6. Are the ticket sales volumes for the expected event high enough to justify the computerized Ticketron system?

In general, the use of Ticketron is more justified in situations in which ticket sales volumes are high; the demand is, at least, regional; there is a premium price for a premium transportation service; the transportation demand occurs infrequently, as in special event transportation; and the park-and-ride system is relatively complex.

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Experiences with Time-of-Day Transit Pricing in the United States

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ABSTRACT

Evidence on time-of-day transit pricing in the United States is examined in this paper, particularly in terms of ridership, fiscal, and equity impacts, as well as with respect to various implementation issues. Thirty-two time-of-day fare programs have been initiated in the United States since the early 1970s, of which 22 currently exist. These are about evenly split between off-peak discounts, peak-period surcharges, and programs involving differential rates of fare increases between peak and off-peak periods. Most fare differentials have been fairly modest to date (i.e., around $0.10 to $0.15), although there have been several cases in which peak exceed off-peak surcharges by $0.35. From interviews, it was found that the most prevalent reason for adopting time-of-day pricing was to encourage ridership shifts to the off-peak. Unfortunately, there was little empirical evidence to suggest that time-of-day fare programs to date have accomplished just that, although in most cases the proportion of total ridership during off-peak periods rose. Off-peak users were found to be more sensitive to differential fare changes than peak riders, with midday discount programs demonstrating the most prolific ridership impacts. Before-and-after analysis generally showed that time-of-day fare programs have had fairly inconsequential effects on efficiency and equity, ostensibly because of the nominal size of most differentials. Cost recovery rates did increase significantly for most peak surcharge programs, however. The most successful programs have been those that collect fares on the basis of run direction (rather than exact time) and that aggressively market their programs.

Since 1970, more than 30 areas in the United States have introduced adult transit fares that vary by time of day. Of these, 12 programs were eventually discontinued, leaving some 23 areas in the United States with time-of-day pricing as of late 1983.

These programs have ranged from additional surcharges for rush-hour services to fare discounts during the midday and bargain passes limited to off-peak periods. Time-of-day fares have been implemented on conventional bus, rapid rail, and demand-responsive (i.e., dial-a-van) modes of public transportation and in metropolitan areas as small as 25,000 and as large as 5 million persons. Fare differentials have ranged from $0.05 to more than $1, and have been as large as 300 percent in relative terms.

Interest in time-of-day transit pricing has been prompted largely by the U.S. transit industry's worsening financial situation over the past several decades. Nationwide, deficits rose from under $300 million in 1970 to more than $4.4 billion in 1982. Despite a massive infusion of government aid to cover these deficits, nationwide ridership increased only marginally, from 5.93 billion annual trips in 1970 to only slightly more than 6 billion in 1982 (1).

With operating subsidies becoming less certain, fare structures that attempt to approximate the costs of providing different types of services are gaining increasing popularity. In contrast to the more common practice of uniform pricing, time-of-day differentials attempt to encapsulate the higher overhead and staffing costs of accommodating rush-hour loads while charging non-peak users a fare reflective of basic level services. Charging more for peak period use can increase farebox returns because rush-hour transit commuters tend to be less sensitive to higher prices than other patrons, mainly because they are locked into a fixed work schedule and are making essential trips. On the other hand, giving a break at the farebox to non-peak users can significantly increase patronage. Differential fares can also serve to efficiently ration capacity--relieving overcrowding during morning and evening rush hours while helping to fill empty seats during off-peak periods. A more even distribution of demand throughout the day can ultimately mean a substantial cash savings to transit properties. In addition, given that rush-hour commuters generally have higher incomes than off-peak customers, peak-period surcharges are considered to be an equitable alternative to across-the-board fare increases.

Recent research on time-of-day fare programs in the United States is summarized in this paper. Included in this summary is an examination of how such programs vary, the motivations behind them, the range of impacts experienced to date, and various implementation issues that have surfaced (2). Particular attention is given to the effects of time-of-day pricing on ridership levels and composition, farebox recovery, and operating performance. Emphasis is also placed on highlighting exemplary cases of these fare programs. The paper concludes with specific recommendations for improving the effectiveness of time-of-day pricing.

FEATURES OF TIME-OF-DAY FARE PROGRAMS

Types of Fare Programs

An assortment of terms are currently used to describe how transit fares can be varied between peak and off-peak periods. Perhaps the most generic is peak and off-peak pricing, which refers to the variation in fares between high demand and base or low demand periods. Peak and off-peak fares can involve charging different rates during rush hours and nonrush periods of the day, between weekdays and weekends, or even over different seasons of the year. Thus, at least three versions of peak and off-peak pricing are time-of-day fares, day-of-week fares, and seasonal fares.

This paper concentrates solely on peak and off-peak fares, which vary by hours of the weekday (i.e., time-of-day pricing) primarily because this represents the most significant form of differential in terms of efficiency potential. A number of American transit properties do offer weekend fare breaks, even though the average costs of these services are probably even higher than those during weekday rush hours. Seasonal fares are less common, although they would appear appropriate when significant cost increases are incurred over several months of the year, as in the case of a summer resort area.

Figure 1 shows a number of possible varieties of time-of-day pricing in terms of changes from the base or average fare level. More than 10 U.S. transit properties have introduced peak surcharges since 1970, increasing fares only during morning and evening rush hours. At least one instance of a non-midday surcharge (Akron, Ohio), whereby fares were raised for all periods of the day except during the interpeak, has been recorded. A number of discount possibilities also exist. The most common has been midday discounts in which fares between peak periods are lowered with the hope of filling up empty bus seats. The discount arrangement can also be extended to early morning, late evening, and weekend periods, and combinations of all three.

Rather than have the fare change be one-sided, more than 10 American properties have inaugurated time-of-day pricing by increasing charges during both peak and off-peak periods, at different rates, however. Although a differential increase effectively results in a higher peak versus off-peak fare, this approach implies different ridership and financial impacts than other options because base fares are increased at all times. The differential change can also be in the opposite direction, involving decreasing off-peak rates faster than peak rates, although there have been no instances of this. Neither have there been any cases of a combined peak surcharge-off-peak discount; that is, a raising of peak period fares coupled with a lowering of off-peak fares.

Finally, several pass possibilities exist for differentiating fares throughout the day. At least three U.S. cities have implemented prepaid passes sold at a discount and restricted to off-peak use. Several cities (e.g., Bridgeport and Tallahassee) have pass programs restricted to peak hours, although the existence of discounted express service-only passes has effectively lowered rush-hour commuting costs in many other cities.

It should be noted that time-of-day fare differentials currently exist in almost every American city for special ridership markets, namely, elderly, handicapped, and student passengers. Monthly unlimited-ride passes, often priced at 40 times the base period fare, yet used upwards of 60 times per month, also end up providing regular, usually peak period, users with a discount. Given the prevalence of student discounts and regular pass programs in the United States, it is probably the case that average peak-period fares are actually lower than those in off-peak periods, at least among markets that do not include the elderly.

Chronology and Setting of Fare Programs

The data in Table 1 chronicle the evolution of time-of-day transit fare programs in the United States since 1970. Based on available records, more than 30 programs have been introduced between 1970 and 1983, including a 1-month experiment with midday discounts on San Francisco's BART rapid rail systems. At least 12 of these programs were subsequently discontinued, and in 2 of these cases (Akron and Youngstown), the differential was eventually reinstated.

The cumulative total column in Table 1 reveals that except for a small drop-off in 1980, the annual count of properties with time-of-day fares has increased steadily since 1970. By 1977 there were eight cases of time-of-day transit pricing, with only Boston having abandoned its differential on rail services. It is noteworthy that all of the pre-1977 programs involved off-peak discounts. It is probably no coincidence that the growth in fare discounts paralleled a period when operating subsidies from all levels of government were increasing by leaps and bounds. The rate of growth in time-of-day pricing slowed by the late 1970s to be followed by a second surge in the early 1980s. Of the 17 programs initiated during 1981 and 1982, 14 involved either peak-only surcharges or differential increases (peak fares rose more than off-peak ones). Clearly, the trend has been more toward time-of-day differentials that add on charges rather than deduct them. This reorientation suggests that threats made during the early 1980s to eliminate operating subsidies, particularly at the federal level, may have prodded some systems to initiate time-of-day fares as a means of generating revenue.

Where time-of-day fare programs have been implemented a wide variety of settings have been found. Twelve programs have been implemented in areas with

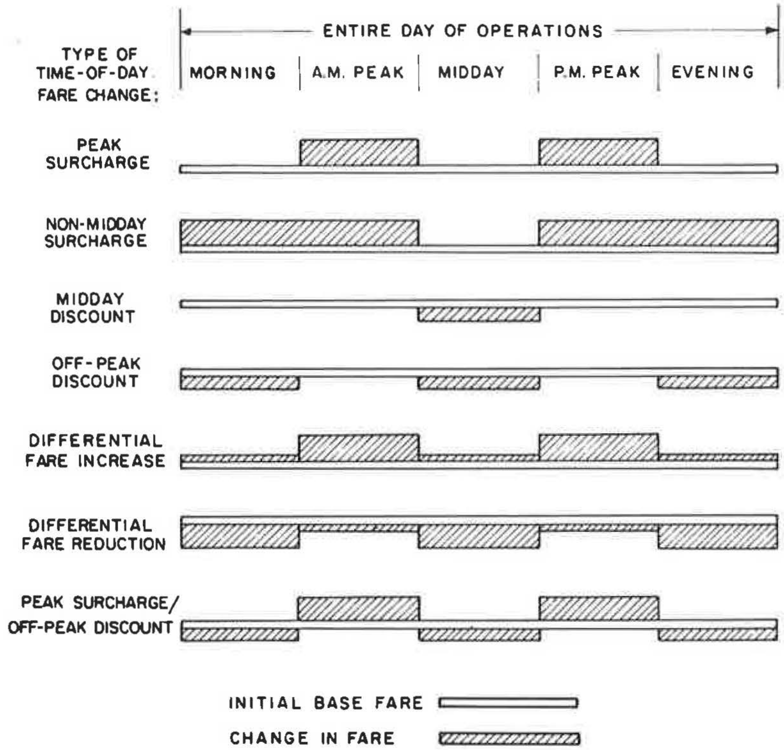

FIGURE 1 Time-of-day pricing options: ways of varying fares from the base level.

metropolitan populations above 1 million, whereas seven have been implemented in areas with populations below 100,000. Besides rail (San Francisco; Washington, D.C.; and Boston) and dial-a-ride (Orange County) applications of time-of-day pricing, bus systems that have nearly 3,000 active vehicles (Washington, D.C., Metrobus) and as few as 5 (Chico) have differentiated fares between peak and off-peak periods.

One statistic particularly relevant to this research is the ratio of peak-to-base vehicles among systems that have priced transit services by time-of-day. A high ratio would generally be associated with large cost differences between peak and off-peak periods; thus, systems that have high ratios can be expected to be likely candidates for time-of-day differentials. The mean peak-to-base ratio of 23 of the 30 nonrail systems that have used time-of-day pricing, and for which data were available, was 2.30 (standard deviation = 0.92). On average, more than twice as many vehicles were being deployed during peak as off-peak periods when time-of-day fares were introduced. This figure is higher than the national average peak-to-base ratio of 2.04 during the late 1970s (when most of the differentials were initiated) (3). Compared to the average U.S. property, systems that introduced time-of-day fares generally appeared to be good candidates in terms of the degree of peaking.

Description of Fare Programs

The absolute size and type of time-of-day differential for programs existing as of 1983 are given in Table 2. Differences between peak and nonpeak adult cash fares have been as small as $0.05 (in Baltimore and Washington, D.C.) and as large as $0.35 (in Columbus, Denver, and Palm Springs). The average differential has only been around $0.15. In relative terms, Columbus currently has the largest differential--base period fares are 140 percent higher than midday fares. The average differential is 40 percent, and the most frequently occurring differential is 25 percent (seven cases). Moreover, in some areas that have both zonal and time-of-day differentials, fares between peak and off-peak periods currently vary by as much as $0.85, in the case of Wilmington, and $1.30, in the case of the Washington, D.C., Metrobus. Overall, 12 of the 32 systems that have introduced time-of-day fares have also used distance pricing.

For almost all systems studied, the time-of-day differential that was initially set has eroded in real dollars' terms because of inflation. Only Denver, Burlington, and Cincinnati have increased their time-of-day differentials since its inception--Denver, from $0.10 to $0.35, Burlington from $0.10 to $0.15, and cincinnati, from $0.05 to $0.10.

Although most systems rely on cash payment to collect differentials, several rely solely on passes, whereas others use combinations of cash, passes, and ticket prepayment. Seven properties offer off-peak discounts ranging from 12 to 100 percent to passholders, whereas in four cases (Denver, Minneapolis, Orange County, and Washington, D.C.), peak surcharges ranging from $0.25 to $1.55 are tacked onto peak pass usage. These prepayment provisions are particularly noteworthy in that off-peak users are receiving fare incentives comparable to those enjoyed by rush-hour passholders.

The designated hours of peak and off-peak periods for systems that have implemented time-of-day pricing are given in Table 3. Fairly wide time bands have often been set, particularly among larger transit properties. In the case of the Washington, D.C., Metrobus and Metrorail, the designated morning and evening peak spans 7 hours. For most other properties, 6-hr peak periods have been designated; although there have been five different versions,

TABLE 1 Chronological Listing: Systems with Time-of-Day Pricing (2,4)

Year	Property	Number Implemented	Property	Number Discontinued	Cumulative Total
1977 or before	Erie (1970) Allentown (1972) Boston (1973) (rail) Denver (1973) Louisville (1974) Akron (1974) Rochester (1975) Baltimore (1976) Washington, D.C. (bus) (1975) (rail) (1976)	9	Boston (1975) (rail)	1	8
1978	Burlington Cincinnati Spartanburg/Anderson Walnut Creek	4		0	12
1979	Youngstown	1		0	13
1980	Albuquerque Duluth	2	Akron Baltimore Youngstown	3	12
1981	Chico Columbus Kansas City Orange County Palm Springs Sacramento Salt Lake City St. Louis	8	Albuquerque	1	19
1982[a]	Akron (reinstated) Chapel Hill Binghamton Kansas City Minneapolis Seattle Tacoma Wilmington Youngstown (reinstated)	8	Duluth Kansas City Palm Springs Rochester St. Louis Walnut Creek	6	21
1983	Wichita	1		0	22

[a]A 1-month experiment with time-of-day pricing by San Francisco's BART rail system during the month of February 1982 is not included in this chronology.

the most common is 6:00 to 9:00 a.m. and 3:00 to 6:00 p.m. Midday discount programs by comparison generally involve 5- to 6-hr discount periods that concentrate on lunchtime.

Although a wide time band can increase revenue yields, it also discourages shifts in ridership between periods because the number of potential beneficiaries becomes small. On the other hand, too narrow a band might result in excessive loss of passenger revenue and higher incidences of fare disputes at time-breaks. Indeed, some of the most vocal protests against time-of-day fare programs to date have been about the duration of the designated peak; some patrons charge that agencies are only interested in collecting more money from customers rather than encouraging shifts. In that most shifts could be expected to occur from the shoulders instead of the heart of the peak, transit managers counter that the cost savings of this redistribution in demand would be minimal. The original designated peak period was extended by 1 hr in the case of Orange County and 2 hr in the cases of Denver and Washington for these reasons.

Rationales for Adopting Time-of-Day Pricing

From extensive one-site and telephone interviews, information was elicited on why properties introduced time-of-day fare programs. The most frequently cited reason (21 of 31 systems) was to encourage increases in off-peak ridership through shifting. This was usually the primary motivation behind off-peak discount programs. The next most frequently cited reason (11 of 31 systems) was to increase farebox returns, promoted mainly by areas introducing peak-period surcharges. Other justifications were to effectuate cost-based pricing, to minimize ridership losses (through peak-only price increases), to help the disadvantaged, and to strengthen downtown areas. Several site-specific rationales were also cited; for example, in Minneapolis the regional transit authority was practically forced to institute a peak surcharge because the Minnesota Legislature precluded the raising of base period fares as a precondition to the receipt of state operating assistance. In general, all time-of-day programs were the products of many different stimuli as opposed to any one factor and usually took their form as a result of hard political bargaining and compromise.

Interviews also revealed reasons for discontinuing time-of-day pricing in some areas. In Akron, Baltimore, Boston, Palm Springs, Rochester, St. Louis, and Youngstown, excessive revenue losses prompted the return to flat fares. In Albuquerque, Kansas City, and Walnut Creek (California), increases in fare disputes and other implementation problems led to the abandonment of the differential. Moreover, there appeared to be an absence of direct beneficiaries of lower off-peak fares in many areas, ostensibly because senior citizens, who often pre-

TABLE 2 U.S. Time-of-Day Fare Programs in Existence from 1980-1983 by Size of Differential and Type of Fare Change

Transit Property	Size of Differential Between Peak and Nonpeak Periods ($)	Type of Fare Change[a, b]
Columbus	0.35	Midday discount
Denver[c]	0.35	Differential increase
Palm Springs[d, e]	0.35	Midday discount
Chico	0.25	Peak surcharge
Louisville	0.25	Off-peak discount
Tacoma	0.25	Peak surcharge
Walnut Creek[f]	0.25	Peak surcharge
Albuquerque[g]	0.20	Midday discount
Rochester[g]	0.20	Midday discount
Minneapolis	0.15	Peak surcharge
Orange County	0.15	Differential increase
Wichita	0.15	Differential increase
Youngstown	0.15	Midday discount
Akron	0.10	Nonmidday surcharge
Allentown	0.10	Off-peak discount
Binghamton	0.10	Peak surcharge
Burlington	0.10	Midday discount
Cincinnati	0.10	Differential increase
Chapel Hill	0.10	Peak surcharge
Erie	0.10	Midday discount
Kansas City[g]	0.10	Peak surcharge
Sacramento	0.10	Peak surcharge
St. Louis[g]	0.10	Peak surcharge
Salt Lake City	0.10	Differential increase
Seattle[h]	0.10	Peak surcharge
Wilmington[i]	0.10	Differential increase
Baltimore[g]	0.05	Differential increase
Washington, D.C.[j]	0.05	Differential increase
Spartanburg/Anderson	—	Off-peak pass
Duluth[g]	—	Peak-restricted pass

[a] Refers to version of time-of-day pricing in existence or first introduced between 1980- and 1983. Types of fare change are: differential increase (raising the peak fare higher than the off-peak); midday discount (lowering fares only during midday hours); non-midday surcharge (increasing fares only during nonmidday hours); peak surcharge (increasing fares only during peak hours); off-peak discount (lowering fares for all nonpeak hours, whether morning, midday, or evening); off-peak pass (discounted pass only for use during off-peak periods); and peak-restricted pass (discounted pass restricted during narrow peak time span).
[b] San Francisco's BART experiment with time-of-day pricing in February 1982 is not included. The differential amounted to a 20 percent discount below the regular fare during the midday period; the exact amount varied by distance traveled.
[c] Denver's local differential is $0.35 ($0.70 versus $0.35) in the city proper and $0.15 ($0.50 versus $0.35) in the city of Boulder.
[d] Subsequently discontinued time-of-day pricing.
[e] For intercity routes the differential was $0.50 in Palm Springs.
[f] Seattle's time-of-day fare differential widens to $0.15 for trips between two zones.
[g] Wilmington's time-of-day fare differential is only $0.10 for travel within any one zone, but is as large as $0.85 for travel between four zones.
[h] Washington's Metrobus time-of-day fare differential is only $0.05 within the District, but is as large as $1.30 for interjurisdictional trips between outer zones in Maryland and Virginia.

dominated off-peak patronage, were already receiving substantial discounts anyway. In general, users were indifferent to the elimination of off-peak pricing. This was reflected by the paucity of formal protests lodged at public hearings.

IMPACTS AND TRENDS ASSOCIATED WITH TIME-OF-DAY PRICING

Data limitations, stemming from the fact that this research was conducted "after-the-fact," restricted the analysis of ridership, financial, and equity impacts. Nevertheless, the examination of "before" and "after" data provided a basis for attributing various trends to time-of-day pricing.

Ridership

Both before-and-after comparisons and econometric analyses were conducted in examining the ridership implications of time-of-day pricing (2). The data in

TABLE 3 Comparison of Time Period Intervals Among Transit Properties with Time-of-Day Fares Since 1970

Transit Property	Designated Peak/Off-Peak Hours	Duration (hr)
Properties with Designated Peak Hours		
Washington, D.C.	6:00-9:30 a.m., 3:00-6:30 p.m.	7.0
Baltimore[a]	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Cincinnati	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Denver	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Kansas City[a]	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Orange County	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
St. Louis[a]	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Seattle	6:00-9:00 a.m., 3:00-6:00 p.m.	6.0
Minneapolis	6:00-9:00 a.m., 3:30-6:30 p.m.	6.0
Binghamton	6:15-9:15 a.m., 3:15-6:15 p.m.	6.0
Chapel Hill	6:30-9:30 a.m., 3:00-6:00 p.m.	6.0
Tacoma	5:00-9:00 a.m., 4:00-6:00 p.m.	6.0
Seattle[b]	6:00-8:45 a.m., 3:15-6:00 p.m.	5.5
Sacramento	6:30-9:00 a.m., 3:30-6:00 p.m.	5.0
Louisville	6:30-8:30 a.m., 3:30-5:30 p.m.	4.0
Salt Lake City[c]	6:30-8:30 a.m., 3:30-5:30 p.m.	4.0
Duluth[a]	7:30-8:00 a.m.	0.5
Properties with Designated Off-Peak Hours		
Albuquerque	9:00 a.m.-3:00 p.m.	6.0
Spartanburg/Anderson	9:00 a.m.-3:00 p.m.	6.0
Wilmington	9:00 a.m.-3:00 p.m.	6.0
Burlington	9:15 a.m.-3:15 p.m.	6.0
Wichita	9:45 a.m.-3:45 p.m.	6.0
Columbus	9:30 a.m.-3:00 p.m.	5.5
Youngstown	9:30 a.m.-2:30 p.m.	5.0
Allentown	10:00 a.m.-3:00 p.m.	5.0
San Francisco (rail)[a]	10:00 a.m.-3:00 p.m.	5.0
Rochester[a]	10:00 a.m.-2:30 p.m.	4.5
Akron	10:00 a.m.-2:00 p.m.	4.0
Erie	10:00 a.m.-2:00 p.m.	4.0
Palm Springs[a]	10:00 a.m.-2:00 p.m.	4.0
Boston (rail)[a]	10:00 a.m.-1:00 p.m.	3.0

Note: This comparison of time period intervals among transit properties with time-of-day fares since 1970 is the latest version of time-of-day pricing for those properties that revised designated hours.

[a] Discontinued time-of-day differential.
[b] Seattle's actual hour intervals are 6:00 to 9:00 a.m. and 3:30 to 6:00 p.m. for inbound trips and 6:00 to 8:30 a.m. and 3:00 to 6:00 p.m. for outbound trips. Hours shown are on average of this range.
[c] Designated peak hour is actually from the first bus in the morning to 8:30 a.m., which, for most runs, is from 6:30-8:30 a.m.

Table 4 summarize the measured ridership impacts grouped in terms of the type of fare program initiated. Most areas that introduced off-peak discounts experienced significant gains in ridership; the average increase (from 1 yr before to 1 yr after the fare change) was about 10 percent. In Burlington, Columbus, and Erie, riders appeared to have been more sensitive to fares than is typical for cities of comparable size; estimated fare elasticities from the introduction of time-of-day fares were about

TABLE 4 Apparent Impacts of Time-of-Day Pricing on Total Ridership, Controlling for Average Fare and Level of Service

Type of Fare Change	Increase	Decrease	Little or Uncertain
Off-peak or midday discount	Burlington Columbus[a] Erie	Allentown[a] Boston	Akron[a] Louisville
Peak surcharge or differential increase	Chapel Hill Cincinnati[a] Salt Lake City Tacoma	Akron[a,c] Baltimore Wilmington	Denver[a] Minneapolis Orange County[a] Sacramento Seattle[a]

[a] Based on ridership model.
[b] Initial implementation October 1972.
[c] Reimplementation February 1981.

-0.80 to -0.90. This suggests that the discounts were more effective in boosting ridership than a uniform lowering of fares (which produced the same average fare) would have been.

With peak surcharges and differential increases, ridership consistently declined an average of about 10 percent in the case of peak surcharges and 15 percent in the case of differential increases. Users in Baltimore and Wilmington appear to have been most sensitive to the initiation of a differential increase. Time-series analysis revealed that Cincinnati's off-peak users were more than twice as sensitive to the area's 1980 simultaneous increase in peak fares (by $0.15) and off-peak fares (by $0.10) as their peak-period counterparts. Fare elasticities were estimated to be -0.31 for peak periods and -0.69 for off-peak periods. Among systems that introduced peak surcharges, the largest ridership decrease occurred in Sacramento, an area that initiated extensive service cuts at about the same time as the 1981 fare change. Overall, however, the patronage losses from both peak surcharge and differential increase programs were generally less than what would have been expected from an across-the-board fare hike that yielded the same average fares.

Unfortunately, attempts to gauge the degree of across-period shifting induced by time-of-day pricing and to compute temporal cross-elasticities were unsuccessful because of data limitations. It bears repeating that the main impetus behind most properties introducing time-of-day pricing was to bring about shifts in use from the peak to off-peak hours. The data in Table 5, which summarize changes in the distribution of ridership from before and after the introduction of fare differentials in 17 areas, does provide some insight in this regard, however. There is some evidence that the off-peak share of ridership rose in about one-half of the areas that introduced midday or off-peak discounts. Areas with the largest relative discounts and the longest designated midday periods appeared to enjoy the greatest increases in off-peak shares. In Columbus, for example, a $0.35 discount extended over the midday hours of 9:30 a.m. to 3:00 p.m. was followed by a midday increase in the share of total ridership from 36 to 44 percent. In contrast, peak surcharge programs appeared to have had an imperceptible influence on ridership distribution. Thus, peak ridership generally held its own in areas introducing peak surcharges; the one notable exception was Chapel Hill, North Carolina, where the off-peak share increased by almost 40 percent 1 year after the 1982 adoption of a $0.10 peak surcharge. Although these findings fail to disclose whether off-peak ridership gains came from the ranks of former peak period users, there is, nonetheless, ample evidence that time-of-day differentials have at least helped fill up underutilized off-peak buses.

TABLE 5 Trends in Ridership Distribution Between Peak and Off-Peak Periods Associated with Time-of-Day Pricing

Type of Fare Change	Transit Property	Fare Differential ($)	Fare Differential (%)	Lower Fares in Effect	Evidence of Change in Ridership Distribution Between Peak and Off-Peak
Midday or off-peak discount	Akron	0.05	9	10:00 a.m.-2:00 p.m.	One-day, on-board passenger counts before and after adoption of differential indicate no shift.
	Boston	0.15	60	10:00 a.m.-1:00 p.m.	Passenger counts indicate percentage of riders during discount period increased from 12.4 percent the week before the fare change to an average of 13.3 percent the first 5 weeks after the change.
	Burlington	0.25	33	9:00 a.m.-3:00 p.m.	88 percent of midday riders surveyed report they plan trips to take advantage of discount.
	Columbus	0.35	58	9:30 a.m.-3:00 p.m.	Midday ridership from 36 percent of 44 percent of total. Staff estimates 10 percent shift from peak to midday.
	Duluth[a]	2.00	21	All except 7:30-8:00 a.m.	Passenger counts and surveys indicate no shift.
	Rochester[a]	0.15	58	10:00 a.m.-2:30 p.m.	Anecdotal evidence of significant shifts from peak to off-peak.
	San Francisco[a] (BART)	0.10-0.35	20	10:00 a.m.-3:00 p.m.	During 1-month experiment, 37 percent of average weekday passengers rode during midday as compared with 36 percent in 3-month period before and after experiment.
	Spartanburg/ Anderson,	—[b]	60	9:00 a.m.-3:00 p.m.	Off-peak pass sales increased 100 percent over 3-year period while overall ridership held steady.
Differential increase	Orange County	0.15	20	9:00 a.m.-3:00 p.m. After 6:00 p.m.	Passenger counts indicate an increase in off-peak share of total ridership from 44 percent to 46 percent.
	Wilmington	0.10-0.70[c]	17-42[c]	9:00 a.m.-3:00 p.m.	Passenger counts indicate increase in midday share of total ridership from 28.5 percent to 29.3 percent.
Peak surcharge	Chapel Hill	0.10	20	9:30 a.m.-3:00 p.m. After 6:30 p.m.	Passenger counts indicate increase in off-peak share of total ridership from 33 percent to 46 percent.
	Minneapolis	0.15	20	9:00 a.m.-3:30 p.m. After 6:30 p.m.	Responding to ridership surveys, 18 percent of users report they have shifted usage to off-peak.
	Sacramento	0.10	17	Before 6:00 a.m. 9:00 a.m.-3:30 p.m. After 6:00 p.m.	Passenger counts indicate off-peak share of total ridership was 63.9 percent in year before differential and 55 percent in year after differential was adopted.
	Seattle	0.10	17	Before 6:00 a.m.[d] 9:00 a.m.-3:00 p.m. After 6:00 p.m.	Ridership survey indicates a 4 percent shift of discretionary trips from peak to base period.
	St. Louis[b]	0.10	17	Before 6:00 a.m. 9:00 a.m.-3:00 p.m. After 6:00 p.m.	Passenger counts indicate off-peak share of total ridership was 43.3 percent before differential, 43.8 percent when differential was in effect, and 43.1 percent after differential was abandoned.
	Tacoma	0.25	50	Before 5:00 a.m. 9:00 a.m.-4:00 p.m. After 6:00 p.m.	Increase in off-peak share of total ridership from 44.6 percent to 47.5 percent.
	Washington Metrobus	0.05	7	9:30 a.m.-3:00 p.m. After 6:30 p.m.	Increase in off-peak share of total ridership from 33.3 to 36.8 percent.

[a] Time-of-day pricing subsequently abandoned.
[b] Discount applies to monthly passes only.
[c] Differential depends on number of zone boundaries crossed.
[d] Hours differ slightly for morning outbound and afternoon inbound trips.

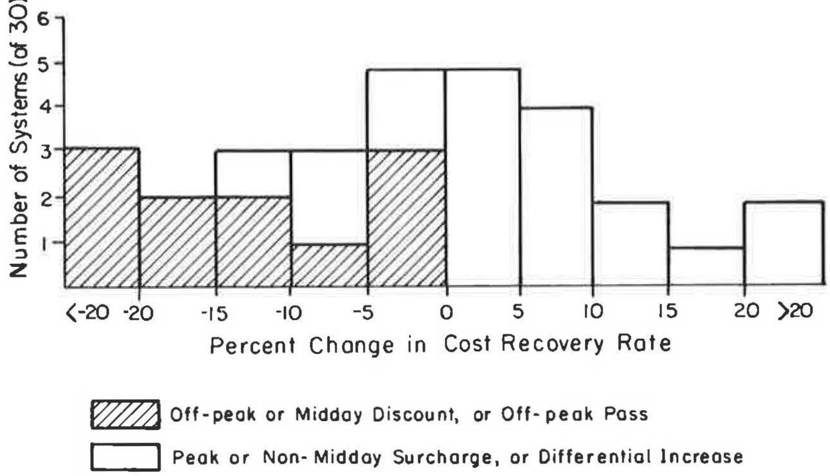

FIGURE 2 Distribution of percent change in cost recovery rates, by type of time-of-day differential.

Efficiency

Besides stimulating shifts in ridership, many time-of-day programs were also initiated with the objective of upgrading financial and operating performance. Figure 2 shows the superior financial performance of surcharge programs by comparing changes in cost recovery rates (passenger revenues and operating expenses) for 30 properties. In all cases, off-peak discount programs experienced a decline in the share of expenses recovered from fares; in seven cases rates fell by more than 10 percent within 1 yr. By comparison, cost recovery rates generally increased by 5 to 10 percent for most systems that introduced either peak surcharge or differential fare increases. The range in the percent change in cost recovery was from -33 percent in the case of Albuquerque's 1980 $0.20 discount to +62 percent in the case of Orange County's 1981 $0.25 peak and $0.10 off-peak fare increase. Although numerous other factors have undoubtedly affected systems' financial performances, it was nonetheless clear that fiscal improvements have generally accompanied peak surcharge programs whereas with off-peak discounts, cost recovery rates have consistently declined.

A common argument in favor of time-of-day transit pricing is that unit costs can be lowered by more efficiently allocating both capital and labor throughout the day. However, the data in Table 6, reveal that there were no significant changes in peak-to-base period ratios of vehicles or employees. Only in the case of off-peak discount programs did there tend to be a slight reduction in this ratio. However, for four larger areas--Minneapolis; Orange County; Sacramento; and Washington, D.C., the ratio of peak-to-base buses did decline by more than 7 percent within 1 yr of the introduction of surcharges. Based on discussions with local transit officials in all four communities, time-of-day pricing appeared to be only one of a number of other efficiency and cost-savings improvements that helped shave peak-to-base ratios.

Moreover, the sizes of properties' labor forces were generally found to be unaffected by time-of-day pricing. By shaving peak services in response to ridership shifting to the off-peak, it is hoped that both overhead expenses and workforce size can be trimmed under time-of-day pricing. Moreover, labor productivity, as reflected by vehicles and vehicle-miles per employee, generally declined by about 2 percent among systems using time-of-day pricing, regardless of the version used. There were notable variations in these trends, however. In Akron and Orange County, for example, vehicle miles per employee increased by more than 10 percent within 1

TABLE 6 Percent Change in Several Efficiency Indicators Following the Introduction of Time-of-Day Pricing by Type of Fare Change

			Average Percent Change[b]			
	No. of Systems	Average Peak-to-Base Ratio for the Year Time-of-Day Pricing Was Introduced[a]	Peak-to-Base Ratio of Vehicles	Employees[c]	Vehicle Miles per Employee	Vehicle Hours per Employee
Systems that currently have time-of-day pricing	22	209.3	−0.2	+2.6	−2.1	−2.8
Surcharge or differential increase	15	197.2	+0.2	+2.3	−2.1	−2.5
Off-peak or midday discount	6	241.2	−1.4	+3.5	−2.1	−3.6
Off-peak pass	1	200.0	0.0	–	–	–
Systems that abandoned time-of-day fares	6	226.2	–	–	–	–
Surcharge or differential increase	4	274.0	–	–	–	–
Off-peak or midday discount	2	130.5	–	–	–	–
All systems combined	28	217.0	–	–	–	–

Note: Dash means data not available.

[a]Two current surcharge programs and two current discount programs are excluded due to unavailable data. Peak-to-base ratio equals number of peak vehicles divided by number of off-peak, or base, vehicles times 100.

[b]Each case is weighted the same regardless of property size. Only non-rail systems are analyzed.

[c]Computed only for 14 surcharge and 4 discount programs; other cases were missing.

year of adopting time-of-day pricing, whereas the same indicator dropped by a comparable rate in Tacoma and Wilmington.

Individual case studies revealed more positive efficiency impacts of time-of-day pricing. For example, Rochester's transit authority redeployed 10 of its peak-hour runs to off-peak hours and shaved its peak fleet following its 1975 lowering of midday fares. Columbus's bus system also reassigned numerous driver tours. There, seat occupancy during the midday increased from 40 to 63 percent, to the point where load factors are now the highest during the noontime. Columbus's $0.25 midday fare, coupled with free midday downtown services, has led to an oversubscription problem, however. Because of excessive noontime crowding, the incidence of scheduled buses running 3 min late or more increased by 22 percent following Columbus's initiation of a combined midday discount-free downtown service.

In terms of other efficiency trends, there was an average decline in revenue passengers per mile following time-of-day pricing among the systems studied, although this did vary markedly among properties. Notably, in Denver and Columbus, two areas that have the largest absolute differentials, this measure increased by 10 percent 1 yr after time-of-day pricing was introduced.

There is also anecdotal evidence that midday discounts have had positive impacts on downtown retail activities in several areas. The most impressive results have been in Columbus where daily ridership to downtown increased by one-third during the first month of the city's $0.25 midday discount program. One year later, sales tax revenues dedicated to the local transit system increased by $2 million more than had been expected, effectively reducing Columbus's need for state and federal operating assistance. Local officials attribute the boom in sales volumes to the multiplier effect of stimulating downtown business activities through the promotional fares. Columbus officials proudly note that sales tax revenues increased 14 percent during the first month of the fare program, whereas for the same period during the previous year they decreased 10 percent. However, any sales tax gains can be expected to be related to larger regional economic forces. That is, in the absence of a growing economy, any increases in downtown business sales would be purely redistributive--that is, taking away retail transactions from areas not in the central business district. Nonetheless, Columbus is in a financially more viable position than several years ago (because of tremendous gains in dedicated tax receipts), lending some credence to the contention that more efficient pricing yields important secondary community benefits.

Equity

This research also included an examination of the effects of time-of-day pricing on ridership composition to determine whether fare differentials would benefit the poor and disadvantaged groups the most (as evidenced by their increased use). The distributional effects of time-of-day pricing were found to be quite modest. This was probably because most time-of-day fare differentials were so small as to diffuse impacts among user groups. Among six properties for which data were available, only in Columbus and Minneapolis did the differential appear to influence ridership mixes to any noticeable extent. In Columbus, the share of older, minority, and low-income users increased overall; however, the proportion of choice riders increased markedly during the midday. In Minneapolis, some shifting of lower income, school-aged and captive users to off-peak periods was found following the add-on of a 25 percent peak surcharge.

IMPLEMENTATION AND POLITICAL ISSUES

Making time-of-day pricing work, both logistically and politically, is a major hurdle to overcome in the minds of many. Several important strategies that facilitated the implementation of time-of-day pricing deserve particular attention.

Fare Collection

Foremost among the successful implementation strategies have been innovative approaches designed for collecting differential fares. In particular, nonobtrusive ways have been devised for coping with the boundary problem; that is, collecting fares at the changeover point from the off-peak to peak period and vice versa. Nearly one-third of all properties collect their differentials on the basis of individual bus runs or arrival at a major activity center rather than according to the specific hands on the clock. Run-based collection virtually eliminates fare disputes, more closely approximates cost variations, and provides the flexibility needed to make differential pricing manageable. In Binghamton, Columbus, Erie, Orange County, Sacramento, Seattle, and Wichita, managers claim that user-driver confrontations have been substantially reduced because everyone boarding a bus from the beginning to the end of a regularly scheduled run pays the same fare as opposed to the fare changing, for example, midway along a route. In instances where run-based collection is used, individual bus schedules have been shaded or printed in boldface letters to highlight exactly where, rather than when, fare rates change.

Special signage (e.g., flip signs and decals) and pulse scheduling have also been used to facilitate the differential fare collection process. Moreover, coinage was chosen in Columbus ($0.25) and Denver ($0.35 token) to reduce change handling in order to expedite the boarding process during high-volume midday hours. In addition, in almost every case studied, drivers were encouraged to exercise discretion when collecting differentials. Although there was some indication of fare evasion in several areas following the introduction of time-of-day pricing; overall there appeared to be a collective spirit of cooperation among users and drivers in enforcing the fare programs.

Reactions to Time-of-Day Pricing

Another important aspect of implementing time-of-day pricing is the general receptiveness of different groups and special interests to fare reform. Numerous individuals were polled about their reactions as well as the reactions of others to the fare changes. In general, most groups appeared fairly indifferent toward time-of-day pricing. Interviews with transit managers indicated that board members of more than three-quarters of all areas were supportive of time-of-day pricing, considering it a more business-like practice. In most of these cases, agency staffers aggressively promoted the idea of time-of-day pricing through special workshops and other efforts designed to explain the rationales behind peak and off-peak differentials. In those areas where board members were initially skeptical, apprehensions tended to wane within several months of implementation.

In most areas, drivers have been fairly ambivalent toward time-of-day pricing. Interviews with rank-and-file representatives in a number of areas indicated that the fare programs themselves were far down the list of priority concerns among drivers. Most drivers indicated that complaints about fare collection generally were related more to matters such as exact payment, multiple passes, and zonal charges than to the time-of-day differential. Some found time-of-day pricing to be a simplification of previous fare practices. No instances were found in which drivers used the differential program and its greater likelihood for fare disputes as a bargaining chip during wage negotiations.

Although there were scattered incidences of user complaints immediately following the introduction of peak surcharges in several areas, acceptance generally came quickly. Aggressive marketing and educational programs certainly had something to do with this. However, the fact that differential pricing was already institutionalized in several areas and that time-of-day fares were actually simplifications of earlier fare practices in others also worked in the transit properties' favor. Moreover, in that the vast majority of users ended up paying the same fare regularly, the differential itself became a nonissue. There were few instances of peak-period customers complaining about unfair treatment. Apparently, the adoption of fairly small differentials helped to assuage potential ill-feelings. A number of transit managers interviewed volunteered that a small differential was consciously chosen initially to guard against disenfranchising any one group, though they had the intention of eventually widening the differential. As mentioned earlier, few properties have actually widened the differential.

Perhaps the most vocal user protests concerned the specific designation of the peak time bands instead of the fare rates. In Denver; Washington, D.C.; and several other areas; users openly complained at public hearings that the designated peak hours were too long, thus limiting their ability to take advantage of lower fares. Although longer peak hours enhance revenue returns and perhaps reduce the incidence of fare disputes, the discouragement of shifting is perceived by many to be a major drawback. Finally, there were a few instances in which certain groups of users were intimidated by fare differentials. In Orange County, for example, bus drivers have reported a high incidence of overpayment during off-peak periods among non-English-speaking patrons, primarily southeast Asians and Latinos, who simply do not understand the differential and are fearful of being accused of cheating.

Marketing and Other Implementation Factors

The general public receptiveness to time-of-day pricing was unquestionably due, in large part, to ambitious marketing and user information programs. Many systems launched aggressive promotional campaigns using extensive media coverage, newspaper advertisements, radio announcements, on-vehicle brochures, educational films, and areawide postering to inform the public about time-of-day pricing. When Columbus initiated its $0.25 midday discount program, for example, an extensive $40,000 promotional effort and media blitz was undertaken. Moreover, merchants gave away more than 200,000 free ride coupons and store prizes as a goodwill gesture during the opening week of the fare program.

A particularly useful marketing ploy adopted by a number of properties was to sell the fare program to the public as a discount fare rather than a peak surcharge, regardless of whether it was or not. Most off-peak discounts were marketed as bargain and incentive fares, rather than peak and off-peak differentials. This tended to cast each program in a positive light and also avoided any hint of discriminatory pricing between peak and off-peak users. In the cases of peak surcharge and differential increase programs, the marketing tactic usually chosen was to emphasize the benefits of off-peak travel instead of the higher cost of peak-period usage. These marketing strategies parallel those currently being used by many oil companies whereby emphasis is placed on receiving cash discounts rather than any mention of credit card surcharges.

An investigation of the role of the private sector in promoting time-of-day pricing revealed that most of the involvement was limited to business merchants giving away free bus tokens and promotional prizes during the first week or more of some programs. The giveaways were linked to service improvements as much as the fare programs in most areas, however. Few instances in which time-of-day pricing was implemented as part of a flextime or staggered work-hour program were found. In the one case where time-of-day pricing was introduced specifically in combination with flextime (Duluth) the demonstration was discontinued after 1 yr because virtually no employers participated. In the absence of joint public and private coordination of work schedules and fare policies, it is perhaps no great surprise that the level of ridership shifting found was fairly inconsequential. It is probably the case that private interests need to believe that there is something in it for them, such as in the case of Columbus, if they are to actively promote and support time-of-day pricing or any other fare innovation.

CONCLUSION

Although it is hoped that some new insights into time-of-day pricing have emerged from this research, knowledge regarding possible ridership and financial effects of such fare reforms remains incomplete. In particular, the ability of time-of-day fares to bring about significant temporal shifts in ridership remains unclear, even though this was the intended result of most programs. Data limitations are partly to blame. But the fact that most of the differentials implemented to date have been fairly nominal, along with the absence of a true peak-increase and off-peak-decrease fare change, have been limiting factors as well. Moreover, because many differentials have been eroded by inflation since they were first introduced, the dearth of significant ridership and performance findings perhaps could have been expected. It is probably also the case that the wide time bands chosen by many transit properties to represent the peak period effectively prevented many passengers from shifting over to the lower-priced off-peak periods.

If the effects of a substantial peak and off-peak fare differential are to be accurately gauged, a carefully designed and administered demonstration program needs to be launched. A more controlled experimental approach using panel groups is essential if the incidence of ridership shifting induced by time-of-day pricing is to be measured. Ideally, a demonstration program involving a combined peak-increase and off-peak-decrease fare change with a large differential would be designed. In addition, every effort should be made to enlist the support of the private sector in coordinating various flextime and staggered work-hour programs with time-of-day pricing.

This research suggests that both off-peak discounts and peak surcharges, as well as combinations thereof, can yield positive dividends to a transit agency as long as they are carefully implemented and other reinforcing factors accompany them. Run-based fare collection appears to be far superior to time-based approaches. Equally as important, driver-user confrontations can be avoided with a well-planned, run-based collection system. Creative marketing also appears to be an important prerequisite. There appears to be less public resistance, moreover, when differentials are marketed as bargain off-peak fares, without any reference to higher peak-period rates. This marketing ploy can cast the fare program in a more positive light without alienating transit's bread-and-butter customers--peak-hour users. It is also essential that careful attention be paid to the designation of peak and off-peak hours, mindful of the trade-offs involved. Although lengthy peak periods usually generate more revenues than narrower ones, they probably have been major deterrents to significant ridership shifting as well. Peak-period time bands need to be seriously reevaluated in some areas with an eye toward encouraging ridership shifting. Along this same line, every effort should be made to implement time-of-day pricing in conjunction with flextime programs. Both public and private interests could materially benefit by doing so.

Of course, there can be no guarantees that if an agency does a certain number of things, then a successful time-of-day fare program will result. Numerous factors, many of which are uncontrollable (e.g., changing gasoline prices and regional economic conditions), have varying degrees of influence on the outcome of any fare reform. But among the factors that a transit agency can directly control, run-based collection, inventive marketing, and the careful designation of time bands all appear to be important ingredients of successful time-of-day fare programs.

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REFERENCES

1. Transit Fact Book. American Public Transit Association, Washington, D.C., 1985.
2. R. Cervero. Evidence on Time-of-Day Transit Pricing in the United States. Vols. I and II. UMTA, U.S. Department of Transportation, 1984.
3. R.L. Oram. Peak-Period Supplements: The Contemporary Economics of Urban Bus Transport in the U.K. and U.S.A. In Progress in Planning, A.D. Diamond and J.B. McLoughlin, eds., Pergamon Press, Oxford, England, 1979, pp. 83-154.

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Abridgment

Distance-Based Fares on Express Bus Routes

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ABSTRACT

Distance-based fares for bus transit have been previously shown to be more equitable than the widely used flat fares. However, with rising transit costs, an additional source of revenue is often needed. In this paper the possibility of distance-based fares as a source for this revenue is explored. Express bus service in Milwaukee, Wisconsin, was used as a case study. Different fares were proposed for each route based on its length. Alternative methods of implementing distance-based fares were then proposed. The findings revealed that a small revenue gain is possible without suffering a ridership loss. Conversely, slightly lower fares could result in a small ridership increase with no revenue loss. A 10 percent revenue gain would require a fare increase on the longest route of 55 to 90 percent for the low and high scenarios. The corresponding fare change on the shortest route is a 20 percent decrease to a 5 percent increase. A 20 percent revenue gain would require a fare increase of 75 to 170 percent on the longest route and a 5 percent decrease to a 45 percent increase on the shortest route.

During the 1960s and early 1970s, many transit operators switched from some form of distance-based fares to a flat fare. This trend occurred both in the United States (1) and worldwide (2) for two reasons: (a) to establish low, stabilized fares, and (b) to ease collection. As more systems adopted a flat fare structure, a smaller percent of the operating expenses was paid from passenger revenue. Consequently, increased subsidies from local, federal, and to a lesser extent, state levels, were required for this trend to occur.

Statistics indicate that the goal of stabilized