The Use of Straw Men in the Economic Evaluation of Rail Transport Projects

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As Don H. Pickrell (1989) has shown, economic evaluations of federally funded rail systems have consistently underestimated capital and operating costs, often by large amounts, while overestimating future ridership and benefits. Halcrow Fox and Associates (1989) reached similar conclusions in a study of rail rapid-transit systems built in developing countries. The use of straw men by these studies may be the most serious flaw of all, however. Nearly all, if not all, assessments of rail transit systems have used costly and poorly designed all-bus alternatives to make the proposed rail systems appear better than they are. In some cases, the use of badly designed alternatives is intentional, while in others a lack of interest in developing better bus systems may account for the inadequacies of the all-bus alternatives.

Section I of this paper first describes a few of the ways in which Houston's regional transit authority, hereafter referred to as METRO, increased the projected ridership and apparent cost-effectiveness of proposed rail alternatives. These include the use of overly optimistic speeds and frequencies for the rail alternatives and the use of poorly designed all-bus alternatives with inflated capital and operating costs. The TSM (Transport System Management) all-bus alternative, which was used as the baseline system in all of METRO's rail transit evaluations, for example, had a network design and operating plan that mimicked the rail alternatives and exploited none of the technological advantages of the bus technology. The impact of this poorly designed all-bus alternative on the economic evaluation of the proposed rail schemes is illustrated by the use of "a Better Bus" alternative, which I developed for METRO.

Proponents of proposed rail systems frequently justify the choice of more costly and less cost-effective rail alternatives over more cost-effective all-bus alternatives by arguing that reductions in congestion and air pollution and other benefits associated with greater ridership justify the higher costs of these systems. For this reason, this paper presents projections of ridership for Better Bus on the assumption that the annualized capital cost savings from not building the higher-cost rail alternatives are used to reduce fares or increase service levels. The paper begins, however, with a brief discussion of 1987 and 1989 evaluations of proposed rail schemes by METRO.

I. METRO's 1987 Alternatives Analysis and 1989 Rail Research Project

In 1987, METRO completed an "Alternatives Analysis" of its proposed System Connector, a 12.6-mile facility that was to connect Houston's downtown to two major activity centers and four regional transit centers. Relying on several cost-effectiveness measures that emphasized annual operating costs, the METRO staff recommended light rail transit. METRO's board agreed. Soon thereafter, voters in METRO's service area "approved" a "revised service plan" that included the proposed rail system. Houston's Mayor, Cathy Whitmire, then appointed Robert C. Lanier to the METRO board. Lanier, a long-time rail opponent who helped sell the revised service plan to the voters, was elected chairman.

A few months after becoming chairman, Lanier became convinced that an exacting and "objective" reexamination of the system connector was needed. To complete this analysis, he created what came to be

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known as the "Rail Research Study" (TTI, 1989). Two features of this study were unusual and particularly significant: (1) the preparation of alternative ridership forecasts by Charles River Associates (CRA), and (2) the development of a Better Bus alternative (Kain, 1989). CRA was hired to prepare alternative ridership projections when questions raised by the peer-review group and others caused the METRO board to question the objectivity and reliability of the METRO's ridership forecasts. Better Bus became part of the study when several members of the peer-review group argued that TSM, the all-bus system used as the do-minimum alternative included in METRO's (1987) "Alternative Analysis," was a straw man.

METRO staff, in defending TSM, claimed that Urban Mass Transportation Administration (UMTA) guidelines required that the build alternatives should be as similar as possible, arguing that "*this consistency is necessary to ensure that the comparisons between the alternatives is a fair one*" [emphasis added] (METRO, 1988 p. 6). Better Bus came into being when I argued that the staff's position was wrong, and that the all-bus system used as the baseline in the study should be the best possible (highest ridership) system that could be provided for a given operating subsidy. METRO's board, apparently somewhat persuaded by this line of argument, asked me to develop a "Better Bus" alternative.

As a first approximation, TSM was a rubber-tired version of the proposed rail-system connector. It required all transitway express buses from the north, west, and southwest parts of the metropolitan area to stop at one or more of METRO's regional transit centers, where most passengers were forced to transfer to the System Connector. Better Bus replaced TSM's flawed operating concept with a scheme that provided no-transfer service for all transitway express-bus users to downtown and to Houston's three major activity centers (Greenway Plaza, Uptown/Galleria, and the Texas Medical Center). The design of Better Bus was strongly influenced by Houston's rapidly evolving transitway system. In Houston parlance, transitways are fully grade-separated, barrier-separated high-occupancy-vehicle (HOV) lanes located in the center of the region's radial freeways. These transitways, which permit express buses, vanpools, and carpools to operate at speeds of 55 mph or better during the most congested parts of the day, are generally one-way, reversible roadways. The number of carpools using these facilities is strictly controlled to insure reliable, high-speed express-bus operations. METRO now operates 46 miles of transitway and expects to have completed 96 miles by 1995.

It would have been desirable to have begun with a completely clean slate in developing Better Bus. Because of serious time and resource constraints, however, METRO's TSM alternative was used as the starting point. The most obvious difference between Better Bus and TSM, is the much larger number of express-bus routes in Better Bus and, in particular, 52 new express-bus routes that would provide direct and normally nonstop service between METRO's Park & Ride lots and Houston's three major activity centers. Unnecessary stops at regional transit centers and forced transfers were eliminated for express buses serving these centers and the downtown. Individual users of these services benefited from more direct and faster journeys and from not being forced to make onerous transfers; provision of direct services to major activity centers reduced the number of buses entering downtown during peak hours and thereby reduced central-area bus volumes and congestion.

Better Bus's other major modification involved changes in the TSM local routes serving the South Rice and Northwest transit centers. More than half of the TSM local bus lines serving these transit centers ended there, even though hardly any users had these centers as their ultimate destination. Substitution of contract-operated minibuses for METRO standard buses on these routes made it possible to provide no-transfer services to the downtown and to two of the three major activity centers and to double frequencies on most segments of the original TSM routes, with no increase in system costs. Not surprisingly, these service improvements produced substantial ridership increases.

Data on operating costs per revenue hour show why substituting contractor-operated minibuses for standard METRO buses on low–moderate density routes is so attractive. METRO analysts and their consultants estimate that the operating costs per hour for contractor-operated minibuses in 2010 would be less than half as large as those for METRO-operated standard buses. While minibus capacities are also about half those of a standard bus, this smaller capacity is not a disadvantage on many low–moderate-density routes, as passenger loads are often less than minibus capacity. In spite of the substantial increases in ridership achieved by Better Bus, there remains considerable scope for further improvements. The unmodified local lines accounted for about half the projected boardings.

II. Rail-Research Study Ridership and Cost Forecasts

Development of Better Bus produced a competitive response. The METRO staff included a number of its features in the TSM and rail alternatives they developed for the Rail Research Study and even began to develop several "Best Rail" alternatives. Of the Better Bus features METRO staff appropriated for their improved TSM and rail alternatives, the most important were the use of minibuses and substantial reductions in the numbers of forced transfers. As a result of improvements inspired by Better Bus, projected 2000 ridership for the TSM and Grade Separated Rail (GSR) alternatives included in the Rail Research Study were 11.1-percent and 11.4-percent greater than for the same alternatives in the METRO (1987).

The choice of forecasting model has a huge effect on the Rail Research Study rankings of Better Bus and GSR in terms of ridership. When the METRO forecast was used, projected GSR ridership was 5.6-percent greater than projected Better Bus ridership. When the CRA model was used, however, Better Bus projected ridership was 5.2-percent greater than GSR ridership. Almost all of the differences in forecasts are explained by the use of smaller transfer penalties in the METRO model. The Rail Research Study peer-review group found that the transfer penalties used in the METRO forecasting model were too low and urged METRO staff to increase them. They refused.

Total costs per trip for the GSR alternatives included in the Rail Research Study are significantly larger than for either TSM or Better Bus for both the METRO and CRA forecasts. Comparisons of Better Bus and TSM are more mixed. Total cost per trip for Better Bus is less than for TSM when the METRO ridership forecasts are used but is slightly larger when the CRA forecasts are used. Both models obtained higher ridership for Better Bus than for TSM in 2000.

III. METRO's 1991 Alternative Analysis

METRO's board responded to the findings of the Rail Research Study by reversing its earlier decision to build the rail System Connector. Houston's Mayor Whitmire, unhappy with the board's decision, refused to reappoint Lanier and replaced him with a new chairman who was committed to building rail. Soon thereafter, METRO's staff began to develop a replacement rail scheme for the now discredited System Connector, and in February 1991 METRO released an UMTA authorized "Alternatives Analysis" for a 13.5-mile initial rail line between downtown and residential areas to the west.

METRO's (1991) Alternatives Analysis was similar to the Rail Research Study, in that it included both alternative CRA ridership forecasts and a Better Bus alternative. The Better Bus alternative appears to be a watered-down version of the Better Bus alternative I developed for the Rail Research Study. The best evidence of this proposition is the very much smaller role given to minibuses. While minibuses comprised more than 50 percent of peak-period vehicles in the Better Bus alternative I developed for the Rail Research Study, they were only 14.2 percent of peak-period buses in the

TABLE 1—ANNUAL RIDERSHIP AND UMTA COST-EFFECTIVENESS INDEXES IN 2010 BY ALTERNATIVE

A.

	Annual trips (millions)		
Alternative	METRO	CRA1	CRA2
TSM	84.9	99.9	93.3
Better Bus	88.8	108.0	101.0
Best Rail	93.7	108.0	98.5
SBB	88.2	107.2	100.2

B.

	UCEI relative to TSM		
Alternative	METRO	CRA1	CRA2
TSM	NA	NA	NA
Better Bus	$3.04	$2.42	$2.61
Best Rail	$5.87	$5.91	$7.80
SBB	$0.04	$1.07	$1.20

Source: METRO (1991 [tables 7-9 and 7-10]) and calculations by author.

Better Bus alternative developed by METRO for the 1991 Alternatives Analysis. In addition, while the 1991 assessment included alternative CRA ridership forecasts, they were given very little prominence. They were presented in chapter 7 of the report as "what if" or sensitivity analyses.

Comparisons of CRA and METRO ridership forecasts, shown in Table 1, indicate why METRO buried the CRA ridership forecasts. Best Rail 2010 ridership is about 5.5-percent higher than Better Bus ridership when the METRO model is used to project 2010 ridership; but when the CRA model is used, Better Bus ridership is either the same (CRA1) or 2.5-percent larger (CRA2) than Best Rail ridership, even though Best Rail capital costs were more than a billion dollars greater than those of Better Bus. The differences in CRA forecasts result from the use of different transfer penalties. CRA1 uses transfer penalties that are equivalent to those used in the 1991 METRO travel-forecasting model, while CRA2 employs larger transfer penalties for peak-period trips. CRA (1989) analysts argue strongly that a large body of empirical evidence supports using the higher transfer penalties.

Best Rail has the lowest UMTA cost-effectiveness index (UCEI) and the highest ridership of the four rail alternatives included in the METRO (1991) Alternatives Analysis. The UCEI, which is used by UMTA in assessing proposed capital projects, is the annualized cost per trip of attracting an additional rider to a proposed system relative to a low-capital-cost all-bus alternative, normally TSM. Costs for each alternative are the sums of annualized capital costs plus annual operating and maintenance costs minus annual travel time savings for transit riders. Differences in projected 2010 ridership have a large impact on the UCEI's. Using TSM as the baseline, the UCEI for Better Bus, which is $3.04 with the METRO 2010 ridership forecast, falls to $2.82 with CRA1 and to $2.61 with CRA2. The UCEI for Best Rail with the METRO's ridership forecast is nearly twice as large as the UCEI for Better Bus. Use of either CRA ridership forecast reduces the UCEI for Better Bus, and increases the UCEI for Best Rail.

IV. Streamlining Better Bus

When analysts want to improve the apparent cost-effectiveness of a preferred rail proposal, they frequently "gold-plate" the all-bus alternatives. METRO has been guilty of this practice in the past. To give but two examples, METRO overestimated the capital costs of the bus-way alternatives included in its 1983 Supplemental Draft Environmental Impact Statement for a proposed Southwest/Westpark corridor rail line by 70 percent, and it added a costly and ineffectual people-mover to the TSM and busway alternatives included in its 1987 evaluation of the System Connector (Michael Berryhill, 1984).

Analyses by METRO indicated that omitting the proposed Westpark Transitway would reduce Better Bus projected ridership by less than 0.3 percent, and omitting the Southwest Transitway extension would reduce projected Better Bus ridership by less than 0.5 percent. While removing these facilities from Better Bus had very little effect on transit ridership, it had a major impact on capital costs and cost-effectiveness. Row 4 of Table 1, labeled SBB for streamlined Better Bus, provides ridership and UCEI estimates on the assumption that neither project is built. As these data reveal, removing both facilities causes the Better Bus UCEI to plummet to four cents, when the METRO forecast is used, and to $1.07 (CRA1) and $1.20 (CRA2) when the CRA forecasts are used. It should be noted, however, that while the benefits to transit users alone are insufficient to justify building the Westpark Transitway and Southwest Transitway extensions, the combined benefits to transit users and carpoolers may be sufficient to justify these facilities.

The preceding calculations very likely underestimate the case for Better Bus. While I have no way of knowing how much the METRO staff may have degraded Better Bus for the 1991 Alternatives Analysis, analyses in Kain (1989) indicated that METRO inflated the operating costs of the Better Bus alternative included in the Rail Research Study by as much as 11 percent. The same report found that the GSR ridership projections used in the Rail Research Study would have been reduced by as much as 4.4 percent and 4.2 percent, respectively, if more realistic rail speeds and frequencies had been assumed for the forecasts.

V. The Choice of Base Line and Benefits from Carpools

According to METRO (1991 pp. 7–12), "the TSM alternative is used as the baseline" in the 1991 Alternatives Analysis because "it is designed to represent the most effective solution to transportation problems in the corridor without the construction of major new facilities." The SBB alternative (i.e., Better Bus without the two costly and ineffective transitway projects) has only slightly higher capital costs than TSM. This fact naturally leads to the question of why METRO did not use SBB as the baseline all-bus system. The most plausible explanation is the impact on the already high rail UCEI's. When SBB is used as the base line, the UCEI's for Best Rail become $9.27 (METRO), $172.83 (CRA1), and −$18.60 (CRA2); the UCEI for CRA2 is negative because in this case SBB has both lower annualized costs and higher ridership than Best Rail.

While METRO included the capital costs of the two ineffective transitways in calculating Better Bus's cost-effectiveness, it ignored the benefits of these facilities to carpoolers. Yet car-pools would use most of the capacity of these facilities, and METRO's 1991 Alternatives Analysis assumes that State Department of Highways and Public Transportation highway funds will pay the entire cost of the Southwest Transitway extension. Ignoring carpool benefits has a significant impact on the relative cost-effectiveness of the alternatives. Including car-pool users in the denominator of the UCEI reduces the cost for Best Rail and Better Bus to $5.96 per trip and $1.95 per trip, respectively (both are relative to TSM); the travel time savings that would accrue to car-pool users are ignored in these calculations.

VI. Using Capital Cost Savings to Lower Fares and Increase Service

While METRO's board agreed to consider alternative bus networks with the same annual operating costs as TSM (i.e., Better Bus), I was never able to persuade them that they should consider all-bus alternatives with the same annual subsidy cost (including annualized capital costs) as the proposed rail alternatives. Savings from not building ineffective capital projects could obviously be used to reduce SBB fares or to increase vehicle miles of service. It is fairly easy to estimate the approximate impact of these alternative policies on ridership and cost-effectiveness. The results of two analyses of this type are presented in Table 2. The top panel gives projected 2010 ridership assuming: (a) the annualized capital and operating cost-savings from not building the Westpark Transitway and the Southwest Transitway extensions are used to reduce fares and (b) that both this amount and the annualized savings from not building Best Rail are used to reduce fares. The bottom panel makes the same assumptions

TABLE 2—STREAMLINED BETTER BUS YEARLY RIDERSHIP IN 2010 WITH ANNUALIZED CAPITAL-COST SAVINGS USED TO REDUCE FARES OR TO INCREASE SERVICE LEVELS

	Annual ridership (millions of trips)		
Alternative	METRO	CRA1	CRA2
SBB	88.2	107.2	100.2
Fare reductions from:			
No ineffective transitways	92.7	111.8	104.7
Plus no Best Rail	106.0	125.4	117.5
Service increases from:			
No ineffective transitways	94.7	115.1	107.6
Plus no Best Rail	110.8	134.8	125.1

Source: Calculations by author.

except that the annualized cost savings are used to purchase more vehicle miles of service. By design, these assumed policy changes have almost no effect on the UCEI's, which are similar to those for Better Bus.

Using the savings from not building the two transitways for fare reductions would decrease average SBB fares from 91 cents to 78 cents (METRO), 80 cents (CRA1), and 79 cents (CRA2). The fares vary because part of the annualized cost savings must be used to purchase additional vehicle miles of service. If the fare elasticity (−0.359) implicit in the METRO model is used to project the ridership increases, these fare reductions would increase SBB ridership by 4.7 percent (METRO), 3.9 percent (CRA1), and 5.0 percent (CRA2). The forecast of SBB 2010 ridership obtained from the METRO model is only 0.8-percent less than the METRO ridership forecast for Best Rail. When either CRA model is used, SBB ridership exceeds Best Rail ridership by significant amounts.

Using the difference in annualized capital costs between the SBB and the Best Rail alternatives to reduce fares results in SBB fares of 40 cents (METRO), 48 cents (CRA1), and 47 cents (CRA2). When the METRO forecasting model is used, these hypothetical fare reductions would increase SBB ridership from 88.2 million trips per year (the base case) to 106.8 million trips per year. Moreover, when the CRA2 forecasting model is used, SBB ridership increases from 100.2 million trips per year to 119.4 million trips per year or by 19.6 percent. The METRO model provides the smallest SBB increase and the smallest percentage difference relative to Best Rail. Even so, projected SBB ridership is 13.9-percent higher than Best Rail ridership.

VII. The Impact of Service Improvements

The possibility of using minibuses for low–moderate-density routes has important implications for the amount of additional service that could be purchased with the savings in annualized capital and operating costs that would be realized from not building the Westpark Transitway and Southwest Transitway extensions and from implementing SBB instead of one of the more capital-intensive rail alternatives. The projections of SBB 2010 ridership shown in the bottom panel of Table 2 assume that the annualized capital cost savings are used to buy equal amounts of local and Park & Ride minibus services. METRO estimates of the per hour costs of these types of service are the same, but because the speeds of Park & Ride services are so much greater than those of local services, a given dollar expenditure buys more vehicle miles of Park & Ride than local service. The resulting projections further assume that each 1-percent increase in vehicle miles of service would cause annual transit ridership to increase by about 0.5 percent. This service elasticity, which is based on time-series ridership models I estimated for the Rail Research Study using Atlanta, Ottawa, and Houston data, is significantly smaller than the service elasticity implicit in METRO's actual 1980–1990 experience.

The first SBB ridership forecast shown in Table 2 indicates that using the annualized savings from not building the two transitways to buy additional vehicle miles of service would increase annual ridership from the 88.2 million trips to 94 million trips per year when the METRO forecasts are used. When the CRA2 forecasts are used, the number of trips increases from 100.2 to 106.9 million trips a year. When the savings from not building Best Rail are used to buy additional vehicle miles of service, SBB ridership increases to 111.3 million trips per year when the METRO model is used and to 126.5 million trips per year when the CRA2 model is used. Depending on the forecasting model used, the SBB alternative that supplies vehicle miles of service costing as much as the annualized cost of the Best Rail alternative would carry between 18.2 and 27.0 percent more transit passengers than the Best Rail alternative in 2010.

VIII. Conclusion

On December 7, 1991, Bob Lanier was elected Mayor of Houston. In his campaign Lanier promised to implement more cost-effective transit improvements and to use the savings for more pressing problems. Whitmire's support for the unpopular rail project and Lanier's opposition appears to have been the decisive factor in the election.

Less than two weeks after Lanier's victory, President Bush signed the Intermodal Surface Transportation Efficiency Act of 1991. Title III of the Act authorizes $5 billion over the six-year life of the act for new starts and includes a Congressional earmark of $600 million for Houston, "provided that a locally preferred alternative for the Priority Corridor fixed guideway project has been selected by March 1, 1992." This deadline gives Lanier very little time to persuade METRO to develop a cost-effective way of using the Congressional largess. As a result, there is a good chance that the strongly expressed preferences of Houston's voters for a cost-effective approach to improving transit will be frustrated. Worse yet, the bill contains earmarks for more than 40 other rail projects. Few of these projects have completed UMTA-approved alternatives analyses, and even fewer, if any, are as justified as Houston's Best Rail alternative.

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