Transit Finance, Economics, and Pricing

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This paper analyzes issues in transit finance focusing mainly on fares and fare-related problems. Special attention is devoted to fare media and problems of fare/technology integration.

Prevalence of Fare Structures

Twelve years ago the Urban Mass Transportation Administration/Service and Methods Demonstration (UMTA/SMD) Woods Hole Conference focused on problems of fare revenue and the need for increased revenue collection by changing from flat fares to other fare structures. At that time, nearly 90 percent of all American Public Transit Association (APTA) members relied on flat fares structures.

As shown in Table 1, the APTA 1993 Transit Fare Summary showed some movement away from flat fare systems. Of the bus systems reporting to the APTA fare survey, 5.2 percent charged time-of-day fares and an additional 37.1 percent had zone surcharges, with speed surcharges (express or premium service) showing in 26.1 percent of all fare structures reporting. However, there is no reason to get carried away by these figures since the zone surcharges typically include a large zone covering the central city and a more distant zone covering the suburban neighborhoods. Sometimes a Central Business District (CBD) zone is also included. There is a need for several more zones (or distance charges) if the revenue generation potential of zone fares is to be realized. Particularly distressing is the relatively small incidence of time-of-day fares, the fare structure that shows more difference in fare categories with respect to fare elasticities of demand.

Commuter rail showed the most divergence from flat fare systems, showing higher proportions of systems charging for distances and time-of-day. The rail systems (heavy, light, and commuter) showed a preference for distance-based over the time-of-day fare structures. All of the modes presented in Table 1, except commuter rail, showed an overwhelming preference for flat fares.

Evidence Supporting the Revenue Raising Inferiority of Flat Fares

The objective of raising fare revenues by shifting into alternative fare structures has not been met because of a combination of factors involving the ease and convenience of administering flat fares structures, as well as by research gaps and doubts concerning the alleged superiority of time-of-day fares and distance/zone fares in raising fare revenues at minimum ridership losses.

The push for the adoption of time-of-day fares and distance/zone fares received a shot in the arm ten years ago when, in the same year, a UMTA-sponsored University of California at Los Angeles (UCLA) study by professors Martin Wachs and Robert Cervero (*1*), among others, concluded that very significant gains in revenues, exceeding by 20 to 30 percent the revenues of flat fare systems, could be achieved by having three large California systems (Oakland, Los Angeles, and San Diego) shift from flat fares to combinations of time-of-day/distance-based fares. In the same year, UMTA released an Ecosometrics (*2*) report on fare and service elasticities which showed numerous cases where peak hour fare elasticities were approximately half the value of base period fare elasticities, and selected cases from the British experience of fare elasticities, in which fare elasticities increased with distance of travel.

Research conducted since then has failed to resolve these gaps in knowledge. Professor Robert Cervero's (*3*) study of peak hour surcharges found cases where the peak hour fare elasticity was not much lower than the base period fare elasticity, in effect nullifying the alleged superiority of peak hour charges. Regarding fare elasticities by distance/zone we know from the UMTA/SMD demonstrations of the late seventies that intra-CBD transit ridership is more elastic than central city ridership (*2,4*), but there is still a gap in knowledge regarding whether distance-based fare elasticities increase with distance.

No wonder then, that faced with these uncertainties, the transit industry has opted for maintaining their reliance on flat fare systems.

Deep Discount Fare

A new revolutionary concept of fare discounting has appeared in the literature and has been applied in several transit properties. This concept, labelled the "deep fare discount" option, consists of offering (20 to 30 percent) discount on short term 10-tickets, day passes, and 10-pack tokens programs. The concept has been applied in Allentown, Pennsylvania; Lafayette, Indiana; Milwaukee, Wisconsin; Chicago, Illinois; and Richmond, Virginia. Table 2 presents the record of the applications of deep fare discounts in several American properties. Because of its importance we present a detailed analysis of this option.

TABLE 1 Prevalence of Fare Structures Among APTA Members, 1993

Fare Structure Elements	Motor Bus	Trolley Bus	Heavy Rail	Light Rail	Commuter
Distance or Zone Surcharges	37.1%	20.0%	38.5%	25.0%	88.2%
Parking Surcharges	1.7%	0.0%	53.8%	6.3%	47.1%
Speed Surcharges	26.1%	0.0%	7.7%	6.3%	0.0%
Time-of-Day Surcharges	5.2%	20.0%	7.7%	12.5%	23.5%
Transfer Surcharges - Same Mode	27.8%	20.0%	15.4%	18.8%	0.0%
Transfer Charges - Other Modes	7.6%	40.0%	46.2%	43.8%	11.8%
APTA Systems Reporting	291	5	13	16	17

Source: (*8*, pp. 20-18 and 20-19)

Basic Underpinnings

The key concept behind "Deep Discount Fares" (*5*) is that the fare elasticities for occasional transit riders (generally ϵ = -0.4 or -0.5) and for choice riders (close to ϵ = -1.0) are more elastic than the fare elasticities for all adult cash riders (ϵ = -0.2 or -0.3). Since occasional riders generally ride while paying via multi-ride tickets, 10-pack tokens or cash, the argument of the "Deep Discount Fare" proponents is that it is cost-effective to increase cash fares, while reducing the prices of multiple ride tickets (and 10-pack tokens). The result of this cross-subsidy, claim the deep discount fare proponents, is that both revenues and ridership may be increased by the "Deep Discount Fares" pricing strategy.

The increase in both ridership and revenues is claimed to occur because the occasional riders are among the most fare-sensitive of the transit rider segments, and these riders increase their number of trips by a larger amount than the decrease in the trips of cash paying riders. This argument is correct and obvious as analyzed in the context of the fare elasticities of demand.

The benefits of "Deep Discount Fares" are exaggerated by claiming that they can increase ridership and revenue even if cash fares are not increased. However, this is clearly incorrect as explained next. In order for decreases in the prices of multi-ride tickets—and other fare instruments applicable to occasional riders—to result in increases in both revenues and ridership in the absence of cash fare increases, the fare elasticities of these fare instruments applicable to occasional riders would have to be larger than unity ($\epsilon > -1.0$). Yet, we have been unable to find one case where a fare elasticity larger than unity has been estimated for any system in the United States, Canada, or Great Britain.

All the fare elasticities of choice riders estimated for Chicago, Denver, San Francisco, and London are lower than unity, and that is the case also of the fare elasticities of ticket programs estimated in U.S. settings. However, we are in agreement with the deep discount fare proponents' more reasonable conclusion that "revenue losses are minimized when the discounts are especially targeted to low frequency riders through the use of direct mail coupons limiting the savings to a single purchase of super-discounted tickets."(*5*)

In conclusion, for the deep fare discounts to result in both ridership and revenue increases, in the absence of a coordinated action to increase cash fares, requires fare elasticities for occasional riders and multi-trip tickets greater than one. The increase in both ridership and revenue is unlikely to occur without the cross-subsidy discussed earlier.

Pricing Complications When Pass Programs Exist

While the basic underpinnings of the "Deep Discount Fares" policy, when accompanied by a cross-subsidy with cash fare increases, are theoretically correct and easy to understand, a more complex situation arises when pass programs are also available. Monthly and weekly pass programs serve commuter riders, which have among the lowest fare elasticities of any transit ridership market segment. A correct pricing decision to restrict the "Deep Discount Fares" to the more elastic markets, would have to exclude discounting the pass programs, which have notoriously low elasticities. A contrary decision to give deep discounts to the pass riders would certainly result in revenue losses, since weekly and monthly pass riders are very inelastic. In fact, they are more inelastic than the cash riders that do not shift to multi-ride tickets as a result of the "Deep Discount Fare" strategy.

TABLE 2 EXPERIENCE WITH DEEP DISCOUNT FARES

Property	LANTA	Greater Lafayette Public Transit Corporation	Milwaukee County Transit System
City	Allentown, PA	Lafayette, IN	Milwaukee, WI
Date of Action	April 1, 1987	January 1988	January 1987
Cash Fare Increase	+50% (peak), +30% (off-peak)	cash fare of $0.50	+18%
Ticket Price Reduction	10-ride ticket price & 40-ride tickets price: -20%	10 ride tickets for $4.00 (20-23% discounts)	10-ride ticket price: -9%
Pass Price Reduction	No passes are available	Introduced Adult Summer Pass (no information on price)	Weekly pass trip: -9%
Passenger Changes	+5%	+5%	+1.3%
Revenue Changes	+10%	+0.50% or +2% in adult fare revenues including pass revenues (depending on the source)	-0.5%
Notes:	A major reorganization of bus services occurred in the 2nd semester of 1986	Mail coupons good for $1.00 discounts on the tickets sent to 30,000 homes	New and expanded service on key South Side routes coincided with major freeway construction program
	Distributed the ticket programs by mail with additional discount coupons (of 20%)		Senior fares went up 25% (because they are half the cash fare)

Source: R. Oram. *Deep Discount Fares*. Prepared for UMTA's Office of Budget and Policy, August 1988.

Extending the "Deep Discount Fares" to pass plans results in revenue losses, as evident in the experience of the Milwaukee County Transit System. In Milwaukee, discounts of nine percent in both 10-trip tickets and weekly pass programs resulted in an overall revenue loss of -0.5 percent for the system in spite of a significant 18 percent increase in cash fares and an expansion of service. The point is, given that most transit properties already have pass programs, the design of a "Deep Discount Fares" policies for most of these properties is not straightforward.

While the correct design policy—not discussed in the basic deep discount fares document—may be not to extend the deep discounts to the pass programs in order to avoid revenue losses, this raises equity problems which are discussed next.

Cross Subsidies and Equity Considerations

The "Deep Discount Fares" policies require a concomitant action to increase cash fares in order to result in increases in both ridership and revenues, thus highlighting the issue of cross-subsidies. The cross-subsidy issue consists of the fact that those cash fare riders that do not shift to multi-ride tickets experience higher fares and thus subsidize those cash fare riders that shift to multi-ride tickets in response to the fare discounts for ticket programs.

The subsidized multi-ride ticket buyers are by definition the most elastic of the cash fare riders, that is, the choice riders. Those remaining cash fare riders which subsidize the multi-ride ticket buyers are among the most inelastic of the cash fare riders, that is the captive riders. The result of the cross-subsidy is that the captive riders, generally low income riders, end up cross-subsidizing the more affluent choice riders.

The issue of cross-subsidy gets even more complicated if the monthly pass plans are brought into the analysis. If the "Deep Discount Fares" are not extended to the pass riders (which may be necessary given the low fare elasticities of pass plans), then we will have a situation where occasional riders are subsidized by both regular riders and commuters. In summary, "Deep Fare Discounting," while based on good economics, has inequity implications that may affect its applicability in some transit settings.(*6*)

Size of Occasional Rider Market

Given the strategy of "Deep Discount Fares" to cross-subsidize the occasional riders, the success of this policy will somewhat depend on the size of this market segment. Deep discount fare advocates claim that the market is sizable and that current on-board survey techniques—with their 20 to 30 percent response rates—underestimate the market for occasional riders.

While it is true that most of the transit riders are occasional riders, these occasional riders hardly ever account for more than 30 percent of all the transit trips. Table 3 summarizes the experience of several systems, supporting the fact that the occasional riders constitute around 30 percent of the market. This finding was validated by LANTA in Allentown, Pennsylvania, which found that "30 percent of the LANTA passengers took the bus once in a while."(*7*) Noteworthy in Table 3 is the fact that in some cities the occasional rider market is substantial, exceeding the average of 30 percent of all transit trips. These cities, which include some smaller cities but also Seattle, would seem to be candidates for a "Deep Discount Fares" strategy. Thus, the widespread applicability of this concept is exaggerated; the concept is more applicable to systems with substantial numbers of occasional riders.

Targeting the Discounts Offered

Deep discount fare proponents correctly emphasize the need for marketing and the success of marketing efforts in the three sites. Particularly impressive was the effort in Allentown and Lafayette to target the discounts via mail coupons. In Allentown nearly 100,000 discount coupons were mailed, while 30,000 discount coupons were also mailed in Lafayette. This is good marketing at work!

Summary

In spite of its exaggerated claims, "Deep Discount Fares" is an appropriate policy when accompanied with cash fare increases in a variety of transit settings characterized by large numbers of occasional riders.

The claim that "Deep Discount Fares" can result in revenue increases even without the accompanying cash fare increases appears spurious. However, "Deep Discount Fares" may be the least expensive discount fares strategy in terms of minimizing the revenue losses. There are also important equity considerations that may complicate the issue of adopting "Deep Discount Fares."

Three more recent applications of the deep discount fares were made by the Chicago Transit Authority, the Metropolitan Transit Commission in Minneapolis-St. Paul, and by the Greater Richmond Transit Commission. In these applications the base fare was significantly raised to cover whatever revenue losses would result from the shifting of cash riders to the short-term fare media. There is a need to conduct an independent evaluation of these applications of deep discount fares and of whatever other applications are undertaken in the near future.

TABLE 3 COMPARISON OF FREQUENT VS. OCCASIONAL RIDERS IN SELECTED TRANSIT SYSTEMS

Weekly Trips Taken	Percent of Weekly Transit Trips										
	Sacramento (CA)	Syracuse (NY)	Mobile (AL)	Portland (ME)	Columbia (SC)	Winston-Salem (NC)	Wilmington (NC)	Denver (CO)	Toledo (OH)	Burlington (IA)	Tuscaloosa (AL)
4-7 days/week	68%	74%	75%	70%	71%	73%	64%	76%	72%	55%	46%
1-3 days/week	21	20	22	21	21	21	31	5	6	27	5
Less than 1 day/week	11	6	3	9	8	6	5	9	12	18	9

	Percent of Weekly Transit Trips			
	Seattle (WA)	Louisville (KY)	Santa Cruz (CA)	Fond du Lac (WI)
More than 10 trips/week	17%	20%	53%	9%
7-10 trips/week	38	60		18
5-6 trips/week	20	20	26	28
3-4 trips/week	21		16	24
1-2 trips/week				21
Less than 1 trip/week			6	

Source: On-board surveys of selected transit properties, 1970-1985.

Fare Changes and Discounting

The 1993 APTA fare survey (*8*) referred to earlier shows that 23.1 percent of the APTA bus systems changed fares during the period 1991-1993, a relatively low rate when contrasted with heavy rail at 42.9 percent and light rail at 41.7 percent. Twenty percent of the commuter rail systems belonging to APTA changed fares during the two years in question. This reluctance to change fares on a periodic basis may reflect the fact that the recent economic period of the mid-eighties and early nineties has been characterized by the lack of inflationary pressures. However, this inertia in postponing fare changes eventually results in larger percentage fare increases with their concomitant adverse effect on ridership. Because of the prevalence of fare discounts in alternative fare media, the following paragraphs describe the incidence of discounting practices.

Discounts for Special Services

No discounts for special services are offered in heavy rail systems, while commuter rail services offer discounts over base fares only in local service. The most frequent discount for special service is the CBD circulator service which shows up in 21.6 percent of the bus systems and in 25 percent of the light rail systems responding to the APTA survey. The most frequent special service discounts in bus systems concern feeder service and parking lot shuttles, with each appearing in 3.8 percent of the systems, transit mall and shopping shuttles at 4.4 percent combined, and university service at 2.4 percent. Discounting the fare for these special services is warranted if the services are provided during the base period, but that is not always the case.

Discounts for Passes

One of the findings of the UMTA/SMD demonstrations of the late seventies and early eighties concerned the futility of offering large discounts on pass media. The reason for the futility is that offering large discounts on passes results in the cannibalization of the cash riders, which shift their purchases to passes to take advantage of lower fares and result in net cash losses. Fortunately, the findings of the UMTA/SMD demonstrations appear to have been taken into account in the current pricing policies of pass programs. Sixty-seven percent of the bus systems have passes, whose median price multiple is 35 rides a month. This is slightly under the approximate range required to avoid large cash revenue losses. Comparable monthly pass price multiplies for heavy rail are 38 monthly rides, and for light rail the median price is 36 monthly rides. Only in the commuter rail monthly passes, where median price is 28 rides, is the pass price policy likely to result in large cash fare revenue losses.

Weekly passes show median prices of nine weekly rides for motorbus and commuter rail systems, ten weekly rides for heavy and light rail systems. Again the discount appears appropriate and will not result in major revenue losses.

Discounts for Tickets, Token, and Cards

According to the APTA 1993 Fare Survey, the median price for ticket and token programs is as follows: 10-trip instruments have median discounts of ten percent for buses, 11 percent for heavy and light rail, and 13 percent for commuter rail systems. The 20-trip instruments have median price discounts of ten percent for bus, light rail, and commuter rail systems. These discount rates appear appropriate in normal cases, but not when the desire is to apply deep fare discounts via 10-trip tickets and 10-token packs.

Social Discounts

Single-trip reduced fare discounts are offered to a variety of population groups that are deemed to require special financial assistance on the part of governmental decision makers. These groups include senior citizens, disabled persons, and students. Most of these fare discounts are offered at all times of the day, rather than restricting them to the less expensive base period where there is excess capacity. Seventy-six percent of all bus systems offer reduced fares at all times of the day for senior citizens and disabled persons. In only 15 to 17 percent of the bus systems are reduced fares restricted to weekday non-peak hours for both senior citizens and disabled persons. Only less than two percent of the bus systems restrict reduced fares to weekday non-peak hours for elementary and secondary school children. In the case of senior citizens, 56.4 percent of the bus systems offer discounts ranging from 46 to 54 percent of base fares, with another 11 percent of the systems offering fare discounts of 62 to 70 percent of base fares. There is no appreciable departure from these ranges for heavy and light rail systems. However, more frequent time-of-day restrictions and smaller fare discount levels appear in the case of commuter rail systems.

While most of the social discounts are mandated by legislation, such as the Urban Mass Transportation Act of 1972, as amended, the time has come to ask whether the revenue losses from the social discounts should be restricted to times of day where there is excess capacity

or whether the social discounts should be considered mainly as one of the strategies to divert disabled and senior citizens from the expensive demand-responsive systems into fixed bus accessible transit systems.

There are two opposite schools of thought regarding social discounts. The first view, reflected in the Urban Transportation Act of 1972, as amended, is that in exchange for Federal government subsidies to the local properties, reduced fares be extended to needy segments of the population such as senior citizens and disabled persons. A second school of thought argues that transit properties provide a very poor job in targeting the really needy and that the role of transit at the most should be to provide "user side" subsidies, such as transportation stamps to social service agencies for selling to their client population. I confess a professional bias in favor of the second school of thought.

Promotional/Business Discounts

Promotional discounts are generally offered to new movers into the transit service area and perhaps to choice riders that can be identified through the mail. While promotional discounts show poor retention rates after the promotional period is ended, they should nevertheless be an integral part of a marketing program. More difficult to justify are discounts offered for shopping, transit mall, and other such trips unless the retailers finance a large part of the discount, or unless the trips are taken during the less expensive off-peak hours.

Free Transit

The benefits and costs of free transit services were the subject of several studies and demonstrations in the seventies. A 1970 pathbreaking study by Charles River Associates (*9*) concluded that given the low fare elasticities that characterize transit, the revenue losses would not be compensated by savings in fare cash collection costs and that only a limited amount of new or generated riders would be attracted to the free transit service. UMTA/SMD demonstrations of free transit service in Denver and Trenton during the seventies confirmed the Charles River earlier conclusions. The demonstrations found a very large number of teenagers and school kids taking free "joyrides" and that few adult riders taking essential trips were generated by the free transit experiments.(*10,11*)

FARE MEDIA AND DISTRIBUTION METHODS

The effectiveness of fare media depends on designs that are fraud-resistant and on the distribution methods. The convenience afforded by prepayment systems is significant. Prepayment media offered at no discount generally achieve penetration rates of 8 to 12 percent of all ridership. Monthly passes priced at 28 to 30 monthly rides achieve penetration rates of approximately 50 percent, but at a high cost in terms of diverted fare cash revenue losses. It is important to note that prepayment offers benefits to the transit riders who purchase it. The most effective option for avoiding fraud in fare media is through the use of magnetic cards and magnetic fare collection equipment, a topic discussed later in this section.

Prevailing Distribution Methods

Some 58 percent of the bus systems responding to the APTA fare survey used the transit headquarters to sell fare media while 54 percent reported using retail outlets. Further, 51 percent of the bus systems had mail distribution programs while 25.1 percent of the systems had employer outlet programs.

In the case of heavy and light rail systems, most of them used retail outlets including 76.9 percent for heavy rail systems to sell fare media, followed by outlets at transit headquarters. Fifty-three percent of these heavy rail systems used mail distribution and 31 percent had employer outlet programs. In summary, there has been a significant growth in the distribution of fare media through non-traditional methods since the early eighties when mail and employer programs were basically non-existent.

Similarly, 12 percent of the bus systems accept credit card payments, proportion which rises through heavy rail, 23.1 percent, light rail, 50 percent, and commuter rail 70.6 percent. Thus, there has also been significant growth in the use of credit cards as payment methods. Selling fare media through automated teller machines (ATMs) is in its beginning stages: five commuter rail systems, four bus systems, two heavy rail, and two light rail systems use ATM. This proportion should be promoted to increase since it is an effective distribution method.

Number of Location of Outlets

One of the usual reasons for the failure of prepayment plans to achieve significant ridership penetration is that not enough outlets are provided or that they are inaccessible. In Cincinnati, only nine outlets were available for distributing the monthly pass in 1982, a factor which led to penetration rates below 12 percent for the monthly pass.

Table 4 presents information on outlets and prepayment instruments sold in selected transit properties. Most of the properties with large numbers of outlets depend on a

vigorous program of employer outlets. Other aspects of prepayment distribution include policies on consignment fees and types of outlets.

Types of Outlets: Transit Versus Employer/Public Outlets Versus Direct Mail Distribution

Methods of selling prepayment instruments involve transit-operated sales outlets, public and employer sales outlets, public outlets with sales contracts, direct mail order, telephone order, pre-authorized bank payments, and automatic vending machines.

The general view of the effectiveness of these sales methods is that the choice between them depends to some extent on the volume of sales at each outlet. Figure 1 presents standardized costs at 11 American transit properties, showing that with the exception of sales contracts that provide variable commission rates, sales distribution methods exhibit economies of scale at relatively low sales volumes. At high volumes all five methods have constant average costs.

As shown in Figure 1, telephone order and direct mail programs are relatively expensive programs to operate with little or no economies of scale. In order to make them cost effective, they should only be employed at low volumes and marketed to those transit users without access to the less expensive sales outlets.

Depending on the sales commission rates asked by public and private sales outlets, it may be less expensive for the transit company to staff and maintain a sales outlet if high outlet volumes are obtained. Generally, a staff-operated outlet is less expensive than public outlets charging more than 2.5 percent in commissions only at volumes of more than 10,000 pass sales per month. Because few staff-operated outlets meet this test, most staff-operated outlets must therefore be judged and justified on grounds other than pass sales.

Employer-Based Programs

The early eighties showed an extensive UMTA/SMD effort in promoting employer-based marketing programs.(*12*) The employer-based programs consisted of selling fare media—monthly passes, but also tickets—through employers. In some cases, the employee would pay for the fare media through payroll deductions, in other instances they could purchase the fare media directly from a company employee, specifically assigned the fare media selling function. The normal discounts on monthly passes and trip tickets were usually applied. The experience with employer-based programs was that they were expensive to administer unless only large firms were targeted. The costs of selling fare media through employers were several times the multiple of selling them through transit outlets or even large volume retailers and banks at 1 to 2 percent commission.

Employer-based programs are also used in areas subject to pollution containment plans. In these cases, the employers are required to subsidize transit fare media at amounts comparable to the subsidization of parking by the employer. In summary, only in cases of large employers or in air pollution containment areas are these programs effective.

A recent development in this regard is contained in the energy bill passed by Congress on October 8, 1992. Under this bill, employers may provide up to $60 per month in tax-free transit benefits to their employees. The $60 monthly cap is equivalent to the average cost of commuting by transit nationally. The same bill places a cap of $155 per month on the tax-free parking privileges previously provided by employers to employees without any previous limit or cap. While just a few years ago, employers could provide their employees unlimited tax-free parking benefits, the restriction of the parking cap to $155 per month is still too high; it is by no means equitable in comparison to the $60 cap for transit, since only in a few large metropolitan areas are parking charges in the range of $155 per month.(*13*)

Electronic Fund Transfers (EFT) and Other Billing Methods

Selling fare media through EFTs (pre-authorized payments, etc.) is still at a infancy. A UMTA/SMD demonstration of prepayment distribution methods in Sacramento found that the costs of pre-authorized payments were the highest of all the distribution methods demonstrated.(*14*) There is a need to research the costs of EFT and other distribution methods and compare them with more conventional methods.

Current Fare Collection Equipment Capabilities

Most of the transit systems still rely on tokens and in non-magnetic passes and single trip tickets. Use of magnetic coded cards is still insignificant except for heavy rail systems. For example, stored value magnetic cards are in use in 53.8 percent of all heavy rail systems while magnetic stored time cards are used by 15.4 percent of the same systems. In commuter rail, the comparable quantities are 11.8 percent for stored value magnetic cards and 5.9 percent for magnetic stored time cards. Only 4.5 percent of the bus systems use magnetic stored value and 0.7 percent use magnetic stored time cards.

TABLE 4 Supply of Outlets at Selected Transit Properties

Property	Location	No. of Outlets	Instruments Sold per Month	Instruments Sold per Month per Outlet
SEPTA	Philadelphia	92	76,870	836
Metro	Seattle	150	44,560	297
Tri-Met	Portland	109	19,870	182
MARTA	Atlanta	21	18,800	895
Ciy of Honolulu	Honolulu	66	23,995	363
MDTD	Miami	103	12,000	116
GRTC	Richmond	60	23,549	392

Source: Patrick Mayworm and Armando M. Lago, The Costs of Transit Fare Prepayment Plans and Their Distribution Systems, in *Transportation Research Record 972* (1984), except for the Richmond data, which was estimated by Ecosometrics for June 1989.

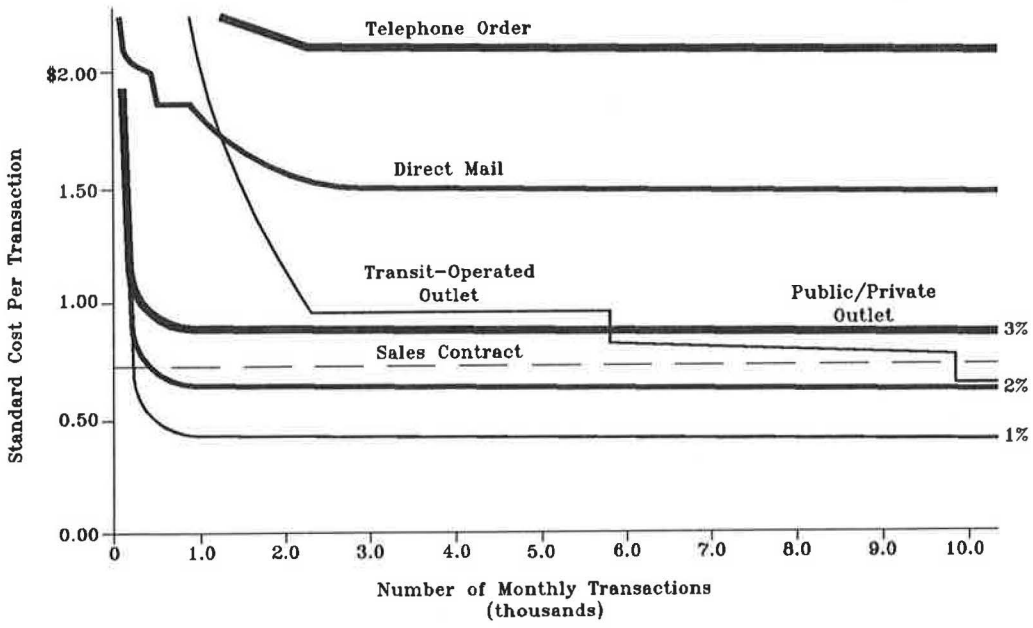

FIGURE 1 Comparison of average costs for five distribution methods at high sales volume (*16*).

The lack of fare collection equipment capabilities in most systems will make it difficult to apply the complex fare structure systems used in Western Europe, which include a combination of time-of-day and distance/zone fare structures. Forty-six percent of the heavy rail systems have magnetic card readers, while 23.1 percent have magnetic card swipe readers. But magnetic fare collection equipment is almost nonexistent in the bus, light rail, and commuter rail systems.

Regarding bus systems, 56 percent have electronic fareboxes and only three percent use cash-only vending machines, while one percent have ATM/credit card vending machines. Cash-only vending machines, which are used by 37.5 percent of the systems, and ATM/credit card vending machines, 6.3 percent of the systems, show only a limited presence on light rail systems. Only commuter rail systems show a significant proportion of ATM/credit card vending machines, with 35.3 percent of the systems reporting their use.

The fare equipment collection area would benefit from the attention and technical assistance supplied via the Federal Transit Administration (FTA). The same growth in non-conventional distribution methods of fare media that occurred in the eighties spurred by UMTA/SMD feasibility studies and demonstrations could happen in the fare collection equipment method if supported by a program of studies and demonstrations.

Transfer Policies and Effect on Demand

The effect of transfers on transit demand is a combination of three factors: 1) the level of transfer surcharges, 2) the number of transfers required on a trip, and 3) the transfer wait time. While the elasticity of demand for transit charges is approximately the same as the fare elasticity, the elasticity of transfer wait times and of the number of transfers is generally greater than the fare elasticity associated with transit surcharges. This topic has received little attention in the literature, yet its impact on transit demand is important. There is a need to estimate the elasticities of transfer times and the number of transfers and to analyze the effects of transit demand on service designs such as the pulse system and other designs that result in increased numbers of transfers. Demonstrations of alternative transfer service designs to analyze the cost-effectiveness of different systems is also needed.

As shown previously in Table 1, the 1993 APTA fare survey showed that 27.8 percent of the bus systems have transit surcharges and that 8.9 percent of these systems do not offer transfers. The extent of bus transfer surcharges is less in the other modes, such as heavy, light, and commuter rail.

Regulatory Framework for Transit Fare Policies

The cumbersome regulatory process that accompanies fare changes accounts partly for the lack of a systematic approach to conducting even bi-year (every two years) changes in fare levels. Most respondents to the 1993 APTA survey replied that fare changes are done when necessary rather than according to some periodic policy. One major contrast with utility pricing is that utility sector regulation is characterized by rate of return regulation, where the regulatory board ascertains the costs—capital and operating—of the utility firm and the pricing that is compatible with a specific and approved financial rate of return. Ever since the early seventies no transit properties have been able to achieve a positive rate of return on investment. The failure to achieve a positive rate of return on investment to cover equipment and investment needs of this industry eventually led to the public sector take-over of a transit service essentially supplied within the private sector.

Not being able to be regulated like a public utility, fare policy attention has focused on fare recovery targets. Most bus systems, some 64.3 percent, have no fare recovery targets or goals; however, fare recovery policies appear more frequently in heavy and light rail systems. Approximately 38 to 39 percent of the heavy and light rail systems do not have a fare recovery requirement or goal. Commuter rail systems fall between the bus and heavy rail systems.

Most of the efforts to impose a fare recovery requirement or goal follow from state governments, whose fare recovery targets apply to 54 percent of the bus systems subject to fare recovery targets, to 50 percent of the heavy rail systems, to 60 percent of the light rail systems subject to fare recovery policies, and to 62.5 percent of commuter rail systems. Transit systems boards are responsible for 25 to 32 percent of the fare recovery targets, depending on the type of system.

However, it is interesting to note that the fare recovery policies do not flow from any study of the benefits and costs of transit, that is, they do not flow from the "value of money" studies conducted in other counties like the United Kingdom (UK).(*15*) In the UK case, the benefits per dollar of subsidy are estimated for large and medium systems and the levels of transit subsidy—or the converse, the required fare recovery target—requirements are determined via an analytical process. Perhaps it is time to initiate these "value of money" studies in American transit properties.

TABLE 5 Summary of Gaps in Knowledge, Demonstration, and Research Needs

Concepts	Gaps in Knowledge	Demonstrations/ Experiments	Research Needs
1. Time-of-Day Fares	Elasticities by time-of-day	Demonstrations needed of a change from a flat fare system	Research studies on elasticities by time-of-day
2. Distance/Zone Fares	Elasticities by distance are unknown/uncertain	Demonstrations/evaluations are needed of a change from flat fare systems	Research studies of elasticities by distance/zone
3. Deep Discount Fares	Elasticities of occasional riders, purchasers of tickets and token packs	Demonstrations/evaluations of deep discount fare systems are needed (Chicago, Richmond, among others)	Research studies on elasticities of deep discounts
4. Effect of Transfers on Demand	Elasticities of no. of transfers and transfer times Effects of transfer systems on demand (pulse system, etc.)	 Demonstration/evaluations of transfer systems are needed	Research studies on elasticities are needed Research on transfer systems are needed
5. Fare Collection Equipment	Cost effectiveness vs. conventional fare collection	Demonstrations/evaluations of cost effectiveness are needed	Feasibility studies of fare equipment
6. Fare Recovery Policies	Value of money in American systems		Value of money studies

Strategic Changes: Preliminary Thoughts

The earlier comments suggest that some of the gaps in knowledge discussed in the previous Woods Hole conference remain. In addition, the lack of magnetic fare collection equipment in place will make it difficult to apply the complex fare revenue structures prevailing in Europe. There is also the danger of proceeding with fare collection technology for the sake of technology per se, without regard to their effects on the transit property costs. Some of the initial demonstrations of non-conventional fare media distribution methods, such as EFT, direct mail, and credit card charges, conducted in Sacramento by UMTA/SMD showed these new distribution methods as more expensive than the conventional methods. The strategy should then be to conduct demonstrations of the new technology for fare collections in actual settings and to estimate their cost-effective feasibility through independent evaluations.

The 1993 APTA fare survey has shown an appreciable gain in implementation of the UMTA/SMD demonstrations on pass pricing and fare media distribution conducted in the late seventies and early eighties. The FTA should take these survey results to show the promise of returns from their involvement in a new demonstration/evaluation/research program on transit pricing and fare collection. Table 5 presents a summary of the gaps in knowledge and demonstration needs.

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