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Developing a Cost Model for Privately Contracted Commuter Bus Service

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ABSTRACT

Provision of public transportation services by the private sector is often cited as a strategy for reducing transit costs and required subsidies. Attempts to compare public agency and private contractor service costs for transit operations of a significant size are complicated, however, by the small number of comparable services now being provided and by the difficulty of comparing estimates of public and private costs when only a portion of the service delivery system is being contracted. An approach is presented in this paper to remedy one aspect of this cost comparison problem by developing a cost model for privately contracted commuter bus service. This model permits the full service costs of a privately contracted commuter bus operation to be estimated. The model utilizes a fixed-variable expense approach to estimate cost, and is based on information obtained from actual commuter bus contractors for two large transit systems. Capital charges, which depend on vehicle use as well as vehicle cost and contract length, represent a major portion of service costs. The model was applied to three situations and the results were satisfactory; it estimated route costs within 2 to 12 percent of the average actual values in each case. The model performed much better than two previously developed models and appears satisfactory for its intended purpose.

Provision of public transportation services by contracting with the private sector has become an important process for urban mass transit. UMTA recently published a formal policy on private enterprise participation in public transit service delivery, and the current UMTA leadership is vigorously promoting the concept of private-sector service contracting. Although many large transit agencies have resisted service contracting and the concept is strenuously opposed by transit labor unions, it is an increasingly prevalent method of transit service delivery. In a recent nationwide survey conducted by one of the authors, it was found that 25 percent of all individual transit services, which represents 8 percent of all revenue vehicle miles, is provided through private-sector contracting.

The primary motivation for private-sector contracting is economic in nature. Public agencies that contract for transit service almost invariably do so because they believe that it saves money. The evidence on cost savings is limited in scope, however, because of difficulties in finding comparable public and private services and the problem of accurately estimating public agency service costs when only a portion of the service delivery system is being contracted. These problems have motivated attempts to construct improved cost models to estimate the differences in costs between public and private service.

Most research efforts to date have focused on developing cost models for public agency service and have directed their attention to peak-period services in particular (1-3). With a single exception (4), analysts who have used cost models to compare public and private service costs have given only cursory treatment to the latter, and have typically relied on price quotations from private operators as the basis for their private-sector cost estimates (5). This approach is understandable in view of the difficulty of obtaining detailed data from private operators, who are reluctant to make such information available because they are concerned about competition. However, the lack of a structural basis

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for cost estimation can easily lead to misleading and nontransferable results. The use of bid quotations for a specific service with particular operating parameters is no substitute for a structural cost model if the objective is to estimate private-sector costs in a variety of service settings under different operating scenarios.

In order to better understand private operator costs, an approach is presented to model the costs of privately contracted commuter express bus service. Only peak-period express bus services were chosen as the subject of the model, for several reasons. Such services have been identified as being unusually expensive to provide by public transit agencies because they utilize labor poorly; consequently, they are often cited as prime candidates for private-sector contracting. In addition, peak-period services cannot be adequately costed in either the private or public sector by using average cost methods. An all-day service with little or no peak period is perhaps appropriately costed with an average cost approach. However, for an operation that consists of only peak-period service, labor conventions, duration of the peak, and amount of service provided can all affect cost in a nonlinear fashion. Furthermore, even among peak-period services, differences in route length, deadhead miles, and type of equipment required can all affect costs in ways not adequately described through a simple cost-per-mile or cost-per-hour approach. Finally, because peak-period services are the most difficult services for which to develop cost models, there is virtually no information available on what reasonable unit costs are for contract services.

WHY DEVELOP PRIVATE-SECTOR SERVICE COST MODELS?

There are three important reasons why private-sector service cost models are needed, particularly for peak-period-only services. First, an agency that is able to use models to estimate the cost of private-service provision before putting a service out to bid can establish where contracting has the greatest potential for saving money before the fact. Most public agencies prefer not to solicit private-sector bids unless they are reasonably confident that significant cost savings will accrue. It is politically embarrassing to discover after the bids are received that no savings will accompany a shift to private-sector service. Moreover, the very specter of service contracting is almost certain to create labor complications, and an agency should be reasonably confident that contracting will yield significant financial benefits before it creates labor problems for itself.

Second, cost models enable an agency to verify, in a rough fashion, the plausibility of private operator bids. Private operators have been known to bid below cost in an effort to secure a contract that they believe will be in their long-term interest. In the short term, however, the contract may become so financially onerous that the operator will seek a rate adjustment or be forced to terminate its involvement, which would result in service disruptions and political embarrassment for the agency. In addition, a financially strapped operator is likely to cut corners, to the probable detriment of service quality. Public agencies can avoid these problems in advance if they can determine whether bid quotations are suspiciously low, and if they require detailed cost estimates from bidders to justify their proposed rates.

Third, private operator cost models can identify which factors most significantly influence service costs. With this knowledge, the public agency may be able to modify certain service parameters, or the bid requirements, to reduce costs. For example, if capital costs are a major portion of total service costs, then allowing a private operator to use less expensive (i.e., older) buses may reduce the costs to the public agency.

CURRENT USES OF PRIVATE OPERATORS FOR COMMUTER BUS CONTRACT SERVICES

Several public agencies in the United States are currently contracting with private bus companies for commuter express service. The largest such use of the private sector is in Houston, Texas, where the Metropolitan Transit Authority contracts for service for 75 buses on 6 routes. The regional transit agency of Dallas has recently begun contracting with a consortium of private companies (including Continental Trailways) for a 60-bus peak-period express service, and plans to expand service in the near future. Other notable examples of peak-period service contracting include the services sponsored by Golden Gate Transit (a subscription bus operation) and the counties of Los Angeles and San Diego. In addition, the city of Los Angeles will shortly begin contracting for express bus services that were previously provided by the regional transit agency. In addition to these competitively contracted services, franchised private operators in Boston, northern New Jersey, and San Mateo County, California, are subsidized by public agencies to continue operating commuter services that might otherwise be absorbed by regional transit operators.

Contract commuter bus operations tend to have a number of similar, distinctive features. The service is usually a park-and-ride type of operation, in which the bus picks up riders at one or two locations and then travels nonstop to its destination, which is generally a central business district (CBD). Service is typically provided only during peak periods, with a limited number of runs on each route (sometimes as few as two per peak period). Contractors are predominantly charter bus operators, who are almost always required to furnish the vehicles used for the service.

As a means of illustrating the characteristics of these privately contracted services in order to understand the operating environment that affects their economics, more detailed information on the Houston and Golden Gate operations is presented in the following sections of this paper. Another reason for describing these operations is that the participating private operators provided data that were used to estimate the parameters of the cost model, and the cost model itself was applied to routes in the two systems.

Houston Metro Contract Bus Program

The Metropolitan Transit Authority of Harris County, otherwise known as Houston Metro, has contracted with private bus companies in the Houston region since 1981 to provide a substantial portion of its express bus service into downtown Houston. The service is of a park-and-ride nature from suburban regions, mostly in northern Houston, that are accessible to the I-45 high-occupancy-vehicle (HOV) lane.

Houston Metro turned to the private sector because of its inability to expand its own operation rapidly enough to meet demand in its fast-growing and increasingly congested service region. The services were implemented in a short time with the aim of meeting the political demands for more commuter buses. The contract operation initially involved 120 buses on 12 routes with 430 bus runs daily. Five private operators were involved in providing service. The transit agency has recently absorbed some of the contracted services, and now only 75 buses operated by two service providers are involved. Routes vary in length from 15 to 25 mi, and essentially all service is provided during the two peak periods. Operating statistics for the contract operation as of 1982, when it was at its height, are summarized in Table 1.

At its height, the commuter bus program included most of the charter bus companies in the Houston region. The transit agency had a policy of awarding routes to all of the bidders because none was large enough to provide all of the service on its own; consequently, competitive pressures were minimized.

Three aspects of the Houston contract operation directly affect its costs, which, as can be seen in Table 1, are relatively high on a per-hour basis. The first aspect is the requirement that contractors supply their own vehicles. This means that Metro must pay the capital costs, which can amount to as much as 30 percent of total contract costs. Few of the buses acquired for contract services can be put to alternative uses during the day. Consequently, operators charge most or all of the capital costs of most of the vehicles to the contract operation. Moreover, the contracts are only for 2 years, so the capital costs must be written off quickly, which in turn adds to the contract cost.

TABLE 1 Total Daily Operating Statistics for Houston Metro Park-and-Ride Contract Services

Route	Operator	No. of Buses	Revenue Miles	Deadhead Miles	Cost/Revenue Vehicle Hour ($)
224	KV	8	777	148	67.02
112	KV	6	643	119	72.08
142	TEI	10	1078	199	83.50
263	7K	7	438	106	87.50
201	NL	13	1078	130	75.00
132	7K	8	642	159	87.50
204	TEI	10	1268	213	88.00
202	KV	13	2315	231	77.81
107	TEI	8	808	165	88.00
221	KV	4	532	100	99.02
270	KV	7	514	89	61.16
205	KV	13	1296	344	96.79

Note: KV = Kerville Bus, TEI = Transport Enterprises, Inc., NL = Northline, 7K = 7-K Bus Company.
Source: Houston Metro Contract Service Reports, May-Dec. 1982.

The second aspect is that Metro requires the use of over-the-road coaches or vehicles with a similar ride quality, and has a strong preference for relatively new vehicles. The result is that the vehicles are relatively expensive ($75,000 to $150,000 if they are new compared with at least $40,000 if they are used). The average vehicle age is about 7 years and the average vehicle value is in excess of $75,000.

The third aspect of the Houston contract operation is that the cost per hour is high because, although the contractors operate only during the peak period, they charge rates approaching those for all-day charter service. Metro saves little more than mileage charges over daily charter rates. Even though there are only about 4 hr of revenue service per bus per day, this time is spread over two peak periods, and there is not enough midday charter work for the drivers to schedule them for more than one piece of work per dispatch. The contractors therefore pay 8 hr of driver labor per bus per day, which is the equivalent of two driver dispatches. (Drivers receive a minimum of 4 hr of pay per dispatch.) Therefore, as is the case in public agency operations, driver labor is used inefficiently, although drivers often perform other tasks when they are not driving.

Golden Gate Transit Subscription Bus Service

The Golden Gate Transit District has been subsidizing privately contracted subscription bus service since 1971. Golden Gate Transit serves Marin and Sonoma counties to the north of San Francisco, and operates what is probably the most heavily peaked large transit operation in the United States. A 5-to-1 peak-to-base ratio reflects both the virtual absence of transit use by the area's affluent residents during off-peak periods and the heavy patronage of the transit system as a means of commuting to downtown San Francisco during peak periods. The severely limited highway capacity of San Francisco has made transit a strong commuting mode for the past 20 years.

A subscription bus service, organized by residents working in San Francisco, has been in place for many years. These commuter clubs have contracted with private bus operators to provide service since they were formed. The transit agency began subsidizing subscription services in 1971; in recent years, private operations have been absorbed into the agency's family of services, although the commuter clubs retain a role in service organization and financing. At its peak, the subscription bus program consisted of 27 daily round-trip bus runs that served 15 routes. Because of program cutbacks and the dissolution of some clubs as a result of work-site relocations, the program now consists of 18 daily subscription buses provided by two bus companies.

Subscription service is currently provided from 12 separate suburban locations, with from one to five bus runs per location; service is park-and-ride in nature. Routes vary in length from 20 to 60 mi, and most of the destinations are employment sites outside downtown San Francisco that are served poorly or not at all by the regular Golden Gate Transit commuter services. Service statistics for 1984 are summarized in Table 2.

Golden Gate Transit has devised rather elaborate bidding procedures for private service in an attempt to minimize costs and maximize the number of potential bidders. Companies bid on a minimum number of routes from a set of zones that are based on a series of 10-mi radii from downtown San Francisco. Adjustments to bid prices are based on actual route mileage and the size of the vehicle specified in the bid. In the past, the transit agency discouraged the use of vehicles more than 10 years old, but now older vehicles are allowed, although they are subject to a preservice inspection and periodic inspections once they are in service. The average fleet age is now more than 12 years; one contractor uses vehicles that are all at least 14 years old. Consequently, the average bus used in the service has a value of only about $50,000.

As is the case in Houston, the two contractors pay their drivers a minimum of 4 hr for any piece of work. One contractor in San Francisco found an opportunity to use excess driver hours in midday charter work, but this is an uncommon occurrence. Both contractors have attempted to locate drivers near the beginning of a subscription route; many of the drivers on these routes were hired because they live in Marin or Sonoma county. This practice minimizes deadhead time and distance, because the drivers park the vehicles near their residences overnight.

TABLE 2 Operating Statistics for Golden Gate Transit Contract Subscription Bus Service

Route	Operator	Origin	Round-Trip Miles	Round-Trip Cost/Day ($)	Cost/Revenue Vehicle Mile ($)
A-1	TransCal	Ignacio	54	190	3.52
A-2	K-G	Santa Rosa	119	262	2.29
A-3	TransCal	Greenbrae	40	151	3.77
A-4	TransCal	Fairfax	42	170	4.04
A-5	TransCal	Tiburon	42	180	4.26
A-6	K-G	Petaluma	87	266	2.60
A-7	TransCal	San Rafael	40	168	4.17
B-1	TransCal	Terra Linda	56	167	2.98
C-1-4	TransCal	Sonoma	100	218	2.18
D-1	TransCal	Peacock	49	177	3.59
F-1-5	K-G	Glenwood	49	225	3.59
H-1,2	K-G	Rohnert Park	106	246	2.28

Note: TransCal = TransCal Tours, K-G = K-G Bus Company.
Source: Golden Gate Bridge Highway and Transportation District.

COMPONENTS OF PRIVATELY OPERATED COMMUTER BUS COST

The cost of privately operated commuter bus services is a function of seven major component costs: (a) vehicle capital, (b) drivers, (c) maintenance, (d) direct operation (fuel and oil), (e) insurance, (f) administration and overhead, and (g) miscellaneous. The factors that affect these costs, and the range over which they vary, are discussed in the following paragraphs.

Vehicle Capital

Four types of equipment are used to describe the range of vehicle capital costs: the MC7 through MC9 over-the-road coaches built by Motor Coach Industries, Inc., (MCI) from 1968 through 1985; the General Motors Corporation (GMC) Suburban, built from 1963 through 1977; new transit-type coaches (Blue Bird City Bird); and new school-bus-type vehicles with air ride suspension (Blue Bird All American). MCI coaches represent the more recent over-the-road coaches, which are designed with charter operations in mind. The GMC Suburban is an example of an older, less expensive bus that is nonetheless suitable for contract operations. The Blue Bird buses represent two less expensive new vehicle options.

In general, the cost of a used bus varies with

- The condition of the bus;
- The availability of new buses;
- The general economic outlook, specifically the interest rate and the overall demand for buses; and
- The type of bus.

The cost range of the different types of vehicles is as follows:

Bus Type	Cost ($000s)
GMC Suburban	10-40
MC7 68-72	35-60
MC8 73-79	55-90
MC9 79-83	95-160 (new)
Blue Bird All American 80-83	48-85 (new)
Blue Bird City Bird 80-83	78-130 (new)

It should be noted that these are values for buses that are purchased new from dealers. Vehicles that have been owned and maintained by the operator since they were new will have greater value. GMC Suburbans are likely to have been rebuilt or refurbished, or both. If so, their value will be closer to the upper rather than the lower end of the indicated price range. Costs for Blue Bird coaches include the cost of charter-type reclining seats.

Drivers

There is a perception that private bus operators have substantially more flexibility than their counterparts in public transit agencies in scheduling and compensating their bus drivers. This is only partly correct. Although drivers for private operators do not enjoy the same generous work rules and benefits as do public transit drivers, there are definite restrictions on how flexibly they can be used, and particularly on the minimum amount of pay they are guaranteed. Work rules are more flexible in private companies and drivers routinely perform minor work tasks other than driving. In most charter bus companies, however, drivers are not compensated solely for actual hours worked in driving, but, as in public transit agencies, are usually guaranteed a minimum level of compensation that often exceeds actual working time.

Eight private companies in San Francisco and Houston that provided contract service were surveyed for their labor practices. All had a guaranteed minimum pay of 4 hr of work per dispatch, which applied to the transit agency routes as well as to other types of operations. (Private charter bus operators generally price their services to the public on a minimum rate per dispatch.) The wage rates vary, but in all cases a minimum compensation applies. Peak-hour express service almost always requires two dispatches; therefore, in most cases a full day's driver's wage must be paid (although two different persons may drive the route).

Hourly wages for bus drivers of contract carriers in Houston and San Francisco are as follows:

Operator	Avg Wage ($/hr)
Kerville Bus	8.50
Transport Enterprises	8.00
7K	7.00
Northline Bus	7.00
TransCal Tours	7.00
Western	6.75
Petersen	6.00
Average	7.18

Wages vary from $6.00 to $8.50/hr, with most operators paying $7/hr or more. Driver cost for the typical 8 hr pay, including benefits, averages about $75/day.

It is possible, but difficult, to bring driver costs below these levels. Some companies engage in buspool-type operations, in which the driver has a job at the trip destination and is therefore only paid for actual driving time. Because time constraints prevent many commuter express buses from making two round trips per peak period, this is often a practical option from a driver-scheduling viewpoint. However, service sponsors may be reluctant to approve such labor arrangements. Companies may also attempt to pay their drivers only for actual working time, but if they cannot find work outside the transit contract, this practice sharply reduces the pool of qualified drivers. Many potential drivers are unwilling to receive only 2 to 3 hr of pay per day, or to work an extreme split shift to obtain 5 to 6 hr of pay. Other types of part-time work are often more attractive. Most established companies have found that the minimum-pay guarantees attract better-quality drivers.

Another possibility for reducing driver costs is for the company to use the drivers on other work between the peak periods. In practice, however, it is difficult to generate charter business that requires the buses only during the time between contract runs. Moreover, even if such work can be generated, the driver will have to be paid for three dispatches, or 12 hr, because the a.m. and p.m. peaks and an intervening dispatch would encompass an 11- to 12-hr working day. Consequently, the contract services will still be allocated most (if not all) of two dispatches' worth of driver cost.

Maintenance

Maintenance costs show a definite relationship to the age of the vehicle fleet. Recent data for both large intercity carriers and small, predominantly charter bus operators indicate an average maintenance cost of $0.21/mi, but this will vary depending on fleet age. An instructive comparison is between two operators with large differences in fleet age. Commuter Bus Lines is a buspool operator based in Los Angeles whose fleet consists primarily of older GMCs with an average age of approximately 25 years. Maintenance expense is relatively high at $0.32/mi. This is probably an upper bound on maintenance costs for express service using intercity-type buses, because this company was going through major fleet rehabilitation during the period for which the data were collected. In comparison, Kerville Bus is a Houston charter operator with an average fleet age of approximately 8 years. Their maintenance expense is listed at $0.213/mi. This figure is comparable with the average for large private carriers.

Maintenance costs for three operators who were surveyed by the authors in the course of an UMTA-sponsored study regarding contract transit operations and the results of a United Bus Owners of America (UBOA) survey of 40 of its members are as follows (UBOA members own an average of 30 vehicles, with an average fleet age of 8 years):

Operator	Cost per Mile ($)
Kerville Bus	0.213
Northline Bus	0.20
TransCal Tours	0.21
UBOA	0.21

Insurance

In recent years, insurance costs for bus operators have fluctuated substantially. Insurance costs depend on the value of the vehicle, the condition of the bus, the size and age of the bus company, and the loss experience of the operator. In addition, insurance costs are sensitive to the amount of excess coverage, self-insurance limits, and deductibles. Currently, liability costs are approximately $2,000 to $3,000 per year per bus, assuming a relatively high level of self-insurance. Coverage for vehicle damage is $3,000 to $4,000 per year per bus for a medium-value bus. Premiums for small operators are on the high end of the scale, and all costs depend on the ability of the insurance broker to obtain the best possible deal from underwriters.

On the basis of survey data and information from Southern California bus fleet insurance brokers, the following costs were used for insurance: high vehicle cost, $4,000 per bus per year; medium vehicle cost, $3,000 per bus per year; low vehicle cost, $2,000 per bus per year. The differences represent the variance in collision insurance rates for vehicles with different monetary values. These insurance costs represent 1983-1984 conditions, because the other cost components were estimated from data for this period of time. Current insurance rates are typically at least 50 percent greater.

Direct Operation

Direct operating costs consist of fuel and oil. These costs depend on the fuel efficiency of the bus, but most buses have relatively similar fuel consumption rates. On the basis of data from several sources, direct operating cost is estimated at $0.20/mi.

Administration and Overhead

Facilities rental, clerical assistance, project management, supplies, contract services (e.g., custodial), and general overhead combine to form administrative and overhead costs. Data from San Francisco and Houston operators and from the survey of UBOA members were used to estimate this cost component at $9,800 per year per bus; these costs do not vary with the amount of service produced. A summary of these costs for two Houston contract operators and the UBOA survey respondents is as follows:

Operator	Cost per Bus per Year ($)
Kerville Bus	9,700
Northline Bus	10,300
UBOA members	9,800

Certain administrative and overhead expenses depend on amount of service (e.g., supervision expense, taxes, and licenses) and these are included with the miscellaneous costs.

Miscellaneous

Miscellaneous expenses are composed of three major cost items: supervision, operating taxes and licenses, and other miscellaneous costs.

Supervision costs are assumed to be mileage-related because the number and the length of the trips required are directly related to the need for supervision. The costs for supervision are based on data procured from three operators (TransCal Tours, Northline Bus, and Kerville Bus). Their estimates of this cost item ranged from $0.043/mi to $0.051/mi. The average was $0.047/mi.

Operating taxes and licenses are assumed to vary with mileage, because in many states annual license fees vary with bus mileage, and fuel taxes depend on miles driven. Based on the UBOA membership survey and figures provided Kerville Bus and Northline Bus, these costs are estimated at $0.085/mi.

The category of other-miscellaneous costs consists principally of contract maintenance labor and is based on data from the same sources as the foregoing data. These costs vary from approximately $0.05 to $0.03/mi with an average of $0.013/mi.

BUS OPERATIONS MODELING CONVENTIONS

Private- and public-sector bus companies employ relatively similar modeling conventions to estimate operating costs. In general the models use the following components, either alone or in combination:

Public Sector	Private Sector
Mileage costs	Wheel costs
Hourly costs	Hourly costs
Pullouts	Dispatch costs
Peak vehicles	

In both the public and private sectors, mileage-related methodologies are generally used to estimate costs that vary with the distance the vehicle travels, notably maintenance, fuel, oil, tires, and certain miscellaneous costs. In the private sector, mileage costs are referred to as wheel costs. In the public sector, hourly cost factors typically model labor costs, especially driver labor, and pullouts and peak vehicles reflect the costs related to operating a highly peaked service. This aspect of a model is used to load costs associated with the administrative and labor burden of peak-only services. In general, in public-sector cost models, hourly, mileage, pullout, and peak-vehicle components are combined.

Private bus operators use the dispatch cost convention to quote prices in blocks of time. Dispatch costs are usually for a minimum of 4 to 5 hr of service, even if the actual required work time is less. In addition, a customer may have to pay mileage charges, at least for any miles beyond a predetermined limit (typically 100). Thus private operators also often combine components to cost out services.

PREVIOUS PRIVATE COMMUTER BUS COST MODELING EXERCISES

Two earlier efforts to explicitly model private operator costs for peak-period commuter services have been published. The first model is a one-variable mileage cost model developed by the Southern California Association of Governments (SCAG) in a study of potential cost savings of peak-period service contracting (2). SCAG requested private operators in the Los Angeles region to provide cost quotations for a number of routes in Los Angeles and Orange counties that could be contracted out to the private sector. The survey requested operators to supply only a total cost for each route, not a breakdown of costs. On the basis of operator responses, it was determined that it would cost an average of $2.79 per revenue vehicle mile to provide the peak-period service in question. This model is obviously not sensitive to the fixed-variable nature of private operator service costs or to the influence of type of bus on cost, nor does it explicitly include deadheading considerations.

The second private-operator model is a marginal cost model developed by Herzenberg in a master's thesis at Massachusetts Institute of Technology (4). Herzenberg compared the costs of 12 bus routes operated by the regional transit agency in Boston with the costs of operating the same routes in the private sector. Two Boston-area private bus companies, Hub Bus Company and Gray Line of Boston, were used to model private-sector costs.

Herzenberg developed private-operator cost models from data she obtained from the two companies. She assumed that only the marginal or incremental cost of operating the routes was relevant. As a result, the routes were assigned no administrative costs. The models developed are as follows:

$$OCG_R = 10.96\ PH_R + .321\ VM_R + 2V_R$$

$$OCH_R = 5.20\ PH_R + .506\ VM_R$$

where

OCG_R = operating cost for Gray Line to operate route R ($/day),
OCH_R = operating cost for Hub Bus Company to operate route R ($/day),
PH_R = platform hours associated with route R (hr/day),
VM_R = vehicle miles associated with route R (mi/day), and
V_R = total number of vehicles needed to operate route R.

These costs do not include vehicle capital costs or insurance; Herzenberg used lease costs for buses to estimate capital costs. When the results of this model were compared with those of others, Herzenberg's maximum cost for vehicles ($97.50/day) for capital and insurance was assumed. This was the figure cited for new buses that can be leased. However, the term of such leases is usually 7 years, and this figure is therefore questionable for a contract with a 2- or 3-year term.

DEVELOPING AN ORIGINAL COST MODEL

In the development of a private-sector cost model, care should be taken to explicitly include all major sources of cost difference inherent in the operating parameters of contract commuter bus operations. In particular, capital cost differences based on equipment specifications, the length of the contract, and the use of the vehicle outside the contract should be included. The model should also treat cost components as variable with hours or miles or both only if they are truly variable and not relatively fixed for an operating day.

These considerations are best incorporated within the framework of a utilization-adjusted fixed-variable cost model. This model is similar to conventional transit agency cost-allocation models in that a mileage category--wheel cost--as well as a dispatch-cost category, which is similar to the public-sector pullout or peak-vehicle category, are used. In this model the following assignments of cost components will be made to the dispatch-cost or the mileage category:

Dispatch Cost	Mileage Cost
Equipment	Maintenance
Administrative	Fuel and oil
Driver labor	Miscellaneous
Insurance	

The dispatch component of this private-sector cost model is attractive also because it provides for the allocation of fixed costs on the basis of vehicle use. The level of charter demand relative to contract demand is the basis for making estimates of vehicle use. As the level of charter demand increases, the proportion of the daily fixed costs that must be allocated to the contract is reduced. In allocating such costs, a simple assumption is made: If the proportion of contract revenues to total revenues is less than 50 percent, then a high-use situation is in effect and fixed costs will be allocated 50 percent to the transit contract and 50 percent to other dispatches. That is, as the percentage of contract revenues relative to total revenues increases, there is a decreased likelihood of other uses for vehicles for contract service, and vice versa. Therefore, a distinction between high and low use will be made within the dispatch-cost category. This will apply to all fixed costs except driver labor, which does not vary on this basis because drivers will generally be paid a full day's (8 hr) rate for working commuter services.

In the model, vehicle capital costs depend on the age of the equipment, which is represented by three different cost levels derived from the information presented previously on the price of buses from dealers:

Level	Vehicle Cost ($000s)
High	95-160
Medium	55-90
Low	10-60

The model differentiates among capital costs for 2-, 3-, and 5-year contracts; the 5-year contract is assumed to apply only in situations where the contractor supplies high-cost vehicles.

The following method was used to determine daily vehicle capital costs:

1. On the basis of discussions with Borg Warner Acceptance--a company that has leased vehicles to commuter bus transit operators--a residual value of 67 percent of the original cost was used for a lease period of 2 years, 60 percent for a 3-year lease period, and 50 percent for a 5-year lease period.
2. An interest rate of 15 percent was used because the Houston and San Francisco contracts had been awarded during the period when interest was at this level or higher.
3. The cost of vehicles used is the mid-range of the foregoing cost levels, namely, high cost, $127,500; medium cost, $72,500; low cost, $35,000.
4. The capital recovery method is used and the duration of the contract determines how much of the cost will be allocated to each year.

The results are summarized in Table 3; 255 operating days per year are used.

TABLE 3 Daily Capital Costs for Different Vehicle Costs and Contract Lengths

Initial Vehicle Cost ($)	Contract Length (yr)	Salvage Value ($)	Cost/Day ($)
127,500	2	85,170	152
127,500	3	76,500	132
127,500	5	63,750	121
72,500	2	48,430	86
72,500	3	43,500	75
35,000	2	23,380	41
35,000	3	21,000	37

The dispatch-cost portion of the model uses a cost per bus per day to reflect the fixed charges of supplying commuter bus service. Thus insurance and administrative and overhead costs are converted from an annual cost per bus to a daily bus cost. The insurance costs range from $8 to $16 per bus per day, depending on the value of the bus, and the administrative and overhead charge is $38 per day per bus. Only 50 percent of these costs is charged to the contract service in high-use situations. In Table 4 the dispatch-cost (fixed-cost) component of the cost model is summarized for different capital cost, utilization, and contract-length assumptions. Obviously the fixed daily cost values in Table 4 can be recalculated to reflect different ones for vehicle capital, contract length, insurance, driver wages, and interest rate.

Finally, the wheel-cost component of the model must be estimated. To represent the total mileage involved in providing service to a route, revenue miles will be combined with deadhead miles to reflect the mileage-related cost more accurately. The mileage-related costs (wheel costs) are summarized as follows:

Expense Item	Cost ($/mi)
Maintenance	0.21
Fuel and oil	0.20
Supervision	0.047
Operating taxes and license	0.085
Other miscellaneous	0.013
Subtotal	0.555
Plus profit of 10 percent	0.055
Total	0.610

The final form of the model is thus

$$TDBC_R = DFC\ (k,\ u,\ l) + .61\ TVM_R$$

where

$TDBC_R$ = total daily cost per bus for route R;
DFC = value from Table 4 for an operator's particular combination of vehicle capital cost, utilization, and contract length; and
TVM_R = total vehicle miles per day to provide service for route R.

RESULTS OF APPLYING THE COST MODEL

The private-operator cost model was applied to three situations: to estimate the cost of the contract subscription bus service provided to Golden Gate Transit and the Houston Metro commuter bus program and to estimate the cost of providing peak-hour service on several park-and-ride bus routes in Los

TABLE 4 Daily Fixed Costs for Different Assumptions of Commuter Transit Capital Cost, Vehicle Utilization, and Contract Length

	Capital-Cost and Use Combination and Contract Length (yr)													
	HL			HH			ML		MH		LL		LH	
Cost	2	3	5	2	3	5	2	3	2	3	2	3	2	3
Capital	152	132	121	76	66	60	86	75	43	38	41	37	21	19
Administration	38	38	38	19	19	19	38	38	19	19	38	38	19	19
Driver	75	75	75	75	75	75	75	75	75	75	75	75	75	75
Insurance	16	16	16	8	8	8	12	12	6	6	8	8	4	4
Profit[a]	28	26	25	18	17	17	21	20	14	14	16	16	12	12
Total	309	287	275	196	185	179	232	220	157	152	178	174	131	129

Note: HL = high capital cost, low utilization; HH = high capital cost, high utilization; ML = medium capital cost, low utilization; MH = medium capital cost, high utilization; LL = low capital cost, low utilization; LH = low capital cost, high utilization. All costs are in dollars per bus per day.

[a]At 10 percent.

Angeles that are now being bid on by private operators. The contracts will be for 5 years.

In all three cases, the estimates generated by the model were compared with the actual price being charged the public agency by the contractor or, in the case of Los Angeles, the bid price of a major private operator. In addition, the estimates of this model were compared with the cost estimates derived from Herzenberg's model and the SCAG vehicle-mile model.

The results of these comparisons are shown in Tables 5, 6, and 7. For Tables 5 and 6 the capital cost and vehicle utilization are noted by route, because different contractors use different vehicles and there are different bid prices by the major operator. In all three applications, the predictions of the model were always within 27 percent of actual costs and in over 80 percent of all routes within 10 percent of actual route costs. In Los Angeles, the fit was amazingly close, and Los Angeles data were not used to develop the model. The model appears to provide an acceptable level of accuracy for the purposes for which it would be used.

In contrast, the Herzenberg marginal cost model and the SCAG mileage cost model produced much less acceptable estimates. The Herzenberg model suffers from its marginal-cost approach--it is apparent that in the programs evaluated, the contract bus operators charge public agencies costs that are closer to fully allocated ones than marginal ones. As a result, the Herzenberg model produces cost estimates that are consistently 30 to 50 percent below actual contract prices. The problem appears to be severe underestimates of driver costs and administrative costs, as well as some dubious assumptions about capital costs. The SCAG model performs reasonably well in Houston but poorly elsewhere. This reflects the absence of a fixed-cost component in the model, which makes it underpredict for shorter routes. That is, for short routes, the actual cost is much greater than $2.79/mi because the fixed charges (for drivers and equipment) are spread over relatively few miles. The mileage cost approach to cost modeling appears to be particularly inappropriate for these types of contract operations.

CONCLUSIONS AND POLICY IMPLICATIONS

The results of applying the private-sector bus cost model developed here indicate that it is relatively accurate and that the cost considerations that the model includes are valid. These considerations are (a) that fixed costs, especially capital costs, are the largest cost component and therefore the primary factor in the expense of contract commuter bus operations; (b) that the level of utilization outside the contract is relevant; and (c) that the length of

TABLE 5 Houston Cost Comparison

			Comparison with Actual Cost					
Route No.	Capital-Cost and Use Combination	Actual Cost	Private-Sector Bus Cost Model	Percent Difference	Herzenberg Model	Percent Difference	SCAG Model	Percent Difference
107	HH/HL[a]	331	270/383[b]	−18/+16[b]	155	−53	282	−14
112	ML	305	310	+1.6	161	−47	278	−8.8
142	HH/HL[a]	346	274/387[b]	−21/+12[b]	161	−53	301	−13
201	ML	309	299	−3.2	151	−52	232	−25
202	ML	295	310	+5.1	158	−46	307	+4.1
204	HH/HL[a]	348	287/400[b]	−18/+15[b]	166	−52	354	+1.7
205	ML	332	311	−6.3	150	−55	279	−16
221	ML	372	276	−26	157	−58	296	−21
224	ML	302	304	+0.7	161	−40	271	−10
270	ML	220 (262)[c]	280	+27 (6.4)[d]	114	−36 (−56)[d]	179	−19 (−32)[d]
				11.3–12.7		49.0 (51.0)		13.3 (14.6)
				(9.2–10.6)				

Note: HL = high capital cost, low utilization; HH = high capital cost, high utilization; ML = medium capital cost, low utilization. All costs are in dollars per bus per day.

[a]Both use assumptions employed because operator's contract accounts for about 50 percent of revenues.
[b]Cost and percent differences for both use assumptions.
[c]Current contract rate; all other current route contract rates are similar to values shown.
[d]Percent difference using current contract for Route 270.

TABLE 6 Golden Gate Cost Comparisons

			Comparison with Actual Cost					
Route No.	Capital-Cost and Use Combination	Actual Cost	Private-Sector Bus Cost Model	Percent Difference	Herzenberg Model	Percent Difference	SCAG Model	Percent Difference
A-1	MH	190	189	−0.5	122	−35	151	21
A-2	LL	262	260	−0.7	155	−41	332	27
A-3	MH	151	178	+18	114	−25	112	26
A-4	MH	170	181	+6	115	−32	117	31
A-5	MH	180	181	+0.5	115	−36	117	35
A-6	LL	226	236	+4	138	−40	243	08
A-7	ML	168	180	+7	110	−35	112	33
B-1	MH	167	191	+13	128	−23	156	7
C1–4	MH	218	225	+3	143	−34	279	28
D-1	MH	177	185	+5	117	−34	137	23
F1-5	LL	225	212	−6	113	−50	240	7
H1-2	LL	246	248	+0.8	139	−45	310	26
Mean				5.4		42		24.8

Note: MH = medium capital cost, high utilization; LL = low capital cost, low utilization; ML = medium capital cost, low utilization. All costs are in dollars per bus per day.

TABLE 7 Los Angeles Cost Comparison

		Private-Sector Bus Cost Model		Herzenberg Model		SCAG Model	
Route	Bid[a]	Cost	Percent Difference	Cost	Percent Difference	Cost	Percent Difference
413	296	304	+2.7	181	-36	132	-52
418	340	339	-0.3	228	-31	240	-27
419	338	336	-0.6	224	-31	194	-40
423	357	349	-2.2	237	-31	237	-31
427	333	327	-1.8	222	-31	203	36
429	335	322	-3.9	229	-29	202	-37
430	327	324	-0.9	218	-31	141	-53
431	320	318	-0.6	213	-31	167	-94
436	352	336	-4.5	237	-30	195	-42
437	355	343	-3.4	237	-31	225	-34
438	337	332	-1.5	223	-31	219	-32
445	337	333	-1.2	224	-31	225	-30
Mean			2.0		31.2		42.3

Note: All costs are in dollars per bus per day.

[a]Actual bid adjusted downward by 5.7 percent to reflect lower profit margin in cost model; high capital cost and low utilization assumed for all vehicles.

the contract is important, especially when new equipment is specified. Each of these points has important policy implications.

The contribution of capital costs to the total cost of privately provided commuter services is very large, whereas capital costs do not even enter into the calculation of the operating cost of publicly provided transit services. This disparity, of course, strongly biases cost comparisons, because capital costs can make up as much as 25 to 40 percent of the total cost of privately provided commuter services and typically represent 20 to 30 percent of total cost. This percentage is the greatest when sponsors require new or recent equipment and the contract is of short duration, for example, 2 years. The obvious strategy for reducing costs is for the public agency to acquire the vehicles with its capital funds and contract only for their operation. If this is not feasible because of labor contract provisions or other constraints, the sponsor can still minimize the capital costs for which it must compensate the operator by allowing older vehicles to be used and award contracts for up to 5 years. Allowing older vehicles to be used also maximizes the number of potential providers, and competition is a powerful mechanism for holding bid prices to the minimum possible level. The sponsor may also wish to guarantee to the contractor that it will buy back, at prevailing market prices, any buses that the operator does not need once the contract has been terminated. Any or all of these actions can result in considerable cost savings.

The utilization findings also suggest certain policy actions. Costs are obviously greater when vehicles cannot be utilized outside the contract. Limited vehicle utilization is a fact of life for commuter services, but utilization can be maximized by spreading the contract business among multiple providers. If one or two operators each provide 30 or 40 vehicles, only a small fraction of the contract vehicles will achieve additional utilization. In addition, it is a wise policy not to become dependent on one or two private operators, because if other potential providers become discouraged from ever participating and do not bid on services, contract prices are likely to be excessively high.

Privately operated commuter bus services are not inexpensive, as this cost modeling exercise demonstrates. Nonetheless, they can often be less costly than comparable public agency services. The model presented here provides a method of estimating private operator costs and also indicates strategies that public agency sponsors can pursue to keep these costs to the minimum level possible.

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