Factors Influencing Transit Use in European and U.S. Cities

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Insights into the underlying factors influencing urban transit travel in the United States and Europe are provided. Transit use in European and American cities was analyzed through regression analysis and by comparing conditions in three cities of similar size. Regression equations were developed using transit usage intensity, transit supply, metropolitan area density, and car ownership. These equations revealed significant differences between U.S. and European cities. Such differences were related to dissimilar economic, social, and cultural factors in the two continents. The influences of these factors on transit usage are discussed, and a conceptual model is presented showing how they affect choice of transit mode.

The purpose of this paper is to provide some insights into the underlying factors that influence the use of transit in European and U.S. cities.

The approach consists of (a) a statistical analysis of the variables that explain transit use: quantity of transit available, car ownership, and population density in the service area; and (b) an examination of socioeconomic, environmental, and cultural factors that affect the use of transit in European and U.S. cities.

STATISTICAL ANALYSIS

Separate regression analyses were performed for bus systems in the cities identified in Tables 1 and 2 (data availability was a major reason for selecting these cities) relating transit ridership and the three variables mentioned previously.

The results of the regression analysis tabulated in Table 3 point to several interesting observations:

1. The coefficients and the constant in the regression equations are generally higher in the equations for European cities. In addition, the constant, which is generally positive for European cities and negative for U.S. cities, reflects the differences in attitudes towards the use of transit in the two continents. These coefficients also express the much higher ridership obtained in Europe for the same values of the explanatory variables.
2. Contrary to U.S. experience, in European cities there is no significant correlation between car ownership and level of transit ridership.
3. The transit supply variable explains most of the variance in ridership for bus systems for both continents. In European cities, however, there is an even higher sensitivity to supply of transit service than in U.S. cities.

Differences in the results of the regression analysis are not negligible. European and U.S. choices of certain travel modes are affected by a number of factors that influence attitudes and behavior.

SOCIAL, ENVIRONMENTAL, AND CULTURAL FACTORS

Attitudes Toward Car Ownership

A comparison of European and American regard for the automobile points out some differences. In Europe the automobile is often a zealously guarded possession, it receives great attention and care, and it is more intensively used for recreation and for personal pleasure. Its use for commuting tends to be lower to avoid (a) driving in congested conditions, (b) decreasing the car's life, and (c) increasing maintenance costs. It is often a major investment and is highly taxed, mainly through gasoline taxes.

Americans regard the car as a more essential possession. It is viewed as a means to achieve personal independence and mobility, it allows avoiding crowds and contacts with socially marginal (or so considered) elements, and it often provides the privacy and comfort of the living room. In addition, especially when traveling at off-peak hours, it provides greater security than mass transit, and it is relatively inexpensive to operate.

Use of the Car

In major European cities, contrary to most cities in the United States, use of the car in downtown areas

Table 1. Transit travel variables for U.S. cities (1).

City	Transit Supply (annual veh-km/ capita)	Metropolitan Area Density (persons/ km^2)	Car Ownership (persons/ car)	Annual Transit Trips/ Capita
Albany, N.Y.	13.8	1,249	2.75	29.8
Atlanta, Ga.	28.7	1,041	2.30	53.9
Baltimore, Md.	23.8	1,970	3.22	75.4
Baton Rouge, La.	7.2	1,581	2.24	9.6
Chicago, Ill.	35.3	2,030	3.18	65.2
Cincinnati, Ohio	18.0	1,280	2.61	27.7
Dallas, Texas	24.7	1,227	2.10	39.1
Detroit, Mich.	37.4	4,232	2.53	64.5
Harrisburgh, Pa.	13.7	1,187	2.48	20.3
Los Angeles, Calif.	13.5	2,095	2.15	28.1
Miami, Fla.	17.4	1,821	2.45	40.2
Minn.-St. Paul, Minn.	16.0	912	2.48	34.3
Portland, Oreg.	22.9	1,194	2.20	29.6
San Diego, Calif.	10.9	1,238	2.27	4.2
Washington, D.C.	28.3	1,937	2.60	44.0

Table 2. Transit travel variables for European cities (1).

City	Transit Supply (annual veh-km/ capita)	Metropolitan Area Density (persons/ km^2)	Car Ownership (persons/ car)	Annual Transit Trips/ Capita
Amiens, France	9.3	1,966	3.90	50.0
Brest, France	10.4	3,500	9.27	60.9
Dijon, France	16.3	1,614	3.35	82.6
Copenhagen, Denmark	41.3	7,291	3.12	199.5
Leeds, U.K.	55.8	3,046	6.59	265.9
Liege, Belgium	28.2	1,529	5.26	92.0
Lille, France	14.2	2,316	4.43	63.9
London, U.K.	26.7	4,645	2.79	199.5
Mulhouse, France	15.6	1,026	4.06	70.4
Nancy, France	15.7	1,284	3.74	88.8
Newcastle, U.K.	71.1	2,241	5.85	228.0
Plymouth, U.K.	41.7	3,059	5.04	143.8
Portsmouth, U.K.	37.7	5,463	5.38	175.7
Rouen, France	11.6	1,548	3.78	48.9
Valenciennes, France	11.1	903	5.74	51.8

Table 3. Results of regression equations (dependent variable: annual transit trips per capita) (2, 5, 6).

	Coefficients of the Regression Equations						
		Variables					
Cities	Constant	Transit Supply (veh-km/capita)	Density (persons/km²)	Car Ownership (persons/car)	Regression Parameters R^2	SE	%SE[a]
1. European	25	3.5	–	–	0.81	33	27
2. United States	-0.3	1.8	–	–	0.69	11	29
3. European	50	–	0.02	–	0.31	65	54
4. United States	17	–	0.01	–	0.26	18	47
5. European	47	–	–	16	0.06	69	57
6. United States	-58	–	–	38	0.43	15	40
7. European	5.3	3.10	0.012	–	0.88	27	22
8. United States	-1.5	1.73	0.002	–	0.69	12	32
9. European	76	3.97	–	-13	0.84	32	26
10. United States	-51	1.50	–	23	0.82	9	24
11. European	24	3.28	0.01	-4	0.88	26	21
12. United States	-52	1.40	0.002	23	0.83	9	24

[a]%SE = SE as a percent of the mean value of the dependent variable.

is discouraged by public authorities by providing zones that restrict automobiles, the placement and pricing of parking facilities, and strong governmental support for transit service.

Quality and Quantity of Transit Service

Transit service in European cities is generally cleaner, safer, and more attractive than that found in the United States. It is better coordinated and better integrated with the activity system; and it is viewed as a vital resource by all elements of society. In the United States transit tends to attract mainly large segments of the so called underprivileged.

Land Use and Transportation Policy

The tendency in most European cities to coordinate land use development with transportation policy has resulted in higher densities along transit service areas. This results in higher use of transit. In the United States less emphasis is placed on this approach to urban development partly because developers and the public view the automobile (not transit) as the major resource for maintaining urban mobility and providing access to the economic activity system.

Economic Factors

The economic growth of the 1960s and early 1970s increased both personal income and the price of petroleum. The impacts of these changes were different from country to country. They were much greater in countries (a) more dependent on a foreign oil supply, (b) with serious problems of balance of payments, and (c) with lower GNPs. They were less dramatic in developed economies and in oil producing countries. Also, the changes in relative prices in different countries were quite different (see Table 4). The possible impact on life-styles, the decisions regarding travel and the means of traveling were also quite different.

A COMPARISON OF THREE CITIES

The influence of economic factors on transit ridership is analyzed using three cities of similar size: Baltimore, U.S.A.; Munich, West Germany; and Lisbon, Portugal. These cities were chosen because they are significantly different in terms of the socioeconomic and cultural indicators discussed earlier but are somewhat similar with respect to population size and the supply of transit service.

For each city, Table 5 gives selected descriptors of transit supply and transit use, area and economic characteristics, and measures of automobile and transit travel costs.

Baltimore Versus Munich

For similar levels of transit supply (Table 5, lines 4 and 5) transit use is much higher in Munich (Table 5, line 6). The results of the regression analysis showed that transit supply is the most important

Table 4. Selected economic indicators for various countries (current dollars) (2, 5, 6).

Economic Indicator	Year	France	Italy	Portugal	West Germany	U.S.A.
GNP per capita	1970	3,715	1,959	653	4,778	4,809
	1975	6,032	2,921	1,690	7,216	7,197
	1978	7,933	3,776	1,856	9,727	9,668
Premium gas (retail price per gallon)	1970	0.90	0.74	0.99	0.91	0.31
	1975	1.69	1.71	2.07	1.34	0.65
	1978	2.38	2.25	2.15	1.76	0.71
Gallons per GNP per capita	1970	4,600	2,600	660	5,300	15,500
	1975	3,500	1,700	820	5,400	11,100
	1978	3,300	1,700	860	5,500	13,600

Table 5. Selected travel indicators for Baltimore, Munich, and Lisbon, 1978 (2, 4, 5, 6).

Indicator	Baltimore	Munich	Lisbon
Metropolitan area population (000s)	1,601	1,800	1,315
Metropolitan area density (persons/km²)	2,000	4,200	4,000[a]
Persons/automobile	1.90	3.46	4.24[a]
Annual transit veh-km			
Surface (10^6)	44.4	42.6	47.0
Subway (10^6)	–	10.5	6.9
Transit network density (km/km²)	1.6	1.7	2.0
Transit trips/day (000s)	217	607	903
GNP/capita (dollars)	9,644	10,443	1,856
Price of premium gasoline (dollars/gallon)	0.71	1.76	2.15
Average transit fare (dollars)	0.40[a]	0.53[a]	0.09[a]

[a]Authors' estimate.

variable in explaining transit ridership in both European and U.S. cities (Table 3, lines 1 and 2). Although car ownership was found to be a significant explanatory variable in U.S. cities, it has no correlation with transit ridership in European cities (Table 3, lines 5 and 6). Also the effect of aggregate population density on transit use is only marginal in both continents (Table 3, lines 3 and 4). Thus, the large difference in transit ridership between Munich and Baltimore cannot be attributed to differences in car ownership and population densities between the two cities.

Although the price of gasoline in Munich is about 2.5 times that of Baltimore, and Munich's transit fare is also approximately 25 percent higher (Table 5, lines 8 and 9), these differences in price are not likely to explain differences in transit ridership because (a) the level of personal wealth (measured in GNP per capita) is similar for both cities (Table 5, line 7), (b) the effect of higher gasoline prices in Munich is partially neutralized by the higher fuel efficiency of European cars, and (c) the higher transit fare in Munich is generally associated with a superior level of transit service.

These observations lead to the conclusion that in Munich social and cultural factors that are different from those prevailing in Baltimore tend to create an environment much more conducive to transit use by the general population. Munich's higher quality of transit service and strong commitment to transit development and maintenance at all levels of government could be cited to support this conclusion.

Munich Versus Lisbon

Transit ridership in Lisbon is approximately 50 percent higher than that of Munich. Both cities, however, have similar levels of transit supply. Environmental, social, and cultural factors are also similar and perhaps even more favorable to transit in Munich than in Lisbon (7). Also, the densities of the two cities are quite similar, although the physical structure of Lisbon (located in the inner bank of a river bend) is more favorable to transit operations. Economic indicators, however, are significantly different and are among the underlying causes of the higher transit ridership in Lisbon.

The GNP per capita for Lisbon is about one-sixth of that for Munich; and gasoline prices are 22 percent higher for Lisbon than for Munich (Table 5, lines 7 and 8). Therefore, the effective gasoline purchasing power in Lisbon is approximately one-

Figure 1. Trend of transit ridership and gasoline purchasing power: Lisbon, Portugal.

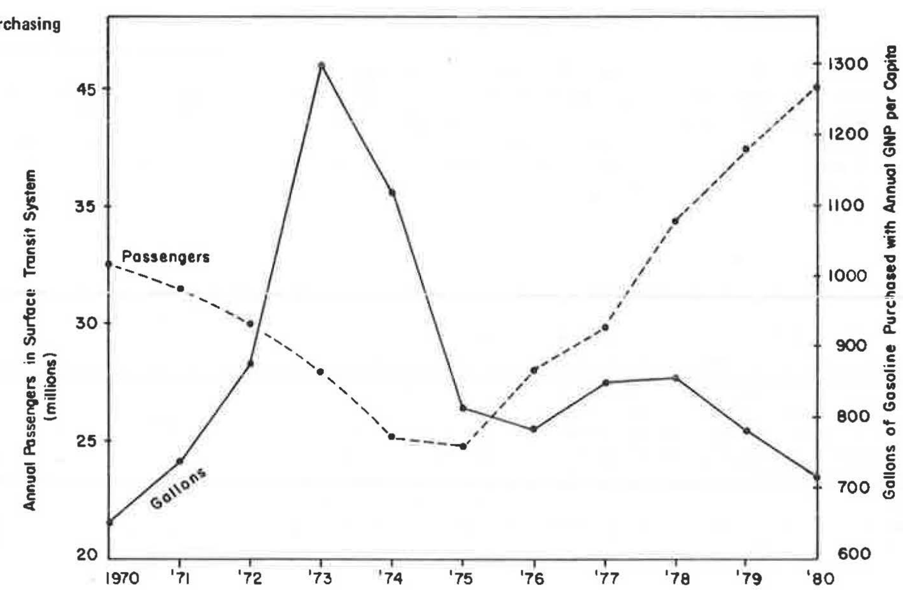
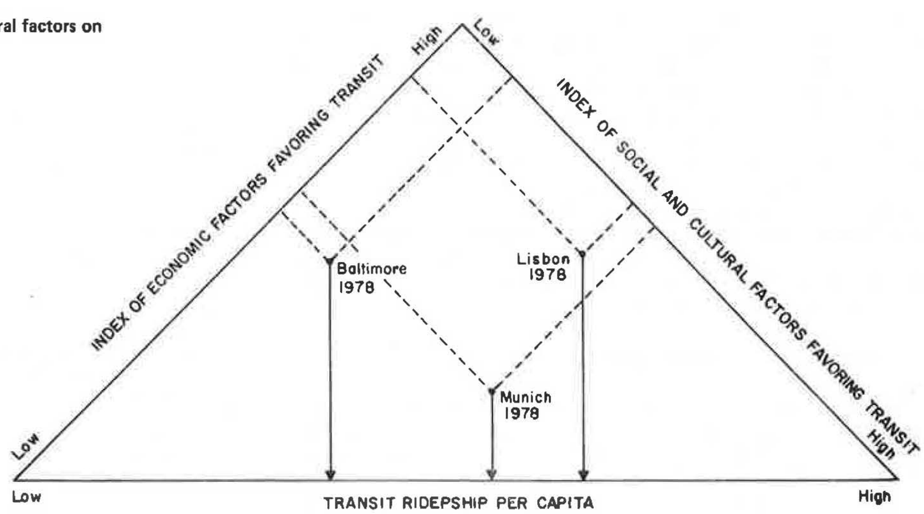


Figure 2. Influence of economic, social, and cultural factors on transit ridership.



seventh of that for Munich (in Lisbon 863 gal of gasoline can be purchased for each GNP per capita: \$1,856 ÷ \$2.15/gal; the comparable figure for Munich is 5,527 gal: \$9,727 ÷ \$1.76/gal). This factor together with the equivalency in transit fares in the two cities tends to explain the higher transit use in Lisbon. (Lisbon: GNP per capita ÷ transit fare = \$1,856 ÷ \$0.09 = 20,622 transit trips; Munich: GNP per capita ÷ transit fare = \$9,727 ÷ \$0.53 = 18,353 transit trips.)

This conclusion tends to contradict the findings of the regression analysis with regard to the independence of transit use and levels of car ownership in European cities. In the case of Lisbon, however, (where effective automobile travel costs are much higher than other European cities included in the regression analysis) the prevailing cost of automobile travel acts as a policy constraint to automobile use and induces correspondingly higher use of transit. An illustration of how transit ridership has responded to gasoline purchasing power in Lisbon is shown in Figure 1.

CONCLUSIONS

In the last two decades transit ridership has experienced changes caused by the economic, social, political, and cultural evolution that has taken place world wide during this period. These changes have been substantially different in the United States and Europe.

The regression analysis showed that for both U.S. and European cities transit supply is the variable that correlates most closely with transit ridership (R^2 of 0.69 and 0.81, respectively). In addition, and most important, for the same level of transit supply, transit ridership in European cities is expected to be twice as large as in U.S. cities.

The regression analysis also showed that car ownership has no significant influence on transit ridership in Europe but that it is a valid explanatory variable in the United States. On the other hand, urban density was shown to have more influence on transit ridership in Europe. Other factors--economic, social, and cultural--play an important role in explaining these differences. This role was analyzed by comparing transit ridership levels in three cities of similar size. The results of this comparison were consistent with the results of the regression analysis.

The relative influences of socioeconomic and environmental factors on transit ridership should, however, be investigated further. A conceptual model is presented in Figure 2. The key problem in the actual development of this model is, of course, calibration of the variables and determination of the respective scales for universal application.

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Public Transit's Survival and Prosperity in the 1980s: Effective Marketing Management Can Lead the Way

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Fiscal pressures caused by rising operating costs, limited farebox revenues, and reductions in government operating subsidies are forcing public transit agencies to seek changes in the way they do business. Survival and future growth will depend on selection of a management approach that will help public transit adapt to changes in environmental conditions. Effective marketing management has proven in the business world to be a trademark of many longstanding successful companies. A study of how the tools and practices of modern marketing management can be harnessed by the public transit industry to help weather the current fiscal crisis and prosper in the late 1980s and beyond is presented. First, the need for a change in transit management philosophy—from the traditional operations view to that of marketing—is established. Then, a structured analysis of the marketing management process interwoven with public transit applications is described.

Presented in this paper is an analysis of how modern marketing management, a strategic approach to management used by many successful corporations, can be applied realistically in the U.S. urban public transit industry. The literature of the 1970s and early 1980s is reviewed to (a) identify major gaps between what is being done and what ought to be done in managing public transit agencies and (b) highlight some potential opportunities for transit in the remainder of the 1980s and beyond. The intended audience for this paper is transportation and business professionals with some background in marketing management principles who have a desire to further the interests of public transit.

The approach taken in this paper on the subject of transit marketing differs from most. It emphasizes the view of the business community and uses language common to businessmen and marketing professionals. This is in contrast to an approach where traditional transit management methods and terminol-