+15	0.00	0.67	+53	-6	+29	+35	+1
Indianapolis[c]	232	+13	0.00	0.44	+33	+16	-8	-35	-12
Madison[c]	193	+14	0.21	0.59	+29	+2	+148	+202	+7
Syracuse	169	+12	0.00	0.53	+39	+6	-8	-25	-6
Tacoma	128	+13	0.37	0.68	+38	+5	+5	0	-1
Harrisburg	81	+16	0.00	0.61	+36	-13	+555	+873	+13
Charleston (WV)	79	+10	0.00	0.60	+47	+3	+39	+17	-4
Albuquerque	66	+11	0.22	0.75	+103	+11	+48	-2	-6
Savannah	60	+10	0.00	0.40	+21	+17	-23	-45	-12
Little Rock[c]	54	+12	0.00	0.71	+67	+4	-30	-55	-11
Wichita[c]	47	+14	0.27	0.79	+38	-12	-5	+98	+17
Dayton	45	+15	0.10	0.72	+70	+3	+34	+10	-5
Greensboro[c,d]	31	+12	0.24	0.65	+54	+15	-29	-57	-14
Binghamton	31	+8	0.22	0.45	+12	-3	-5	+43	+13
Lafayette (IN)	17	+12	0.00	0.81	+106	+5	+32	-37	-15
Spartanburg[c,d]	16	+11	0.09	0.51	+42	+25	-26	-54	-12

[a]Ridership figures reflected in these statistics include transfers, free riders, and reduced-fare passengers.
[b]Average fare was calculated as total passenger revenue divided by total passengers.
[c]Privately managed.
[d]Privately owned.

Section 15 data for 1979 obtained for each system from the Urban Mass Transportation Administration (UMTA) (17), public annual reports available for most of the systems, and supplemental, unpublished information obtained from all 34 systems. Use of this range of sources permitted cross-checking of statistical values and facilitated the identification and revision of inaccurate figures.

Table 3 displays trends in key operating and financial statistics for each of the 34 bus systems, which are listed in order of bus fleet size. All the systems experienced increases in costs and in degree of subsidy from 1970 to 1979, but increases in some cities were much larger than in others. For example, per-hour costs in Chicago rose three times as much as in Charleston or Savannah. Similarly, the subsidy ratio increased 80 percentage points in Denver but only 23 points in Binghamton. Increases in per-rider subsidies ranged from $1.06 in Lafayette to only $0.12 in Binghamton.

The statistics shown in the last four columns of Table 3 display even greater variation among cities. Not only are there differences in the magnitude of changes but also in the direction of changes. Average fares on some systems increased, whereas on others they decreased. Likewise, bus hours of service, total ridership, and load factors (riders per bus hour) rose in some cities but fell in others. Thus, the aggregate, nationwide data in Table 1 conceal some important variation. On the basis of this variation, subsequent sections of this paper explore the statistical relationship between trends in operating and financial statistics and various possible explanatory variables.

STATISTICAL ANALYSIS OF BUS DATA

Statistical analysis of the bus data is organized into three parts. The first part categorizes the 34 bus systems on the basis of eight different factors and compares the different average values of the trend variables for bus systems in different categories. The second part calculates simple correlation coefficients between the trend variables and the explanatory variables. Finally, regression equations are estimated for each of the trend variables and different groupings of explanatory variables are included in each equation.

Differences in Variable Averages by Category of System

Table 4 presents calculations of average changes in a range of operating and financial statistics for each of a variety of transit system categorizations. From a policy perspective, the first four categorizations are probably the most significant. Degree of public ownership, public management, transit tax earmarking, and federal subsidy are all aspects in the design of the transit program that can be manipulated. The last four breakdowns--by local tax effort, fleet size, population growth, and density--may contribute to the explanation of variations among cities in transit trends, but they are mostly external to the transit program itself.

The impacts of public ownership, public management, and tax earmarking are consistent with expectations. For example, publicly owned systems have had larger increases in cost per bus hour, smaller

Table 4. Average trends in bus costs, fares, subsidies, service levels, and ridership by type of system, funding, and city, 1970-1979.

Category	Number of Systems	Change in Operating Cost ($/bus hour)	Change in Average Fare (cents)	Change in Subsidy per Rider (cents)	Change in Operating Ratio[a]	Change in Operating Subsidy Funded Locally (%)	Change in Route Miles (%)	Change in Bus Hours (%)	Change in Riders (%)
Ownership									
Public	31	+15.4	+2	+46	−0.64	−8	+42	+45	+54
Private	3	+12.7	+16	+37	−0.37	−54	−17	−21	−42
Management									
Public	23	+15.9	+1	+48	−0.63	−8	+44	+52	+62
Private	11	+13.7	+6	+40	−0.59	−20	+22	+12	+12
Percent of state and local subsidy dedicated (1979)									
75% or more	12	+18.5	−4	+55	−0.72	−7	+67	+51	+52
15-75%	8	+14.6	+1	+38	−0.65	−4	−1	+76	+124
Less than 15%	14	+12.6	+10	+42	−0.51	−21	+32	+8	−5
Federal subsidy as percentage of total operating subsidy (1979)									
45% or more	17	+13.1	+3	+42	−0.63	−25	+26	+38	+49
25-45%	8	+15.9	+3	+49	−0.54	+1	+69	+47	+49
10-25%	7	+20.3	−3	+49	−0.72	+1	+49	+54	+62
Less than 10%	2	+11.6	+20	+48	−0.41	0	−48	−28	−55
Local tax effort (1976)[b]									
High	12	+15.7	+3	+45	−0.60	−2	+81	+44	+39
Medium	16	+15.9	+1	+38	−0.58	−16	+14	+12	+21
Low	6	+12.2	+6	+67	−0.75	−21	+8	+103	+124
Fleet size (1979)									
500 or more	13	+18.4	−1	+42	−0.66	−4	+43	+36	+42
100 − 500	10	+14.3	+5	+40	−0.57	−21	+70	+27	+21
Less than 100	11	+12.0	+5	+54	−0.61	−14	−19	+54	+72
Population change (1970-1978)									
+50% or more	1	+12.5	+13	+22	−0.50	−12	+36	+2	−6
+10% to +50%	8	+15.6	+4	+67	−0.66	−1	+100	+62	+40
+2% to +10%	15	+13.7	+3	+41	−0.63	−18	+14	+52	+69
−2% to +2%	6	+17.5	−3	+33	−0.56	−20	+12	+11	+38
−2% or less	4	+17.0	+5	+43	−0.60	−2	+33	−3	−9
Central-city density (1978)									
10 000 or more	6	+17.7	+8	+27	−0.52	+5	+4	−1	+2
5000-10 000	12	+16.0	−3	+46	−0.74	−16	+58	+75	+102
5000 or less	16	+13.5	+5	+52	−0.56	−16	+33	+27	+19

[a]The operating ratio is calculated as operating revenues (excluding subsidies) divided by operating costs.
[b]Local tax effort in each urban area was calculated as the ratio of local government own-raised tax revenue divided by total personal income.

fare increases, larger increases in subsidy per rider, bigger declines in operating ratios, more service expansion, and greater ridership growth than have privately owned systems. Precisely the same pattern of differences is found between publicly managed systems and privately managed systems. Similarly, systems funded primarily by earmarked transit taxes had larger cost increases, smaller fare increases, larger increases in subsidy per rider, bigger declines in operating ratios, more service expansion, and greater ridership growth than have systems with little or no funding from dedicated state and local taxes.

The differences in trends for systems receiving different levels of federal operating assistance are puzzling. In many respects they run directly counter to the hypothesis that federal aid encourages cost escalation. Although the smallest cost increase is indeed calculated for the two systems with the least federal aid, the largest average increase occurred in systems with only 10-25 percent federal funding. Because all seven of the systems in this 10-25 percent category were also in the largest fleet-size category, it seems likely that the unexpected result arises from the effects of size on costs rather than any beneficial impacts of federal subsidy on productivity. As seen further down in the table, cost increases have been much larger for big systems than for small systems. Similarly, the performance of the two systems receiving less than 10 percent federal aid may reflect more the impact of private ownership and management than of federal subsidies, since both are private. In short, it is difficult to isolate the independent effect of federal aid because of its correlations with other explanatory variables.

The differences among calculated averages for the four control categories may also be of some interest. The strongest relationship appears to be between fleet size and cost escalation, with the 13 largest systems having incurred increases of more than $6/bus hour larger than those of the 11 smallest systems. It is not clear, however, to what extent this implies diseconomies of scale. The larger cost increases in larger systems may arise from greater union power and higher costs of living in the larger cities; both factors would lead to larger wage increases for larger systems. It is debatable whether such factors represent genuine diseconomies of scale. Of course, managerial inefficiency, coordination problems, and reduced worker incentives might also account for part of the larger cost increases for larger systems, but the limited data do not permit isolation of these effects.

Local tax effort was used as a barometer of willingness to spend for local public services. It was anticipated that the greater the tax effort, the less would be the incentive for cost control and fare hikes and the greater would be the increases in subsidy, service levels, and ridership. As shown in Table 4, this expectation was not strongly confirmed, perhaps because tax effort could be differently interpreted. For example, the marginal burden of yet more taxes for transit subsidies would probably be greatest in cities with a high tax effort. Thus, one might alternatively expect greater resistance to public expenditures for transit where the local tax burden was already high. The results in Table 4 do not provide an adequate basis for choosing between the two interpretations.

Population change was included primarily to help explain changes in service levels and ridership.

Table 5. Correlations among selected operating and financial statistics for 34 bus systems, 1970-1979.

Explanatory Variable	Change in Operating Cost per Bus Hour	Change in Average Fare	Change in Subsidy per Rider	Change in Operating Ratio[a]	Change in Percentage of Operating Subsidy Funded Locally	Percentage Change in Route Miles	Percentage Change in Bus Hours	Percentage Change in Riders
Public ownership (1979)	+0.18	-0.39[b]	+0.11	-0.34[b]	+0.40[b]	+0.14	+0.18	+0.17
Public management (1979)	+0.24	-0.18	+0.17	-0.08	+0.17	+0.09	+0.18	+0.15
Percentage of state and local subsidy dedicated (1979)	+0.57[c]	-0.57[c]	+0.23	-0.35[b]	+0.16	+0.10	+0.11	+0.08
Federal subsidy as percentage of total operating subsidy (1979)	-0.42[b]	-0.04	-0.16	-0.04	-0.37[b]	+0.05	+0.02	+0.05
Local tax effort[d] (1979)	+0.34	-0.01	-0.20	+0.15	+0.34[b]	+0.19	-0.06	-0.06
Fleet size[e] (1979)	+0.71[c]	-0.10	-0.29[f]	+0.06	+0.12	-0.13	-0.12	-0.05
Population change (1970-1978)	-0.15	+0.20	+0.04	+0.04	-0.02	+0.14	+0.03	-0.03
Central-city density (1978)	+0.40[b]	+0.11	-0.34[b]	+0.09	+0.26	-0.14	-0.09	-0.02

[a]Operating ratio calculated as operating revenues (excluding subsidies) divided by operating costs.
[b]Significant at 0.05 level.
[c]Significant at 0.01 level.
[d]Local tax effort calculated as local government own-raised revenues divided by total personal income in each urban area.
[e]Natural logarithm of fleet size used for correlation analysis.
[f]Significant at 0.10 level.

Excluding Dallas, the one city in the growth category of 50 percent or more, the results are generally in the expected direction (i.e., positively correlated) but are not so strong as anticipated.

The most interesting aspect of the disaggregation by central-city density is the finding that most of the growth in transit service and ridership has occurred in low- and medium-density urban areas. In contrast, the six densest cities maintained roughly constant levels of service and ridership. Costs per bus hour have increased faster in dense areas, but this may be partly due to the correlation between density and size. Although one would expect a very significant impact of density (via traffic congestion) on speed and thus on cost per bus mile, it is not clear why density should affect costs per bus hour.

Correlation Analysis

Table 5 contains statistical correlation coefficients for the relationships between the various transit trends (column headings) and a range of explanatory variables. Both the trends and the explanatory variables are the same as those examined in Table 4 except that all the variables but public ownership and management are measured continuously rather than categorically. In general, the pattern of results is roughly the same as that in Table 4. The directions and magnitudes of relationships, however, are more readily discerned from the more compact correlation matrix.

The correlation coefficients clearly indicate that public ownership, public management, and earmarked transit taxes are all associated with large cost increases, small fare increases, large increases in subsidy per rider, large decreases in the operating ratio, large increases in the proportion of local tax funding, large increases in service, and large increases in ridership--all relative to privately owned, privately managed systems without earmarked taxes.

The results for the federal subsidy are as perplexing as they were in Table 4 and probably for the same reasons. Again, high federal ratios are associated with relatively small cost increases as well as small increases in subsidy per rider. Somewhat more in line with expectations, generous federal aid was also associated with relatively small fare increases, decreases in the operating ratio, decreases in local funding, and increases in service and ridership. With the exception of local funding, however, these associations are surprisingly weak.

A few of the relationships with the four control variables are also interesting and can be more easily seen in Table 5. The very high positive correlation between fleet size and cost increases supports the inference about scale impacts drawn from Table 4. In spite of large cost increases and small fare increases, subsidy per passenger increased the least in the largest systems. The explanation for this paradoxical result almost certainly lies in load factor differences among systems of different size. Referring back to Table 3, the reader will note that over the decade, the number of passengers per vehicle hour (a proxy for load factor) decreased more for smaller systems than for larger systems. Thus, although costs increased faster in larger systems, these costs continued to be spread out over more passengers. Load factors, which are higher in denser cities, probably explain the negative correlation between density and per-rider subsidy as well.

All the correlations with the service level and ridership variables are weak. Nevertheless, they suggest that service levels and total ridership have been declining the most (or increasing least) in dense cities with large bus systems. In contrast, service levels and ridership have been increasing the most (or declining the least) in publicly owned, publicly managed systems with dedicated state and local funding and generous federal operating assistance.

Of course, these correlations are only meant to be suggestive of the nature and extent of the relationships between various trends in the transit industry and a selection of possible explanatory variables. They obviously do not prove hypotheses about causes of the trends. Moreover, as noted in various instances above, correlations among the explanatory variables make interpreting the calculated coefficients a challenging task.

Regression Analysis

In spite of the inevitable limitations caused by the small sample size, regression analysis of the bus data yields some interesting results. Nine of the many equations that were estimated by ordinary least squares are shown in Table 6. (The overall statistics for Table 6 are given in Table 7.) The regression coefficients and t-statistics for each equation are located in the column under its dependent variable.

Cost Equations

Perhaps of greatest interest are the cost equations in the first four columns. The first version includes a dummy variable for public ownership and was estimated for all 34 systems, whereas the second version excludes the public ownership variable and was estimated only for the 31 public systems. Both equations find that percentage of state and local tax dedication is the single most significant policy variable for explaining the differences among cities in increases in per-hour operating costs from 1970 to 1979. Moreover, the estimated coefficient is roughly the same in both versions. It indicates, for example, that if one system had 10 percent more of its state and local funding dedicated for transit than another system, its per-hour cost could have been expected to increase by about $0.30-0.34/h more when other factors affecting costs are controlled for. Although not as statistically significant, the coefficients of the public ownership and management variables also have the expected signs. The first version indicates that the independent effect of being publicly owned was to increase costs by an additional $0.68/bus h; being publicly managed led costs to increase by an additional $0.33/h. When the three private systems are thrown out of the sample, however, the management variable becomes more important (causing $0.94 additional increase in cost) and more statistically significant. The federal subsidy variables, both in continuous and categorical form, display the same unexpected sign as in the earlier correlation analysis. Perhaps even more surprisingly, the coefficients for federal subsidy are not far from statistical significance. It seems unwarranted to interpret the strange result as evidence that federal subsidies encourage efficiency, but the expected contrary impact is certainly not confirmed by the regressions.

Two other variables are noteworthy. Fleet size has a significant positive effect on cost increases regardless of type of specification. The coefficient in the first equation suggests that if one system had 100 more buses than another, its per-hour costs could have been expected to increase by $0.30/h more over the decade than for the smaller system. The other variable of interest is percent of costs subsidized. Although not statistically significant, its coefficient indicates that the larger the proportion of a system's costs financed by subsidies instead of the farebox, the larger was the increase in cost, suggesting that subsidization in itself (i.e., regardless of source) may induce cost escalation.

Other Equations

Space limitations prevent a detailed analysis of the other equations. A few notable results, however, are highlighted below:

1. Public ownership is estimated to have encouraged smaller fare increases and larger increases in subsidy per rider. Public management is estimated to have encouraged larger subsidies per rider as well as service expansion. None of these coefficients, however, is statistically significant.
2. Tax earmarking evidently had a tendency to reduce fares or at least to keep fare increases small. It also encouraged larger subsidies per rider.
3. When other variables are controlled for, federal subsidies are estimated to be associated with smaller increases in subsidy per rider and less service expansion--both counterintuitive results.
4. Urban areas where local tax burdens were already high experienced smaller increases in cost, bigger fare increases, and smaller increases in subsidy per rider.
5. The greater local government expenditures per capita (a proxy for disposition to public spending), the greater was service expansion.
6. Population growth tended to promote greater service expansion but, inexplicably, smaller ridership growth (or larger losses).
7. The denser the central city, the greater was the loss (or the smaller was the increase) in service.
8. The greater the transit modal split (as represented by transit riders per capita), the greater the tendency over the decade for fares to decrease (or increase more slowly), for the operating ratio to increase, and for the subsidy per rider to increase.
9. On average, there was only a 0.25 percent increase in hours of service over the decade for every 1 percent increase in total operating costs.
10. Finally, percentage change in number of bus hours is by far the most significant variable for explaining changes in ridership, and the relation is positive, as expected. The relation between fares and ridership is negative--also as expected--but much less significant.

Limitations of Analysis

Although the preceding analysis suggests some interesting statistical relationships among various policy variables and trends in transit operations and finances, the estimates are limited in a number of ways. Due partly to the small sample size, few of the coefficients are statistically significant. A related problem is multicolinearity among some of the explanatory variables. Multicolinearity, which is especially difficult with small samples, can lead to large standard errors in coefficient estimates, which thereby are rendered less reliable. A number of potential explanatory variables were already discarded to mitigate this problem, but it seems likely that at least some multicolinearity still exists in the equations listed in Table 6.

Perhaps the most severe problem is the unavoidable simultaneity of many of the relationships. For example, one hypothesis that was being tested was whether institutional and policy variables could explain differences among cities in transit cost increases over the decade. It was anticipated that public ownership, public management, and degree of subsidy would have exacerbated cost increases. Alternatively, however, it could be argued that the direction of causation was just the reverse: that systems experiencing the largest cost increases were the most likely to need and get the largest subsidy increases and to be taken over by public agencies. Similarly, in other estimated equations, there are explanatory variables that are determinants of the dependent variable as well as functions of the dependent variable. Such relations can lead to simultaneous equations bias of the coefficients. Unfortunately, the small sample size and various other practical considerations precluded use of more refined statistical methods such as two-stage or three-stage least squares (instead of ordinary least squares) in order to alleviate this problem.

SUMMARY AND POLICY IMPLICATIONS

The transit industry in the United States experienced three significant changes during the decade of the 1970s:

1. Public ownership, public management, regional

Table 6. Selected regressions for trends in bus operations and finances, 1970-1979.

	Dependent Variable							
	Operating Cost per Bus Hour							
	Version 1		Version 2		Avg Fare		Operating Ratio	
Explanatory Variable	Change ($)	t-Value	Change ($)	t-Value	Change (cents)	t-Value	Change	t-Value
Public ownership (1979)[a]	+0.677	0.29			-8.41	1.05		
Public management (1979)[a]	+0.333	0.27	+0.941	0.76	+0.219	0.05	+0.001	0.02
Percentage of state and local subsidy dedicated (1979)	+0.034[b]	2.32	+0.030[c]	1.97	-0.102[b]	2.08	-0.001	0.93
Federal percentage of total operating subsidy (1979)	-0.048	1.31			-0.072	0.51		
Whether federal operating subsidy at least 45 percent of total (1979)[a]			-1.88	1.34			-0.104	1.21
State percentage of total operating subsidy (1979)					-0.007	0.07		
Local tax effort (1976)[d]	-0.068	0.27			+0.811	1.06	+0.030	1.59
Local government expenditures per capita ($) (1976)								
Fleet size (1979)	+0.003[e]	2.79						
Log of fleet size (1979)			+1.32[b]	2.46			-0.072	1.37
Percentage change in population (1970-78)								
Central-city density (1978) (000s)	-0.024	0.13						
Increase in percent of costs subsidized (1970-79)			+0.033	0.85				
Transit rides per capita (1979)					-0.012	0.12	+0.006[c]	1.97
Increase in cost per bus hour ($) (1970-79)					-0.635	0.98	-0.020	1.36
Percentage increase in total costs ($) (1970-79)								
Percentage change in bus hours (1970-79)								
Change in average speed (mph) (1970-79)								
Change in average fare (cents) (1970-79)								
Intercept	+13.82[e]	4.88	+5.98	1.43	+21.09	1.46	-0.239	0.85

[a]The indicated explanatory variables were specified as 0-1 dummy variables.
[b]Significant at 0.05 level.
[c]Significant at 0.10 level.
[d]For regression analysis, tax effort was defined to be local government own-raised revenues as percentage of total personal income in each urban area.
[e]Significant at 0.01 level.

Table 7. Overall statistics for regression equations in Table 6.

	Change in Operating Cost per Bus Hour ($)		Change in Avg Fare (cents)	Change in Operating Ratio	Change in Subsidy per Rider (cents)		Change in Route Miles (%)	Change in Bus Hours (%)	Change in Riders (%)
Statistic	Version 1	Version 2			Version 1	Version 2			
Mean	+15.17	+15.40	+2.84	-0.617	+45.5	+46.3	+36.8	+39.1	+45.5
Standard deviation	2.84	2.97	9.18	0.212	20.4	19.1	125.1	17.0	44.8
F-statistic	7.02	8.06	2.37	1.69	2.88	4.94	0.58	178.1	96.5
Probability value	0.0001	0.0001	0.473	0.1560	0.0230	0.0028	0.7638	0.0001	0.0001
R^2	0.65	0.62	0.43	0.31	0.44	0.50	0.14	0.98	0.93
No. of observations	34	31	34	34	34	31	34	34	34

consolidation, and public regulation increased.

2. Transit was increasingly dominated by bus service, with decreases in vehicle hours of service as well as in ridership for other modes of transit. Within metropolitan areas, service and ridership followed the shift of population from the central city to the suburbs.

3. Both capital and operating costs of transit skyrocketed, compelling a corresponding burgeoning of government subsidies to finance these increased costs.

Perhaps of greatest interest in this story of change is the impact of public policy. From 1950 to 1970, transit was generally expected to finance operating costs through fares, and government subsidies (both operating and capital) were minimal (2, pp. 31-47; 11; 12). Partly as a consequence of this policy, vehicle miles of transit service in the United States fell 37 percent during these two decades, and ridership fell 57 percent (1, pp. 55, 58). In contrast, government subsidies to transit increased 15-fold during the 1970s and reached $7.8 billion by 1980. Although this infusion of funds into an ailing industry has indeed reversed the declines of the previous two decades, the resulting service expansion and ridership growth nevertheless have been small (11 and 6 percent increases, respectively).

Some might argue that the very design of the subsidy program has been responsible for the disappointing yield of large transit subsidies. Although the preceding statistical analysis of bus data was not entirely conclusive, it did suggest that public ownership, public management, and tax earmarking tended to have an inflationary impact on costs during the 1970s. Moreover, one formulation indicated that the higher the percentage of costs financed by subsidies, the greater was the increase in costs, implying that subsidization in itself may encourage productivity declines and cost escalation.

These results suggest the need for more careful monitoring of transit operations and for explicitly relating levels of subsidy to output. Because most transit subsidy programs in the United States simply cover costs, whatever they happen to be, without regard to any index of goal achievement, there is not much incentive for a transit system to use subsidies efficiently. The current program fails to distribute funds among cities in a manner that rewards efficient systems and penalizes inefficient ones. Instead, distribution formulas (especially at the federal level) arise from political bargains and have little relationship either to the transportation needs of each urban area or to the performance of individual transit systems. Clearly, in the current era of fiscal austerity at all government

Subsidy per Rider									
Version 1		Version 2		Route Miles		Bus Hours		Riders	
Change (cents)	t-Value	Change (cents)	t-Value	Change (%)	t-Value	Change (%)	t-Value	Change (%)	t-Value
+4.80	0.29								
+7.93	0.89	+2.71	0.34	+3.21	0.06	+2.61	0.37		
+0.098	0.91	+0.138	1.37	+0.040	0.07	-0.023	0.29		
-0.298	1.09								
		-21.7[b]	2.40	-15.7	0.33	-2.36	0.37		
-2.52	1.49								
				+0.182	1.17	+0.014	0.65		
				+0.511	0.40	+0.007	0.04	-0.341	0.81
				-7.35	1.10	-0.540	0.59		
-0.694[e]	3.10	-1.26[e]	4.55						
1.65	1.15	+1.82	1.37						
				+0.056	0.99	+0.262[e]	34.3		
								+1.40[e]	14.0
								+1.87	0.22
								-1.27	1.37
+65.9[b]	2.48	+59.0[e]	3.06	-33.5	0.33	-45.3[e]	3.23	-4.42	0.32

levels, it is essential that limited public funds be spent as effectively as possible. There is no good reason for making transit the exception. Transit systems receiving public subsidies should be held accountable for achieving the objectives that are the basis for justifying such subsidies.

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