CHOICE OF AN INITIAL FARE STRUCTURE FOR THE BAY AREA RAPID TRANSIT DISTRICT

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FOREWORD

The economics fraternity is heir to a healthy literature on public utility ratemaking. The concepts of marginal-cost prices, fully-dsitributed cost, long-run and short-run incremental costs and second-best prices are found in this literature. Dupuit told us long ago that if it costs society little to allow another person to cross a bridge then we should consider charging even a zero price for the crossing. Like Dupuit's, most discussions which survive in the literature are normative. Mr. Pozdena's contribution has the virtue of being positive. Pozdena went back to review the earliest planning documents on rapid transit fares (a 1956 report of the Stanford Research Institute). He discusses the legal guidance the San Francisco Bay Area Rapid Transit District had for fare determination and how the District proceeded from there to set fares. The paper has the further virtue of not simply reporting a final fare schedule but of reporting some of the alternatives considered by the BARTD staff, as much as an outside observer could know of the process of reaching a decision. BARTD's fare-setting motivation is discussed both as to its justification in light of institutional realities and as a means of accomplishing the popularly conceived objectives of transit. Four plans were considered: the flat fare, a distance-related fare, an automobile-competitive fare, and a multi-purpose fare. The final fare has a mileage component as well as a scheduled speed component. The traveller is charged a fare premium

at two cents per minute for each minute saved over the system average for a trip of the same length. Fares are reduced by two cents for every minute a passenger is taken out of his way.

This paper has a natural sequel: the comparison of fares and marginal costs. The theoretical optimal fare structure could not be reasonably presented without a more thorough knowledge of the cost structure underlying BART's services. According to economists, for example, the price charged the user should, under certain conditions, be equal to the marginal social cost incurred to produce the service. Whether the current BART fares are near this level, however, is a moot question until its cost structure is analyzed. Such a study is crucial to the normative aspect of fare impact analysis. A complete study of pricing such as this would contribute significantly to the understanding of transit's performance and potential in an automobile-dominated environment.

Nevertheless we have here the usual product of Pozdena's hand; a careful, craftsmanlike piece which is attentive to the legal environment, takes note of the organizational facts of life, and deals primarily with the economic issues. It is further characteristic of Pozdena in that it criticizes the District for certain facets of its pricing policy. These criticisms are his own. Sample fares for typical trips are included as well as a complete tariff.

Fares are an important policy parameter of urban transit systems. BARTD's fares seem to have been chosen on a criterion of revenue-maximization subject to the constraint of just meeting operating costs. Other urban rapid transit systems or BARTD at another time may have different objectives, e.g., patronage maximization,

maximization of auto patron diversion or marginal-cost pricing. It is interesting that the resultant fares are distance-related. Peak and off-peak differentials are appealing since the urban transportation problem, like many problems of public utilities are peak-loading problems. SRI in 1956 recommended peak and off-peak differentials, but they do not appear in the present fares. The concept of paying for time: a day, a month, or a year, regardless of distance travelled, used in some European cities, does not seem to have been attractive to the BARTD staff.

Leonard Merewitz

Table [1]

Sample Fares Bay Area Rapid Transit

	CR [a]	S&C [b] plan B 4	IBM [c] installation	SFBARTD [d]
	1962	1967	1971	1971
Berkeley to Montgomery St. (S.F.)	.50	.70	.75	.65
Richmond to Fremont	.85	1.00	1.05	1.10
Walnut Creek to S.F.	.70	.85	.95	1.10
Daly City to Concord	.95	1.00	1.05	1.20
Daly City to Montgomery St.	.25	.35	.40	.35

Source:

a Parsons Brinckerhoff et al.[7]

b Simpson and Curtin[8]

c BARTD Office of Research[9]

d San Francisco Bay Area Rapid Transit District[10]

fare systems, appears to be dominated by a concern for attaining optimum system revenues. They make a rather simplistic division of the fare analysis into level vs. structural aspects of fares. The level, they maintain, is primarily related to revenue while the structure is the realm within which the District may emphasize various social/economic impacts of the fare system. They analyze four different structures (flat-fare, distance-related, auto-competitive, and "multi-purpose") and within each of these structures analyze the sensitivity of patronage and revenues to the level of fares. A total of 33 different fare schedules were tested. The flat-fare and multi-purpose structures were not recommended because they could not produce enough revenue. The competitive structure produced 1.7 million more riders than the distance-related structure, but fell short of producing the same revenue by $1.5 million. The 30+3 and 30+4 mileage-based fares were the only levels of this structure that could meet the self-sufficiency criteria by 1975.[11] Thus although other structures and motivations were contemplated, the solvency requirement reigned supreme and eliminated 31 out of 33 contending fare schedules. It should be noted, however, that one of BART's analytical assumptions is that the demand for BART will be generally fare-inelastic with respect to mileage-based fares and that they believe that the level of fares within these structures could be raised and that the net effect on gross-revenues would be beneficial. This implies that the 30+3 and 30+4 structures and levels were not revenue maxima but that there was still some revenue-generating capacity left. Thus, the motivation apparent here is that structures were discriminated against on the basis of revenue-generating capacity but that the full revenue-productivity of the mileage-based fare was not exploited (i.e. the level was not optimized.)

The recommendation of the research staff in May 1971 was that the higher (30+4) fare be installed as a non-official fare to satisfy contracts with the turnstile manufacturer, IBM. However, the BART Administration Committee felt apparently that there is some "lock-in" effect that would be benefitted by inducing riders with the lower (30+3) level at first and raising the fares later in the operation if revenues were insufficient. It should be noted that most modal split studies find such lock-in effects to be non-existent. The Administration Committee also recommended at this time (May 27, 1971) that the structure of the fare-system be further explored to see if there was some developable aspect of the structure.[12] There was no indication of what the committee felt were the short-comings of the mileage-based fare, but perhaps the best indication is given by the changes made in the 30+3 structure for the final official comprehensive structure published on January 24, 1972. The basic formula adopted was as in Table 2. Table 3 contains the complete interstation fare schedule.

Table 2: Fare Structure Formula[13]

Mileage Component

Minimum fare for trips up to 6 miles:	30¢
Trips 6 to 25 miles long:	35¢ + 3¢/mi.
Trips over 25 miles long:	92¢ + 1¢/mi.
Transbay surcharge	15¢

Scheduled Speed Component

Trips faster than system average scheduled speed: premium per minute saved:	+ 2¢
Trips slower than system average scheduled speed: bonus per extra minute:	- 2¢

This modified mileage structure reveals cogently an attitude that has been prevalent in BART managerial decisions: "BART has other competitive

BASIC INTERSTATION FARE SCHEDULE

CONCORD	PLEASANT HILL	WALNUT CREEK	LAFAYETTE	ORINDA	ROCKRIDGE	RICHMOND	EL CERRITO DEL NORTE	EL CERRITO PLAZA	NORTH BERKELEY	BERKELEY	ASHBY	FREMONT	UNION CITY	SOUTH HAYWARD	HAYWARD	BAYFAIR	SAN LEANDRO	COLISEUM	FRUITVALE	LAKE MERRITT	MACARTHUR	19th ST. OAKLAND	12th ST. OAKLAND	OAKLAND WEST	DALY CITY	BALBOA PARK	GLEN PARK	24th ST. MISSION	16th ST. MISSION	CIVIC CENTER	POWELL	MONTGOMERY
.30																																
.30	.30																															
.50	.30	.30																														
.60	.45	.40	.30																													
.80	.65	.60	.50	.30																												
1.00	.90	.85	.75	.60	.45																											
.95	.85	.80	.70	.55	.35	.30																										
.95	.80	.75	.65	.50	.30	.30	.30																									
.90	.75	.70	.55	.45	.30	.35	.30	.30																								
.85	.70	.65	.55	.40	.30	.40	.30	.30	.30																							
.85	.70	.65	.50	.40	.30	.40	.35	.30	.30	.30																						
1.25	1.20	1.15	1.10	1.05	.95	1.10	1.05	1.05	1.00	1.00	1.00																					
1.20	1.15	1.10	1.05	1.00	.90	1.00	1.00	1.00	.95	.95	.95	.30																				
1.10	1.05	1.00	.95	.90	.70	.95	.90	.90	.80	.80	.80	.45	.30																			
1.05	1.00	1.00	.95	.80	.60	.90	.85	.80	.70	.70	.65	.55	.45	.30																		
1.00	.95	.95	.85	.70	.50	.80	.75	.70	.60	.60	.60	.65	.55	.30	.30																	
1.00	.95	.90	.75	.65	.45	.75	.65	.60	.55	.55	.50	.75	.60	.45	.30	.30																
.95	.85	.80	.65	.55	.35	.65	.55	.50	.45	.40	.40	.85	.70	.55	.45	.30	.30															
.90	.75	.70	.60	.45	.30	.55	.50	.45	.40	.35	.35	.90	.80	.60	.50	.40	.30	.30														
.90	.70	.65	.55	.45	.30	.50	.40	.35	.30	.30	.30	1.00	.85	.70	.60	.50	.40	.30	.30													
.85	.70	.65	.55	.30	.30	.45	.40	.30	.30	.30	.30	1.00	.90	.75	.65	.55	.45	.35	.30	.30												
.90	.70	.65	.55	.45	.30	.50	.40	.35	.30	.30	.30	1.00	.85	.70	.60	.50	.40	.30	.30	.30	.30											
.90	.70	.65	.55	.45	.30	.50	.40	.35	.30	.30	.30	1.00	.85	.70	.60	.50	.40	.30	.30	.30	.30	.30										
.90	.75	.70	.60	.45	.30	.50	.45	.40	.30	.30	.30	1.00	.90	.75	.65	.55	.45	.35	.30	.30	.30	.30	.30									
1.20	1.15	1.15	1.10	1.00	.80	1.00	.95	.90	.85	.85	.80	1.25	1.20	1.15	1.10	1.05	1.00	.90	.80	.75	.75	.75	.75	.70								
1.20	1.15	1.15	1.10	.95	.75	1.00	.95	.85	.80	.80	.75	1.25	1.20	1.15	1.10	1.05	.95	.85	.80	.70	.70	.70	.70	.65	.30							
1.20	1.15	1.15	1.05	.95	.75	.95	.90	.85	.80	.75	.75	1.25	1.20	1.15	1.10	1.00	.90	.80	.75	.65	.70	.65	.65	.65	.30	.30						
1.20	1.15	1.10	1.00	.90	.70	.95	.85	.80	.75	.70	.70	1.25	1.20	1.10	1.05	.95	.85	.75	.70	.60	.65	.60	.60	.60	.30	.30	.30					
1.20	1.15	1.10	1.00	.85	.65	.90	.85	.80	.70	.70	.65	1.25	1.20	1.10	1.05	.95	.85	.75	.70	.60	.65	.60	.60	.55	.30	.30	.30	.30				
1.20	1.15	1.10	.95	.85	.65	.85	.80	.75	.70	.65	.65	1.25	1.20	1.10	1.00	.90	.85	.70	.65	.55	.60	.55	.55	.55	.35	.30	.30	.30	.30			
1.20	1.15	1.10	.95	.85	.65	.85	.80	.75	.70	.65	.65	1.25	1.20	1.10	1.00	.90	.85	.70	.65	.55	.60	.55	.55	.55	.35	.30	.30	.30	.30	.30		
1.20	1.15	1.10	.95	.85	.65	.85	.80	.75	.70	.65	.65	1.25	1.20	1.10	1.00	.90	.85	.70	.65	.55	.60	.55	.55	.55	.35	.30	.30	.30	.30	.30	.30	

Fare Structure Formula:

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Note:
1) All fares are rounded to nearest 5c.
2) All fares to central business district stations in Oakland and San Francisco are rounded to a common fare.
3) Trips which begin and end at the same station entail the equivalent of at least two minimum fare rides and thus are charged 60c.

advantages which should lead to a marketing strategy that is not wholly dependent on price competition. The value of the BART trip to the passenger may be greater than by competitive mode. BART will often provide a faster line haul trip free of congestion and annoying delays, free from vehicle operational duties and in climate-controlled comfort."[14] Thus the scheduled speed component is an effort to exploit the supposed competitive advantage of BART in scheduled speed and travel time in an effort to wring more revenue out of the lower level fare structure.*

2. Analytical Weaknesses Inherent in BART's Fare Analysis.

It is relevant at this point to discuss whether the basic motives of BART have even produced a viable fare system. Without belaboring the theoretical issues too much, several flaws must be identified in the District's attempts to exploit the elasticity of the demand for BART travel in a revenue-optimizing sense:

1) The assumption of price inelastic demand for transit and the assumption that BART will be service-competitive with the auto are contradictory. The second assumption implies that the auto and BART are close substitutes, while the first implies that BART has some captive user population. This contradiction seriously impairs the believability of their patronage and revenue predictions.

2) In all of the District's comparisons of BART trip costs with auto trip costs, no allowance is made for the costs (out-of-pocket, time costs and inconvenience costs) which will be

*There may have been some equity considerations in this judgment as well. Because of the necessity of travellers on the Richmond line to spend extra time on the swing through downtown Berkeley and downtown Oakland on the trip to San Francisco, these trips are slower than average system speed over a similar distance.

> incurred by users in getting to BART stations. It is my opinion that the major portion of the perceived costs of transit are these non-line haul costs. Any estimates of modal split that ignore these costs would have to be skeptically accepted.

What of the basic motives themselves? Namely, how justified are the attitudes of the District toward fares first as a revenue-producing device and a [distant] second as a means of encouraging efficient and equitable utilization of Bay Area transportation facilities? Certainly within the strict confines of the Act, BART has done the only possible thing with respect to fares; the emphasis on the revenue productivity of the various structures would have been less important had the cost-inflationary events and the harsh realities of the patronage potential of BART not made even the lower bound of operating costs a serious upward constraint.

The mileage-based structure conforms to my basic preconceptions of an equitable allocation system in the sense that it penalizes (albeit at a diminishing rate) the abuse of scarce urban space. (Property in suburban reaches of the Bay Area is effectively moved closer to regional centers and property values will increase by some amount representing the capitalized value of these proximity benefits. In a rough income-distributional sense, those users, and non-users, receiving larger shares of the benefits should contribute a larger share to the system's operation. Some distance-related fare may be a roughly accurate benefit levy for users.) Inherent in the public view of a Bay Area Rapid Transit system, however, is a rather sophisticated perspective on the urban transportation problem: rapid transit should aid in correcting the misallocation of urban resources caused by the poor pricing and investment policies in automobile transportation.

Depending on what one feels to be the degree of deviation in this regard, one may encourage various second-best pricing schemes in transit. Generally, a transit price lower than its marginal cost may be justified to correct the modal imbalances so obvious, given contemporary automobile pricing policies. Since BART was sold as an instrument in the satisfaction of this goal, it must be noted that the District's performance with regard to fares contravene these efforts. Yet it must be admitted that given the physical design of the system and the legal constraints on the district, there is not much practical latitude available to BART's fare planners. The turnstile system, for example, does not have the capability to allow fares to vary with the time of day, as an economist might recommend for optimal utilization of the investment (although BART is currently assessing the re-engineering required to permit such peak-load pricing). Nor does the fare-collection system allow for convenient joint pricing when a patron is transferring to or from another transit system. Regardless of the theoretical attitudes of the BART research staff toward pricing under each of these circumstances, they are constrained by the turnstile technology. Similarly, the characteristics of the system itself may contravene planners' efforts to develop optimal pricing structures. While it may be desirable from an equity point of view to charge a higher fare to a Daly City patron embarking at the Daly City station (since his community has made no contribution to the fixed costs of the system), it is impossible to discriminate in a practical way between Daly City and San Francisco patrons since the station lies at the boundary of these two communities. Along with this constraining technology, the staff inherited a major solvency constraint. The financial conditions written into the BART Act, further limit fare

planners' options. It is not so much the fault of the current BART staff as it is the system's planners (who had a too myopic engineering view of rapid transit) that the system may fail to satisfy the public expectation.

FOOTNOTES AND REFERENCES

Footnotes

1. Stanford Research Institute Report to the San Francisco Bay Area Rapid Transit Commission, March 14, 1956, p. 87.

2. Ibid., p. 108.

3. Ibid., p. 89.

4. Ibid., p. 108.

5. San Francisco Bay Area Rapid Transit District, Interoffice Communication, "BART Interstation Fare Schedule Report," May 18, 1971, p. 13.

6. Telephone conversation, April 19, 1972.

7. Parsons Brinckerhoff-Tudor-Bechtel, The Composite Report: Bay Area Rapid Transit, SFBARTD, May 1962, p. 31.

8. Simpson and Curtin, Transportation Engineers, Coordinated Transit for the San Francisco Bay Area -- Now to 1975, final report, Northern California Transit Demonstration Project, October 1967, p. 159.

9. SFBARTD, July 1, 1971, p. 6.

10. San Francisco Bay Area Rapid Transit District, Exhibit A, December 20, 1971.

11. SFBARTD, May 18, 1971, p. 53.

12. SFBARTD, BART Interstation Fare Schedule, IBM Initial Installation, July 1, 1971, pp. 3-5.

13. SFBARTD, Executive Resolution No. 1871.

14. SFBARTD, May 18, 1971, p. 67.

References

Parsons Brinckerhoff-Tudor-Bechtel, The Composite Report: Bay Area Rapid Transit, SFBARTD, May 1962.

San Francisco Bay Area Rapid Transit Commission, Report to the Legislature, December 1957 (with Appended Stanford Research Institute Report to the Commission).

SFBARTD, BART Interstation Fare Schedule Report, May 18, 1971.

SFBARTD, BART Interstation Fare Schedule Report Supplemental Memorandum, May 26, 1971.

SFBARTD, BART Interstation Fare Schedule, IBM Initial Installation, July 1, 1971.

SFBARTD, BART Interstation Fare Schedule, January 24, 1972.

SFBATSC, Bay Area Transportation Report, May 1969.

SFBATSC, Supplement I, May 1969.

SFBATSC, Supplement II, June 1969.