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ESTIMATING THE COST IMPACTS OF TRANSIT SERVICE CONTRACTING

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16. Abstract

This study reports the results of an analysis of the potential cost impacts of private sector service contracting by transit agencies as well as the results of a nationwide survey of the magnitude and characteristics of existing transit service contracting. Using cost models developed during the study, an evaluation was made of the cost impacts of contracting out 5 to 20 percent of the existing services of 19 medium and large transit agencies, and all service of 3 small agencies. This evaluation determined that large agencies would save 2 to 49 percent of the costs of the contracted service, with a mean savings of 28 percent, and that medium size agencies would save up to 31 percent of the cost of service they contracted, with a mean savings of 14 percent. No cost savings were indicated for some small and medium agencies. A separate analysis of potential cost savings, using a statistical model developed from data supplied by agencies which currently contract for fixed-route bus service, predicted that agencies of 100 or more vehicles would save 26 percent of the cost of contracted services.

The nationwide survey of transit contracting found that 35 percent of all public agencies responsible for transit currently contract for some or all of their transit service. Transit service contracting is concentrated among small agencies, particularly municipalities. Consequently, contracted service represents only 5 percent of national transit expenditures and only 8.5 percent of transit service miles.

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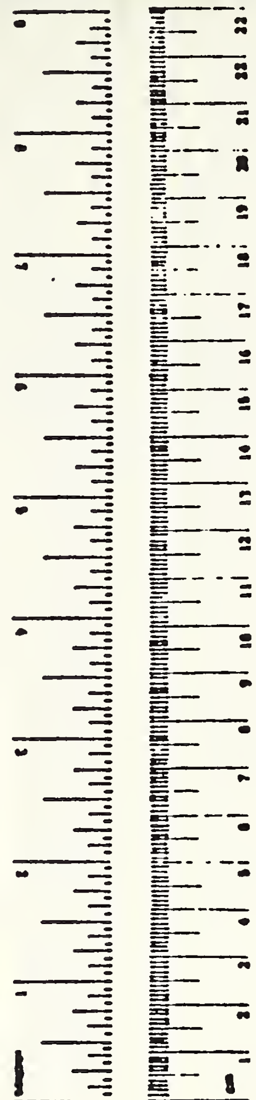
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

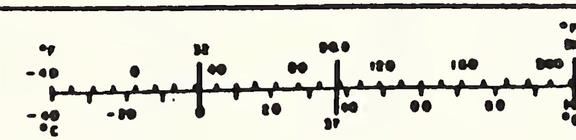
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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This report was produced in its entirety by the ITS administrative staff. The outstanding word processing skills of Cynthia Wenks are greatly appreciated.

While many people contributed to the virtues of this report, any errors or omissions are the responsibility of the authors.

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EXECUTIVE SUMMARY

Contracting with private providers for the delivery of transit services has been increasingly advocated as a means of improving the cost effectiveness of public transportation. The Urban Mass Transportation Administration (UMTA) has recently adopted policies to ensure that this strategy is considered when transit agencies establish new or redesigned services. But while transit service contracting is widely used in certain states (e.g., California) and for certain services (e.g., demand-responsive transit for the elderly and handicapped), no definitive information on either the utilization of transit contracting or its cost savings potential had been available prior to this study. The purpose of this study was to produce this information.

The study consists of four components: (1) a nationwide survey of transit service contracting; (2) a comprehensive review of the literature on contracting for all types of public services; (3) development and application of an avoidable cost model to twenty-two transit agencies to determine the cost savings which would result from contracting out selected portions of these agencies' services; and (4) development and application of a statistical model for estimating the magnitude and distribution of national level cost savings from transit service contracting. The results of each of the components of this study are contained in this report.

The first major element of this study was a national survey of the current scope and characteristics of transit service contracting. The survey achieved a response rate of 75 percent, and it includes information on 864 transit systems which represent over 85 percent of all transit systems in the United States. The survey results provide a definitive picture of transit contracting as it existed in 1985. Service contracting is a widespread practice: 35 percent of all the public agencies providing transit service contract for all or part of their transit system. The survey also revealed that contracting is heavily concentrated among small transit systems. When used by larger transit systems, contracting is typically employed for only a small fraction of the agency's services. Nationally, only about 5 percent of the operating expenditures and about 8.5 percent of all vehicle miles of service for bus and demand-responsive transit are accounted for by contracted services. Thus, there is an enormous untapped market for service contracting, particularly among large transit agencies.

The second component of this study reviewed findings of other research on the relative costs of public and private sector provision of a range of public services. This research has found that private providers can typically supply the public services analyzed (refuse collection, school bus transportation, fire protection, and other services) at lower cost than public agencies. A range of cost savings from 0 to 50 percent has been found, with an average cost savings of about 30 percent. These cost savings are of the same magnitude as those estimated for public transit in this study.

Interest in transit service contracting stems largely from its potential to generate significant cost savings for transit agencies. Three different cost comparisons conducted for this study confirm that service contracting is likely to lead to significant cost savings. All three cost comparisons found cost savings of 20 to 30 percent or more for services which would be contracted by large transit agencies. For medium and small transit agencies, the magnitude of the cost savings determined by this study is smaller, although quite significant; typically 10 to 30 percent in the case of medium size agencies.

One approach to analyzing potential cost savings involved direct comparisons of unit operating costs for fixed-route bus services operated by public agencies and private contractors for systems of various sizes. Data used in these comparisons were collected as part of the national survey. These direct cost comparisons, which are adjusted only for number of vehicles operated and not for service area characteristics, indicated that contracting out portions of the fixed-route bus services of medium and large transit agencies could reduce costs considerably. An appropriate comparison is between privately contracted services operating 25 or more vehicles in a fixed-route bus system and transit agencies operating 250 or more vehicles, as private contractors would typically operate only a relatively small portion of a large agency's service package. This comparison reveals that privately contracted services had 34 percent lower unit costs than public agencies of 250 to 500 buses and 44 percent lower costs than public agencies operating 500 or more buses. The unit cost differential for medium sized bus systems (25 to 250 vehicles) is 14 to 33 percent, depending on the size of the agency. The survey data indicated only a small cost differential (about 5 percent) for fixed-route systems of 25 or fewer vehicles.

The third component of this study was the development and application of an avoidable cost model to estimate savings from contracting out portions of transit agencies' existing services.[1] Model results indicated savings ranging

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[1] It is important to note that the avoidable cost methodology used in this study is different from UMTA's fully-allocated cost approach. UMTA's fully allocated approach has been endorsed by the Competitive Services Board, an advisory group made up of representatives from the public and private transit industry, and jointly sponsored by UMTA and APTA. The UMTA methodology requires that all cost elements be accounted for in the cost analysis. Justification must then be provided on a case by case basis for those cost elements that do not apply. The UMTA methodology is therefore more versatile in that it is applicable for any length of time desired and covers expansion of new services as well as replacement of current services. The avoidable cost methodology was designed to show near-term savings for current services being replaced by competitively provided services.

The cost savings based on the avoidable cost methodology and the assumptions used in this study are conservative since they did not include vehicle cost and, therefore, any potential savings generated by private operators being able to better utilize vehicles. Furthermore, savings possible through sale or rental of unused garage space and other facilities, as well as through reduction of certain overhead staff time and salaries, are not considered by the avoidable cost approach, as these cost elements are fixed for service changes of the magnitude considered in this study.

from 9 to 35 percent, with an average of 27 percent, for transit agencies operating 150 or more buses (13 observations). For transit agencies operating 250 or more buses, average estimated savings was 29 percent. Savings estimates for six medium-sized transit operations (25 to 150 buses) ranged from 3 to 20 percent, with an average of 13 percent. Analysis of three small systems (less than 25 vehicles) resulted in savings estimates of less than 10 percent in all cases.

The distribution of savings is also important. Although some medium-sized transit operations may not be able to achieve any appreciable cost savings by contracting, some large transit agencies may be able to achieve above average savings. For example, five of the ten agencies with 250 or more buses had estimated most probable cost savings of 35 percent or more. On the other hand, many small transit agencies are predicted to achieve little or no cost savings by contracting.

The final component of this study is a statistical model developed to estimate cost savings by the University of Pennsylvania research team. The model was developed using data obtained from twenty-six agencies that contract for fixed-route bus service. It was then applied to all agencies of 100 or more buses to estimate national savings from contracting out a portion of the bus service of each of these agencies. If the contracted service had a service profile (i.e., peak-to-base ratio and speed) similar to the agency's overall service package, the model predicted aggregate national savings of 28 percent for the amount of service contracted. In addition, there is at least 90 percent statistical confidence in the prediction that aggregate national level savings will exceed 20 percent for the amount of service contracted.

The analyses of cost savings conducted for this study can be used to generate an estimate of national cost and subsidy savings from a particular level of transit contracting. Assuming that agencies of 100 or more buses contract 20 percent of their service over the next several years, and that contracting saves an average of 25 percent of the avoidable cost of these services (where avoidable cost is equal to 92 percent of total operating cost), then national savings would be about $265 million at 1985 expenditure levels. This represents approximately 4 percent of operating expenditures for the entire bus transit industry and 6.5 percent of total subsidy requirements for bus service. Assuming that savings might range from as little as 20 percent to as much as 33 percent in the aggregate (percentages consistent with the results of the analyses performed for this study), the range of estimated national savings for the 20 percent contracting scenario would be $200 million to $365 million. This represents 3 to 5.5 percent of industrywide bus transit expenditures, and 5 to 9 percent of bus transit subsidy requirements. Moreover, this magnitude of service contracting would probably also lead to substantial indirect cost savings resulting from wage and work rule concessions made by transit workers in order to keep service operation within the transit agency.

The results of this study provide convincing evidence that transit service contracting can lead to substantial cost savings. The three different methods used to make cost comparisons predicted savings in the range of 20 to 30 percent for large transit agencies. Competitively provided services are thus a serious option for significantly reducing the cost of public transit.

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

The continuing financial problems of public transportation have motivated a search for more cost-effective ways of delivering transit services. This search has proceeded in two directions. One direction has been to focus on improving the internal cost efficiency of the services directly operated by transit agencies, for example by using part-time drivers to operate heavily-peaked services, by reducing absenteeism and by employing computer technology for a variety of routine functions.

The second direction of search has focused on alternatives to the current service delivery system. While internal reforms are desirable, they rarely produce significant cost savings. The use of part-time drivers, for example, expected to be a major cost savings innovation, has been widely implemented, but has led to relatively minor cost reductions (Chomitz, Giuliano, and Lave, 1985). Further, purely internal changes do nothing to address a fundamental factor behind the industry's cost escalation: the absence of competitive forces to keep costs under control. As a subsidized, monopoly-organized industry at the regional level, transit agencies face no economic incentives (beyond the simple availability of subsidy) to keep costs low. Not surprisingly, costs have risen at a rate exceeding inflation for the past two decades.

Various forms of private sector involvement have been advocated as a means of injecting competition into the transit industry and fostering more cost-effective service (Lave, 1985). Service contracting has emerged as one of the most promising alternatives. Evidence suggests that transit service contracting can reduce public agency cost by 10 to 50 percent (Cox, 1984; Morlok and Viton, 1985; and Teal, 1985). Service contracting is widely employed for small local transit services, but its use among medium and large transit agencies has been limited. Thus significant opportunities exist to realize potentially large cost savings through wider implementation of service contracting. Given transit's current fiscal environment, it is critical that the potential of this strategy be carefully evaluated.

1.2 RESEARCH OBJECTIVES

The purpose of this research was to evaluate the potential of transit service contracting to reduce bus transit costs, reduce the need for subsidies. The research had two major objectives. The first was to determine the current magnitude and characteristics of service contracting in existence within the U.S. transit industry. The second was to develop and apply methods for estimating the potential cost savings that would result from widespread industry adoption of service contracting.

Despite substantial interest in all aspects of privatization on the part of researchers and policymakers, no comprehensive and consistent information on the extent of transit service contracting had been gathered prior to this research. A few case studies had evaluated contracting of various types of service in specific regions of the United States (Teal, et al., 1980; Teal, et al., 1984), and a small number of state Departments of Transporation had compiled and published data on contracted services, but no national data base on service contracting was available. Thus, the first objective of this research was to conduct a comprehensive survey of the contracting practices of all public transit entities in the United States.

The second major task of this research, estimating the potential cost savings of competitive service contracting, has also been the subject of only limited and largely anecdotal research. A variety of case studies have been performed to estimate possible cost savings for a specific transit agency (Herzenberg, 1982; Southern California Association of Governments, 1982; McKnight and Paaswell, 1984). Several studies have reported cost savings which have resulted from service contracting (Cox, 1985; Morlok and Viton, 1985; Teal, 1985). However, no prior efforts have been made either to develop a consistent method for estimating possible cost savings, or to generate estimates of the possible impact on the transit industry of widespread use of service contracting strategies. Thus, in order to accomplish the second objective of this research, an avoidable cost model for estimating cost impacts of service contracting was developed and applied in a series of case studies. In addition, a statistical model for estimating the probability distribution of cost savings was also developed and applied. This model was developed using data provided by agencies actually contracting for service. With these tools, a comprehensive analysis of the cost impacts of transit service contracting was undertaken.

1.3 WHY SERVICE CONTRACTING?

Over the past decade, transit service costs have escalated far more rapidly than either fare revenues or subsidies. This "fiscal crisis" has led to renewed efforts to improve both the efficiency and cost effectiveness of transit services. These efforts have met with only limited success, however, because they have been targeted at the outward manifestation of the problem--high costs--rather than at the problem itself, the absence of any real incentive to control costs.

Within the private sector, costs are controlled through the competitive process. If a firm has substantially higher costs than its competitors, it will not survive. Thus, the market itself provides the incentive for efficiency. Only competitive markets provide this incentive, however. When the market is controlled by one or a few firms, competitive incentives disappear. The transit industry, organized as a geographic monopoly, is such a market. In most U.S. urban areas, a single public agency has responsibility for all transit services provided within its assigned service area. It is the designated recipient of transit subsidies, and has allocative responsibility for these funds. In many areas, the agency also acts as the operating service provider, that is, the traditional transit authority. The institutional organization of transit consequently mitigates against efficient service provision.

The impress of politics has also contributed to transit's fiscal problems. The desire to gain widespread political support for transit programs in the 1970's led to expansion of service into difficult to serve, low-demand suburban areas and increased emphasis on costly commuter services. Both of these strategies have contributed to the increase in service costs (Fielding, 1983, 1983a; Lave, 1985). Political considerations have also discouraged transit management from confrontations with unionized transit labor. National funding for mass transportation has historically been contingent on support from organized labor, and protection of transit labor has been a highly visible element in transit public policy (Altshuler, 1979). As long as subsidies were essentially unlimited, it was politically expedient to concede to wage and benefit increases without insisting on commensurate productivity gains.

The transit industry can no longer afford insulation from competitive pressures. Its current challenge is to separate the question of what service should be provided from the question of who should provide the service. The industry must now enlarge the supply of potential providers by increasing the role of private operators.

When public subsidies are involved, privatization requires that the public funder and the private provider be institutionally linked. This linkage is a contracting arrangement. To date, service contracting has primarily occurred in areas in which the funding agency and the operating agency have been separate. That is, service contracting exists where counties, cities, and transportation boards have funding authority and pass funds to local operating agencies. Among transit authorities that have both funding and operating functions, contracting with the private sector has largely been limited to demand-responsive operations and, occasionally, to new services. In the case of transit authorities, service contracting implies a brokerage arrangement in which the agency retains responsibility and control of the service, but shifts operation to the private provider. In the case of separate funding agencies, the agency in effect is already a broker, and the service shift is from a public to a private provider. An example of this form of contracting is a municipality that formerly purchased transit services from the regional operating agency, but subsequently contracted with a private operator for similar service.

Any significant implementation of service contracting will require the shift of services now being directly operated by public transit agencies to private providers; substantial service expansion is no longer viable in the current fiscal environment. Yet it is precisely this type of contracting that is most difficult to accomplish; indeed it has occurred in only one known case--that of the Tidewater Transportation District in Virginia.[2] Contracting of existing publicly provided services is difficult, because institutional constraints, unfavorable labor contract provisions, and Section 13(c) of the Urban Mass Transportation Act can severely restrict the transfer of public agency operated service to private contractors.

While widespread implementation of service contracting may be difficult, its potential benefits may be great. As mentioned earlier in this chapter, existing evidence suggests that service contracting can generate potential cost savings of up to 50 percent. These potential savings reflect the difference between public and private service costs. Private costs are lower for several reasons: lower driver wages and benefits, less restrictive work rules, and lower administrative or indirect costs. Thus, the immediate, direct benefits of contracting may be large. The transit agency's cost savings can be used either to reduce subsidy requirements, to expand the total amount of service available, or to reduce fares (relative to the level they would otherwise assume).

Implementation of service contracting may also generate significant indirect benefits. Direct competition with the private sector can reduce the pressure for wage and benefit increases among public agency employees and provide management with more bargaining power during contract negotiation. Cost containment incentives may increase throughout the organization as competition for transit jobs increases. These incentives could lead to significant efficiency gains within the public transit organization. Given

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2 All other service provider changes have occurred in situations where the public transit operator involved was acting as a contractor to a higher-level funding agency. See Teal (1985) for examples.

the potential benefits of transit service contracting, a careful examination of the issue is appropriate.

1.4 ORGANIZATION OF THE REPORT

The research results presented in this report are the product of a joint effort between the University of California, Irvine, and the University of Pennsylvania. The report summarizes research conducted at both locations.

Chapter Two provides the conceptual background for a study of transit service contracting. A literature review of public service contracting was performed by the University of Pennsylvania research team. The review describes results of contracting for a variety of public services, and provides guidelines on characteristics of services which result in their being amenable to contracting. Issues which are important to the long-term viability of contracting, such as service quality and maintenance of competition, are also identified and discussed.

Chapter Three presents the results of a nationwide survey of transit service contracting conducted in 1985 by the University of California research team. This survey provides the first definitive national evidence of the magnitude and characteristics of this form of service delivery. The survey is also comprehensive: 85 percent of all public transit providers in the United States were included. The survey results thus offer an extremely accurate picture of the current status of service contracting in the United States.

Results of the second task of the research, the estimation of potential cost savings, are presented in the remaining chapters. Chapter Four describes the development of a cost model for estimating potential savings of transit service contracting. The model is designed to evaluate the cost impacts of contracting out existing transit agency services. The modeling approach is based on the concept of avoidable cost--the transit agency cost that would be reduced if the service were not provided. Costs considered in the model depend on the assumptions made regarding service contracting arrangements. Previous related research is discussed, and an overview of the cost model system is presented. It bears emphasizing that the avoidable cost model is not a fully-allocated costing approach, and may produce results that are somewhat conservative from the perspective of long-term cost savings, particularly as regards capital costs. (A more detailed description of the transit cost model is presented in Appendix B.)

The cost models were applied to a total of twenty-two transit agencies, and estimates of potential cost savings for different service contracting options were generated. The participating transit agencies represent a wide variety of size, operating characteristics, and environmental conditions. Results of cost model applications are presented in Chapter Five. Model results are summarized, and potential cost saving implications are discussed. A final section of the chapter evaluates the accuracy and reliability of the model results. Individual case studies are presented in Appendix C. Research presented in Chapters Four and Five was conducted by the UCI research team.

The University of Pennsylvania model for estimating contracting cost savings is presented in Chapter Six. The chapter begins with a description of the data base used in the research. Patterns and characteristics of competitive contracting are then described. The statistical model is developed from a series of hypotheses regarding possible determinants of cost savings. The model is then used to estimate a probability distribution for potential cost savings at the national level.

Chapter Seven summarizes the research results and discusses policy implications of the research. Potential direct and indirect benefits of contracting are discussed in the context of other industries in which competitive forces have increased. The chapter concludes with an overall assessment of service contracting as a cost saving strategy.

CHAPTER TWO

CONTRACTING FOR PUBLIC SERVICES: REVIEW OF THE LITERATURE

2.1 INTRODUCTION

Faced with budgetary cutbacks and taxpayer demands for fiscal austerity, local governments have increasingly turned to the private sector for the provision of services traditionally performed by public agencies. Contracting with private firms has become a popular method of achieving cost savings. Cost savings of approximately 30 percent have been estimated for a variety of services through the use of contracting, with a range of savings between 15 and 50 percent (Mercer, 1983; Bennett & Johnson, 1980; Bennett & Johnson, 1979; Marlin, 1984).

The cost advantages of private sector contracting are assumed to result from the greater efficiency of private firms as well as from competition among potential contractors. This competition is said to enable public agencies to purchase service at the lowest possible cost (Bennett & Johnson, 1979; Fisk, Kiesling & Miller, 1978; Kirlin, Reis & Sonenblum, 1977; McGuire & Van Cott, 1984). For this reason, competitive bidding is the preferred method of obtaining service from private firms. When competitive bidding is not required, market contestability--the availability of alternative service providers--is said to assure that the public agency receives the service for a reasonable price.

Contracting has been used for a wide variety of public services formerly provided by public employees (Bennett & Johnson, 1980; Savas, 1982; Savas, 1977; Savas, 1974; Fisk, et al., 1978; Kirlin, et al., 1977). Trash and garbage collection are frequently provided under contract with private firms. School bus transportation and public transit are also frequently provided in this manner. During 1979-80, almost half of the school buses in the United States were owned and operated by private contractors (McGuire & Van Cott, 1980). In California, over 50 percent of all transit systems use private contractors (Teal, 1985). Municipal governments also contract for vehicle maintenance, custodial services, landscape and street maintenance, and for a variety of social services.

2.2 WHAT MAKES SERVICES AMENABLE TO CONTRACTING?

There are specific technological, managerial and marketplace characteristics which make certain services amenable to contracting with the private sector. Table 2-1 presents a summary of the most relevant characteristics. These are discussed in detail in the following sections.

2.2.1 Managerial Issues

The ease of defining and monitoring a service contract is clearly very important (Niskanen 1971). Because the private sector generally seeks to maximize its profit by providing only the level and quality of service required by the contract, development of performance standards and monitoring techniques are essential (Delaat, 1982; Fisk, et al., 1978; Fitch, 1974; Kirlin, et al., 1977; Savas, 1974; Marlin, 1984). Service standards must be clearly outlined in the contract specifications so that the bidders are aware of the requirements before assigning a cost to their service package proposals. Follow-up monitoring throughout the length of the contract ensures that the provider continues to perform adequately.

TABLE 2-1

CHARACTERISTICS OF SERVICES WHICH MAKE THEM AMENABLE TO CONTRACTING

Managerial Characteristics

1. The performance of the contractor is easily monitored.
2. Service quality is easily determined and can be quantified.

Marketplace Characteristics

3. The service contract is awarded competitively.
4. Alternative contractors are available to perform the service.
5. Easy entry into the business is available (also a function of technology).

Technological Characteristics

6. The need for service fluctuates over time, and contracting would reduce the public agency's requirement for equipment or manpower.
7. The need for the public agency to maintain a back-up service is minimal.
8. There is no need for a high degree of trust between the service contractor and the user.

The use of precise, quantifiable performance specifications in contracts is recommended (Delaat, 1982; Fisk, et al., 1978; Kirlin, et al., 1977; Savas, 1974). Even then, these measures are susceptible to circumvention (Fitch, 1974). Measures of effectiveness for social services, such as education and counseling, are difficult to define and monitor. In contrast, it is relatively easy to prepare performance indicators and monitoring programs for trash collection, highway and landscape maintenance, and other tasks with well-defined outputs.

2.2.2 Marketplace Issues

The marketplace is a second area which influences the feasibility of contracting for public services. Competition among potential service providers who are engaged in the bidding process for service contracts helps lower the cost of services (Fisk, et al., 1978; Fitch, 1974; Ho, 1981; McGuire & Van Cott, 1984; Savas, 1974; Savas, 1977). Without reasonable levels of competition, a private supplier enjoys a monopoly and can drive up prices to a point at which contracting is no longer a less costly alternative to public provision. The ease of entry into the market by new providers is an essential factor in maintaining a competitive situation over the long term (Hughes, 1982; McGuire & Van Cott, 1984).

2.2.3 Technological Issues

The nature of the service also affects the feasibility of contracting. Services which have seasonal or daily fluctuations, by nature, require excess equipment or manpower which remain idle during nonpeak periods. Contracting for services during the peak periods thus lessens the cost to the public entity (Fisk, et al., 1978; Kemp, 1982; Kirlin, et al., 1977).

A second issue is the possible need for the public agency to maintain back-up service capability when the entire service is contracted to the private sector. Services which are indispensable, such as police and fire protection and solid waste removal, must have contingency plans in case the contract is unexpectedly terminated (Delaat, 1982). Other services which are not as indispensable do not require contingency planning of the same magnitude.

The relationship between the service provider and the consumer or user is also important. Those services in which the provider and user have little or no contact, such as trash collection, maintenance, and custodial services, are especially amenable to contracting (Delaat, 1982; Fisk, et al., 1978). Contracting for services which require closer contact (e.g., school bus transportation, social services and police protection) places the responsibility on the contractor to hire employees who respond well to the public.

2.3 ARE TRANSIT SERVICES AMENABLE TO CONTRACTING?

Public transit has most of the characteristics of a readily contractible public service. Transit services are easily defined and monitored. The service desired can be clearly specified by routes and schedules, vehicle characteristics, and requirements for adherence to a variety of service standards. Current technology such as vehicle locator systems, automatic vehicle identification at key locations, and advanced communications make close monitoring feasible.

Competition in the transit industry has been shown to exist in several areas. The charter bus industry, intercity bus lines, school bus operations, sightseeing lines, airport limousine services, and demand responsive transit companies all compete in their respective markets. Entry into the industry is not difficult. When contracting situations are structured so that potential contractors need not make large capital outlays to participate in service delivery, there is likely to be a strong response to competitive contracting opportunities from private operators. Thus, public agencies can help ensure that sufficient competition will exist so that contracts can keep prices as low as possible.

Due to the peaked nature of transit demand, capital and labor costs can be substantially reduced through contracting for peak hour services. This allows the public agency to utilize its fleet and work force efficiently and to reduce the number of full-time employees.

The major liability for transit service contracting is the high degree of interaction between the contractor's employees (i.e., bus drivers) and users (i.e., passengers). Careful selection of prospective contractors and effective monitoring by the sponsoring public agency are essential to ensure that the contractor provides an adequate quality of service to the user (e.g., courteous and appropriately dressed bus drivers, on-time performance, etc.)

2.4 EVIDENCE OF COST SAVINGS FOR CONTRACTED SERVICES

Table 2-2 summarizes a number of studies which compare public vs. private costs for delivery of non-transit public services. The majority of this research has focused on solid waste collection. Only one study systematically examined the costs of several different services across many different governmental units. Ecodata, Inc., surveyed eight services provided by 121 cities in the Los Angeles metropolitan area (Marlin, 1984). Only services for which at least ten cities provided service directly and ten cities contracted were surveyed. These included refuse collection, road paving, street cleaning, and tree maintenance. The survey found that with the exception of payroll preparation, the contracted services were an average of 35 percent less expensive, with savings ranging from 27 percent to 48 percent for different services (Marlin, 1984).

For the twelve studies which reported cost data for non-transit services, average cost savings of 30 percent were found. Several of these studies will be reviewed in detail in the following section.

TABLE 2-2: QUANTITATIVE STUDIES OF COMPARING SERVICE DELIVERY COSTS

Type of Research Method Study (Reference)	Percent Savings	Comparison Measure	Number of Sites/Firms	Controls for Service Quality/ Similarity
Comparison Studies				
1. Solid Waste Collection Fairfax Co., VA (Bennet & Johnson, 1979)	30%	$/year/household	1 site 29 firms	Housing type; Front or rear collection; Number of collections/week
2. Solid Waste Collection New York City (Savas, 1974)	30-50%	$/ton; tons/hour	1 site 450 firms	Vehicle type; Type of waste; Expense category
3. Solid Waste Collection St. Paul (Fisk, Kiesling, & Miller, 1978)	0%*	NR	1 site	NR
4. 8 Municipal Services (Marlin, 1984)	27-48%	Varied by Service	121 sites	Quality controls depended on service
Before/After Studies				
5. Solid Waste Collection Minneapolis (Savas, 1977)	35-51% 0% After*	$/ton; $/hshld; tons/truck/shift	1 site	Same service specified in the contract; Housing type; Number of complaints
6. Solid Waste Collection Birmingham, England (*Economist*, 1983)	34% 0% After*	NR	1 site	NR
7. Custodial Service Little Rock, AK (Mercer, 1983)	50%	$/work unit	1 site	"Similar service"
8. Public Works Maintenance Lafayette, CA (Goodin, 1984)	15%	NR	1 site	NR
Statistical Cost Averages				
9. School Bus Service Indiana (McGuire & Van Cott, 1984)	12%*	$/trip/$/student $/mi/ $/student-mi	257 sites	Trip length; Students/trip
Regression Analyses				
10. Solid Waste Collection Columbia Study (Delaat, 1982)	16-30%	$/ton	100 sites	Wages; Weather; City size; Waste/household; Population density; Service level
11. Solid Waste Collection Connecticut (Kemper & Quigley, 1976)	13-30%	$/hshd; $/ton	145 sites	Service frequency; Service type; Population density; Wages
12. Fire Protection Services Scottsdale (Bish & Nourse, 1976)	30-50%	$/capita	1 site	Population; Area; Insurance rates;
Case Study				
13. Solid Waste Collection Pittsburgh area (Delaat, 1982)	Not relevant	Monitoring costs; Wages & benefits; $/ton; $/hshd; No. of complaints	8 sites 6 firms	Not relevant

* Competitive environment between the public and private service deliverers.

NR Not reported.

2.4.1 Refuse Collection

Kemper and Quigley (1976) analyzed the cost of trash collection in various Connecticut cities, reporting that collection cost appeared to vary by the type of service arrangement. Private collection, in which individual households contracted directly with private firms, was about 30 percent more costly than municipal collection which, in turn, was about 25 percent more expensive than contract collection. The difference between private contractor and municipal cost tended to be biased in favor of the municipalities, according to the authors, because cities generally tend to underestimate the cost of vehicle operations and maintenance, interest, and depreciation. The City of Hartford, for example, underestimated its costs by 41 percent. Economies of scale may account for the difference between the two types of private operating systems. When economies of scale are present, private firms operating under contract in a specific area can provide less costly service than a firm which serves individual households.

Bennett and Johnson (1979) studied refuse collection costs in Fairfax County, Virginia, where the County Division of Public Works and 29 private firms provided trash collection services. The average annual cost to homeowners for public service was significantly higher than prices charged by private firms: $126.80 vs. $85.76. Only one firm charged as much as the government. Thus, private cost levels were 32 percent less than municipal costs.

2.4.2 School Bus Transportation

A statewide study of school bus transportation in Indiana was completed by McGuire and Van Cott (1984). The authors collected cost and output (trip) data from most school districts in the state and compared cost per vehicle trip and cost per mile. Public provision was found to be 12 percent more costly than private bus service.

2.4.3 Fire Protection

Although fire protection services are generally provided by the public sector, Scottsdale, Arizona, contracts for this service with a private firm. Ahlbrandt (1974) used regression analysis to compare costs of fire service provision in 44 cities and five districts in the State of Washington with the Scottsdale system. The Washington data were calibrated and verified for cities in Arizona and were then used to predict costs for Scottsdale. The model predicted costs of $7.10 per capita. The actual cost was $3.78, a saving of approximately 47 percent.

2.4.4 Public Transit

A small number of previous studies have compared the cost of public versus private sector provision of transit in various operating environments. Wallis (1983) analyzed the cost of publicly versus privately provided fixed-route urban bus service in Melbourne and Sydney, Australia. He found that private operators had costs 30 to 50 percent below the levels reported by public operators. Teal and Giuliano (1986) estimated that privately contracted subscription bus service in San Francisco was provided at a cost 25 percent below that of the public agency which contracted for the service, even though the private operator's costs included vehicle depreciation and the public agency's costs did not. Echols (1985) presented data from the Tidewater Transportation District in Virginia, where the agency was able to reduce its service costs by at least 45 percent by contracting for the same fixed-route service it had previously operated itself. Teal (1985) and Morlok and Viton (1985) presented cost comparisons from a number of locations around the United States demonstrating cost reductions of 10 to 50 percent through private sector provision of transit services. Although a range of comparative techniques have been used, and the precision of these analyses have varied, the sheer magnitude of the estimated cost savings for the privately provided services indicates that they are likely to be substantial.

2.4.5 Overall Results of Cost Studies

Taken together, these studies suggest that contracting with the private sector for the provision of public services can result in significant cost savings. Considerable savings in the areas of refuse collection, fire protection, school bus transportation and public transit were found. In addition to the issue of cost, service quality and competition also influence the effectiveness of contracting. These are addressed in the following sections.

2.5 SERVICE QUALITY

The issue of service quality is often cited by opponents of contracting as a major obstacle to service provision by the private sector. Private firms, ostensibly interested only in making a comfortable profit, are alleged to provide as little service as possible with minimal regard for quality. Studies have indicated, however, that many other factors affect the issue of the quality of service (Poole, 1983; Fisk, et al., 1978). Contracting for services requires public agencies to define service objectives and performance measures, often for the first time. This forces the municipality to examine the outputs of the service in relation to the inputs (costs) and to assess the service in a new way. Public officials have often found private contractors to be more responsive and concerned about the quality of service than municipal employees, who are not motivated by the incentive of contract renewal based upon the satisfaction of the sponsoring agency. The Ecodata, Inc., study found no significant differences in quality between public and private provision for the eight public services examined (Marlin, 1984).

These findings imply that contract monitoring is of paramount importance. Contractors will provide quality service if they know that their performance is being closely monitored by the public agency. Service objectives must be clear, easily monitored, and fair to both parties. Several studies have considered quality of service when comparing public and private service provision and have found that private firms provided service of equal or better quality than the public agency (Ahlbrandt, 1974; Bennett & Johnson, 1979). One study, which compared private versus public trash collection, found that trash was collected more frequently by the private operator and the level of complaints about the quality of service was similar to that of the public provider (Bennett and Johnson, 1979). In Scottsdale, Arizona, the private fire department was compared with public departments in terms of service. Scottsdale ranked first in speed of response to alarms, comparable fire insurance rates, and comparable fire losses (Ahlbrandt, 1974).

2.6 COMPETITION IN CONTRACTING

Competition is a critical factor in obtaining low-cost contracts. Studies confirm that the existence of a competitive market generally results in relatively low bid prices because firms must compete with each other to win the contract (Savas, 1977; Bennett & Johnson, 1980; Kirlin, et al., 1977; Fisk, et al., 1978). However, other studies (Hain, 1983) point to the difficulties involved in maintaining a competitive market. They suggest that private market mechanisms are inadequate for sustaining competition, that oligopolistic or monopolistic situations can evolve with long-term contracts and that bid rigging and other anti-competitive practices can drive up prices. Adequate cost information and economic controls to assure competition are mandatory if contracting is to be effective. However, while anecdotal accounts of such problems can be found, the systematic research which has been done on municipal service contracting has not supported these contentions.

Several studies (Savas, 1977; Hughes, 1982; Bennett & Johnson, 1980) investigated the effect of competition on public and private costs for services. The results indicate that competition has had a beneficial effect on public agency service costs. Savas (1977) points to the effect of competition between private contractors and the municipal government in Minneapolis, Minnesota. The city contracted for part of its trash collection and provided the remainder of this service itself. Initially, the private firms showed superior productivity in terms of labor hours per household, tons per man-hour and households serviced per shift. The private firms also had significantly lower costs. Over a five-year period, however, the city department improved to the level of its competitors. The City of Phoenix contracts for a number of municipal services. City departments, in fact, compete directly with the private sector in a competitive bid process. The city contracts for garbage collection, chip sealing of streets, fixed-route public transit, Sunday dial-a-ride services, and maintenance of roadway medians. Contracting has trimmed costs for those services provided by the private sector and has led to lower costs in the public sector as well. The city government has found ways to tighten the budget and to be more productive (Hughes, 1982).

These studies indicate that competition and private sector involvement can directly affect costs of public services. In Minneapolis and Phoenix, public sector costs for service provision approached those of private contractors. Contracting for only a portion of the public service may also lead to overall lower public agency costs. These spillover effects of contracting (sometimes called the "ripple effect") can be very significant in terms of overall public sector cost reduction.

2.7 CONCLUSIONS

Private sector contracting for public services has been a generally successful endeavor. This method of service provision is common in the areas of trash collection, demand responsive transit, school bus transportation, park and landscape maintenance, vehicle maintenance, custodial services, traffic signal maintenance, road repairs, and a number of other services typically provided by the public sector.

Several issues are related to the success of contracting with the private sector. Competition is probably the most critical component in obtaining high quality, inexpensive service. Competition among bidders for a contract will help reduce the cost of service. Sufficient competition should be available in the marketplace or entry should be easy so that additional firms can provide service if the need arises. Competition between the public and private sectors often results in the public sector becoming more cost conscious, efficient, and productive.

The service which is being considered for private sector provision should have performance standards which are easily measured. The ability to monitor the performance of the vendor is critical in obtaining high quality services. Public services which meet these criteria have been shown to benefit from contracting. Cost savings averaging 30 percent have been obtained, largely in solid waste management, but also in other public services.

CHAPTER THREE

RESULTS OF NATIONWIDE TRANSIT CONTRACTING SURVEY

This chapter presents results of a nationwide survey of transit service contracting among public agencies which are responsible for public transportation provision. Despite substantial interest in transit service contracting on the part of both public agencies and researchers, little was known about the use of contracting at the initiation of this research. The nationwide survey was thus undertaken to determine the scope of contracting which currently exists within the industry. The survey data provide a comprehensive description of the magnitude and characteristics of service contracting within the United States. The survey obtained information on whether public agencies contracted for transit service, and if so, on the types and amounts of service provided. Information was also obtained on vehicle ownership and the mehtod of contractor selection. This chapter presents results of the national survey. The survey data are also used to provide cost comparisons of privately contracted and publicly operated transit services.

3.1 METHODOLOGY

The national survey was conducted in 1985. Using information obtained from state DOT's and a previously published UMTA transit directory, efforts were made to identify and contact every public transportation provider in each of the 50 states, with the exception of systems which were targeted exclusively at an elderly and handicapped, social service agency-oriented clientele. Judging by the comprehensiveness of the information provided by the states, it seems likely that at least 95 percent of all transit services in the United States were included in the survey, and possibly as many as 98 to 99 percent. Survey forms were sent to each of the providers in the Spring of 1985. A copy of the data collection instrument is included in Appendix A. As many as two follow-up letters were sent to each agency in an effort to maximize the response rate. Telephone follow-up was also occasionally used.

The combination of a one page survey form and extensive follow-up produced an excellent response rate. Of 982 systems identified and contacted, responses were received from 732 systems (approximately 75 percent). If an agency did not respond after repeated contacts, UMTA's Section 15 data, when available, were used for that agency. In a few cases, such as California and Minnesota, information provided by the state was of sufficient quality that it could be used when a system did not respond to the survey. In this fashion, information was obtained on an additional 132 systems. A total of 864 transit systems are included in the data set. The sample is thus highly representative.

The data collection instrument asked the public transportation sponsor to provide the following information: (1) which types of transit service (e.g., fixed route, demand responsive) are provided, and whether they are operated by the public agency or a private contractor; (2) aggregate operating statistics for all of the agency's transit services; (3) operating statistics for each contracted service; (4) sources of funding; (5) vehicle ownership for contracted services; (6) the nature of the contractor selection process (e.g., competitive bidding, negotiation); and (7) the length of the contract. Respondents were asked to supply 1983-84 operating statistics whenever possible, although some supplied 1984-85 information. Approximately 825 systems supplied reasonably complete data.

TABLE 3-1

AMOUNT OF CONTRACTING VS. TYPE OF SPONSOR

Type of Sponsor	Amount of Contracting			N
	All	Some	None	
Transit Agency	12.9%	20.4%	66.7%	255
City	30.5	5.4	64.1	410
County	20.7	12.6	66.7	111
Other	37.5	6.3	56.3	48
All Types	24.2	11.0	64.8	
N	199	91	534	824

3.2 EXTENT AND MAGNITUDE OF SERVICE CONTRACTING

Approximately 35 percent of all the public agencies included in this survey contract for at least a portion of their transit service. Table 3-1 indicates that there is not a large difference in the use of contracting by different types of public agencies, with 33 to 44 percent contracting for at least some service in each public agency category. However, as shown in Table 3-1, types of agencies differ significantly in terms of contracting for "all" or "some" of their service. Municipalities which contract typically do so for all of their transit service, whereas most contracting by transit agencies is for only a portion of the total service delivered.

System size has a strong and pervasive influence on patterns of service contracting. Although small public transportation systems, those with 50 or fewer vehicles, are less likely to contract for service than systems with more than 50 vehicles, most of the service contracting by the latter group is for

TABLE 3-2

CONTRACTING VS. SYSTEM SIZE

	Any Service Contracting	Contract All Service	Contract Some Service
1-50 Vehicles	33.4%	27.1%	6.2%
51 or more Vehicles	46.5%	9.3%	37.2%
All Systems	35.4%	24.3%	11.0%

only a portion of their service, whereas the bulk of contracting by small systems is for the entire transit service (Table 3-2). Among systems with 50 or fewer vehicles, 81 percent of contracting is for the entire system, whereas among systems with more than 50 vehicles, only 20 percent of the contracting is for an entire system. The very size of the smaller agencies means that contracting decisions are often of an "all or nothing" character--these systems are typically so small that it makes most sense to either operate the entire service in-house or to contract for all service. Thus, it is frequently infeasible to contract for only a portion of the system.

Because of this pattern, there is much more contracting as a percentage of agency expenditures among small systems. As Table 3-3 illustrates, the percentage of average agency expenditures for contract operations sharply and systematically declines as system size increases. (Table 3-3 does <u>not</u> report the percent of total contract expenditures to total operating costs for each category, but the <u>average</u> percentage contract expenditure in that size category.)

TABLE 3-3

PERCENT OPERATING EXPENDITURES FOR CONTRACT SERVICE BY SYSTEM SIZE

System Size	Average Agency Percentage Contract Expenditures for Size Category	N
1-10 vehicles	31.6%	453
11-25 vehicles	25.3%	166
26-50 vehicles	18.2%	98
51-100 vehicles	11.2%	59
101-250 vehicles	9.5%	39
More than 250 vehicles	9.5%	41

Table 3-4 provides a breakdown of contracted services by the type of service, as well as the ratio of private to public service provision for each category. It should be noted that the data are presented on the basis of service, not agency. Since many agencies provide more than one type of service, the total number of services is much larger than the number of agencies.

Demand responsive transit services are most likely to be contracted, both as a percentage of all contracted services and as a percentage of contract service for each service type. Contracts for demand responsive transit (DRT-EH and DRT-GP in Table 3-4) represent 58 percent of all service contracting. Moreover, one-third of all demand responsive transit services are contracted. Nonetheless, there is a surprisingly large amount of contracting for fixed-route service, with over 160 such services

TABLE 3-4

NUMBER OF TRANSIT SERVICES PRIVATELY CONTRACTED BY SERVICE TYPE

	Type of Provider			
Service	Public	Private	Both	Portion Privately Contracted[a]
FRT (All Day)	450	119	18	23.3%
DRT-EH[b]	223	118	13	37.0
DRT-GP[c]	231	99	11	32.0
Commuter	42[d]	16	1	28.8
Weekend/Evening	75[d]	7	3	11.8
Other	16	14	2	50.0
All Services	1037	373	48	28.9%

a Portion privately contracted = "private" + "both" divided by row sum.
b EH designates elderly and handicapped service.
c GP designates general public service.
d Probably understated due to agencies including these services in all-day FRT category.

(including commuter service and weekend/evening service) contracted to private operators. Approximately 23 percent of all-day fixed-route services are contracted. Overall, approximately 29 percent of all separate transit services provided by the agencies included in the sample are contracted to private operators.

Because contracted services tend to be relatively small scale, the amount of contracting measured in dollar and mileage terms is considerably smaller than the percentage of all services which are contracted. Service contracting represents 5.1 percent of total nationwide transit operating expenditures for bus and demand-responsive service and 8.6 percent of total revenue vehicle miles of such service produced. Although much smaller than the percentage of services contracted, these measures nonetheless indicate that service contracting is already a phenomenon of significant importance. This is particularly the case for municipally provided transit services, as 27 percent of all operating expenditures for such systems represent privately contracted services.

Service contracting occurs in at least 41 states, but is most prevalent in a relatively small number of states. One-half of all the systems which contract for service are contained in California, Massachusetts, and Minnesota, even though these three states contain only 34 percent of the transit systems in the survey. Other states where a substantial amount of contracting occurs include Connecticut, Illinois, Iowa, Michigan, North Carolina, Ohio, Pennsylvania, Texas, and Wisconsin. Collectively, these twelve states account for 80 percent of all systems which engage in some form of service contracting, while they contain only 69 percent of all the systems included in the survey.

The survey identified several notable examples of large scale service contracting. At least seventeen public agencies contract for service involving 50 or more vehicles. The largest contracted service is in Honolulu, Hawaii, where a 480 bus fixed-route system with an annual operating cost of $55 million is contracted to private operators. The entire 350 bus Phoenix transit system is contracted to two private operators. Large contract operations which do not represent an entire transit system include a large segment of suburban service in Dallas (over 100 vehicles), the Houston and Dallas commuter bus programs (each with more than 60 vehicles), and the demand responsive services of Orange County Transit District (130 vehicles) and the San Bernardino County transit agency (over 40 vehicles) in California.

3.3 PATTERNS OF SERVICE CONTRACTING

When public agencies do contract for service, they tend to award short term contracts, often only one year in length. Table 3-5 provides the percentage distribution of contract lengths for the three major types of contracted services. One-year contracts are most prevalent for all three service types, although 42 percent of the fixed-route operations had a contract of at least three years duration. In contrast, only 23 percent of the DRT operations had a contract of this length. In addition, the duration of the average fixed-route contract is nearly 50 percent greater than the average DRT contract.

Vehicle ownership is the most likely explanation of why fixed-route services tend to have longer contracts. Nearly 40 percent of all fixed-route systems require the contractor to provide the vehicles. The economic advantages of amortizing the relatively expensive buses used in such systems

TABLE 3-5

CONTRACT LENGTH VS. TYPE OF CONTRACTED SERVICE

	Type of Service		
Length of Contract (years)	Fixed Route	DRT-GP	DRT-E+H
1	51.5%	66.2%	61.9%
2	6.8	10.8	14.4
3	24.3	12.5	17.5
4+	17.4	9.5	6.2
Average Length (months)	30.2	21.2	20.6

over a multi-year period is one major reason for contracts of three or more years in length. Some fixed-route contract services, morever, are franchised operations of long duration.

The survey results indicate that in about 53 percent of all cases formal competitive bidding is used to select a contractor, with the remainder split between negotiated contracts and contract renewals (Table 3-6). It is assumed that contract renewals are not competitively bid unless explicitly stated by the agency; in this case, the selection process was categorized as competition. The results shown in Table 3-6 reveal that specialized DRT services and commuter services are most likely to be competitively bid.

TABLE 3-6

CONTRACTOR SELECTION PROCESS BY TYPE OF SERVICE

	Selection Process			
Type of Service	Competitive Bid	Negotiation	Renewal*	N
FRT	51.0%	24.0%	25.0%	104
DRT-GP	45.6	20.5	33.8	68
DRT-EH	58.8	17.6	23.5	102
Commuter	71.4	21.4	7.1	14
Other	45.4	18.2	36.4	11
All	53.2%	20.7%	26.1%	299

* Unable to ascertain whether contract renewal with existing provider was competitively bid or negotiated, although strong implication that contract was negotiated.

It bears noting that long term contracts are the most likely to be competitively bid. Among the major types of contracted service (DRT and all-day fixed-route service), a competitive process is used to award 67 percent of all contracts of three or more years, and 75 percent of those for four or more years. In contrast, only 43 percent of all one-year contracts are awarded competitively. Many one-year contracts, however, are renewals of an existing contractor. This operator may have initially been selected by a competitive process. If renewals are disregarded, 69 percent of one-year contracts are awarded through competitive bidding. It appears likely, therefore, that competitive bidding is the norm for contract awards unless an agency has developed an ongoing and mutually beneficial relationship with a contractor. In such cases, one-year renewals of the contract become a popular option (38 percent of all one-year contracts are renewals.)

Information obtained on vehicle ownership indicates that about 50 percent of all vehicles used in contracted services are owned by the private operators which provide the service (Table 3-7). Most vehicles used for fixed-route services are owned by sponsors, whereas contractors own the bulk of the vehicles used in DRT systems. Table 3-8 provides a further breakdown of vehicle ownership by system (as opposed to total vehicles) for each of the major service types. This reveals that contractor ownership is the most prevalent for commuter services, whereas sponsors own the vehicles used by contractors in the majority of all-day fixed-route services. Sponsors own some or all of the vehicles in 40 to 45 percent of DRT systems.

These different ownership conventions presumably reflect the high cost of the large buses often used for fixed-route service in comparison with the relatively inexpensive vehicles used for DRT. A major reason that contractors for commuter service typically own the (expensive) vehicles used by the

TABLE 3-7

VEHICLE OWNERSHIP FOR CONTRACTED SERVICES BY SERVICE TYPE

	Number of Vehicles Owned by:		
Type of Service	Sponsor	Contractor	Percent Owned by Sponsor
FRT	2482	502	83.2%
DRT-GP	352	777	31.2
DRT-EH	515	1746*	22.8
Commuter	7	204	3.3
Other	28	94	22.9
All	3384	3323	50.4%

* In some cases, vehicles included in this category represent taxicabs used for a variety of services, not just service sponsored by public agency. This number thus overstates vehicles dedicated to transit service.

operation is that they can use the buses for other private services (e.g., charter) at other times of the day or week.

The survey was not specifically designed to obtain information on factors which influenced a public agency's decision to contract for transit service, but the available data do provide some limited insight into this issue. It has been previously suggested that public agencies which face budgetary constraints, or can use transit subsidies for other local government purposes, are most likely to contract for transit service (Teal and Giuliano, 1986). The results of the survey are consistent with this hypothesis.

This is most easily seen by looking at small transit systems, those with 50 or fewer vehicles, where it is most likely that the entire system will be

TABLE 3-8

SYSTEM OWNERSHIP OF VEHICLES BY SERVICE TYPE

	Entity Which Owns Vehicles		
Service Type	Sponsor	Contractor	Both
FRT	53.7%	39.0%	7.4%
DRT-GP	42.1	54.7	3.2
DRT-EH	34.2	60.0	5.8
Commuter	20.0	80.0	--

contracted if any service contracting occurs. Examining only those agencies which contracted for either "all" service or for "no" service (this included 94 percent of all systems with 50 or fewer vehicles), it was found that of the 113 agencies which had access to only state or local funds for transit subsidies, 49 percent contracted for all of their service. In contrast, among 292 similar agencies which had access to all three sources of subsidy (i.e., local, state, and federal) and thus presumably were better endowed financially than their counterparts, only 23 percent contracted for all service. This is strongly suggestive evidence that financial constraints are a key motivator of total system service contracting.

In addition, among larger agencies, over 90 percent of which have access to multiple sources of subsidy, 80 percent of all contracting is for only a portion of the transit system. This type of contracting is less likely to be in response to strong financial pressures. The total subsidy savings from contracting are small in such cases, and these agencies are likely to operate under less severe financial pressures in absolute terms than their smaller counterparts, many of whom have limited access to subsidy.

3.4 OPERATING CHARACTERISTICS OF CONTRACT SERVICES

The public agencies in the sample were divided into three categories: (1) those which contract for essentially all of their transit service; (2) those which contract for only some of their service, and for whom public agency operation is the primary mode of service delivery; and (3) those which contract for no services. Table 3-9 provides relevant statistics on the annual operating cost, revenue vehicle miles, and number of vehicles for transit services in each of these three categories. Both mean and median measures of central tendency are used. The mean values are strongly biased upwards, as reflected by the very large differences between mean and median values. The differences between the large mean and the small median values reflect the fact that while each of the contracting categories contains some large systems, resulting in high mean values, most contracted systems are small, leading to low median values. Neither mean nor median is an accurate indicator of the "representative" contracting situation, although the median is closer to being representative than the mean.

As measured by revenue vehicle miles, the average totally contracted system is only 31 percent as large as the average system which contracts for no service (Table 3-9). Annual operating expenditures are only 19 percent as great. The median sized fully contracted system is about one-half as large as the median sized non-contracted system.

Contracted services which represent only a fraction of the entire service delivery system are even smaller in scale, averaging 80 percent of the operating cost of the fully contracted systems. These services, moreover,

TABLE 3-9

OPERATING STATISTICS BY LEVEL OF SERVICE CONTRACTING

	Amount of Service Contracting			
	ALL	SOME		NONE
Mean Values		Entire System	Contract Service	
Op. Cost	$1,221,710	$20,447,490	$895,877	$5,962,559
Rev. Veh. Mi.	562,114	6,239,540	477,408	1,810,588
Vehicles	20.3	196.5	23.2	57.5
Median Values				
Op. Cost	$229,340	$4,430,000	$154,800	$315,650
Rev. Veh. Mi.	154,874	1,911,388	123,000	292,900
Vehicles	6.4	61.5	6.3	8.4

typically represent a very small portion of a transit system's total service package, with a mean value of 4.4 percent of operating expenditures and 7.6 percent of revenue vehicle miles. In addition, the agencies which engage in only partial service contracting are much larger than the other two types, with average annual operating costs of over $20 million, and median operating expenditures of $4.3 million.

Table 3-10 provides a further breakdown of the contracted services, illustrating that most partial service contracting is for DRT service--76 percent of all services contracted by the partial contracting agencies--whereas a substantial amount of total service contracting is for all-day

TABLE 3-10

CONTRACTED SERVICE OPERATING COST BY TYPE OF SERVICE

Transit System is Totally Contracted

Service Type	Mean	Median	% of All Systems	N
FRT	$1,790,552	427,621	41.2%	113
DRT - GP	209,567	126,511	29.9	82
DRT - E&H	283,239	11,500	26.6	73
Commuter	151,096	92,612	2.2	6

Transit System Contracts for Some Service Only

Service Type	Mean	Median	% of All Systems	N
FRT	$812,161	130,448	19.0%	20
DRT - GP	471,887	90,155	27.6	29
DRT - E&H	621,201	200,000	48.6	51
Commuter	4,423,415	1,123,000	4.8	5

fixed-route service and commuter service--43 percent of all services among totally contracted systems.

Table 3-10 also reveals that contracted fixed-route services are likely to be much larger in scale than other types of contracted services. All-day fixed-route services and commuter services have much larger average operating costs and revenue vehicle miles than do the DRT services. Nonetheless, contracted fixed-route services tend to be considerably smaller than public agency provided fixed-route operations.

3.5 COST COMPARISONS

The results of the survey provide an opportunity to compare public agency and private contractor operating costs for comparable transit services. Comparisons are possible for both fixed-route and DRT services.

The survey obtained basic operating data on a total of 468 all-day fixed-route transit services. These include 384 publicly operated systems and 84 privately contracted services. These systems were disaggregated based on the number of vehicles, and compared on the basis of cost per revenue vehicle mile and cost per revenue vehicle hour. The results are shown in Table 3-11. Note that costs are for public systems and private services including, typically, the public agency's cost of monitoring the privately contracted services. The survey provides no direct information on the size of the private contracting firm. Thus the size categories give comparisons of public transit operators with privately contracted fixed-route bus services, not private bus operations per se.

This comparison indicates that differences in unit operating costs between public and private operators are strongly related to size. Depending on whether cost per mile or cost per hour is used, there is a 2 to 8 percent difference in unit costs between public and private operators for systems of 50 or fewer vehicles. As the size of the service increases, however, public agency costs increase markedly, whereas private contractor costs increase less rapidly. Because few large privately contracted systems exist, the results for the largest such systems must be viewed cautiously. The sample sizes are too small to infer that large contracted systems are necessarily less expensive than large public agency operated systems, or that the cost differentials found here are necessarily indicative of those which would be obtained in actual contracting situations. Moreover, some of the largest

TABLE 3-11

PUBLIC AGENCY VS. PRIVATE CONTRACTOR
OPERATING COSTS FOR FIXED-ROUTE TRANSIT BY SIZE OF SYSTEM

	Cost/RVM	N	Cost/RVH	N
25 or fewer vehicles				
Private Contractor	$1.79	63	$25.08	58
Public Agency	1.88	201	27.22	170
26 to 50 vehicles				
Private Contractor	2.30	11	28.17	10
Public Agency	2.34	68	29.78	67
51 to 250 vehicles				
Private Contractor	2.06	7	33.75	6
Public Agency	2.67	83	36.95	79
251 to 500 Vehicles				
Private Operator	2.81	3	38.05	2
Public Agency	3.45	11	45.13	9
More than 500 Vehicles				
Private Contractor	N/A	N/A	N/A	N/A
Public Agency	4.11	23	53.09	23

privately operated systems are franchise operations, whose costs may be greater than competitively procured services. Thus, cost differences could be greater or smaller in competitive contracting situations.

The same phenomenon of small unit cost differences for public and private operators of small systems also holds for demand responsive service. There is only a slight difference between cost levels of public and private DRT operators in the sample, virtually all of which operate 50 or fewer vehicles, even when adjusting for vehicle ownership costs for many of the privately contracted DRT systems.

The results indicate that the greatest significant cost savings from contracting are likely to occur in cases where a large public agency contracts a portion of service to a private operator. The average cost per vehicle mile for public systems with more than 500 vehicles is $4.11. If those privately contracted systems of more than 25 vehicles are considered to be representative of the cost of a contractor which would operate some significant portion of the fixed-route service of a large agency (e.g., 5 percent or more), then the relevant unit costs are $2.29 per vehicle mile. This is 44 percent less than the average unit costs of the large bus operators in the sample. These particular cost differences are indeed relevant, for if contracting does become commonplace among larger transit systems, it will undoubtedly involve only segments of the system. Indeed, there are many reasons to minimize dependence on any one contractor, and hence to award only relatively small contracts (Morlok and Viton, 1985). Therefore, large private operators will not necessarily be needed to operate such services.

In view of this likely eventuality, an important comparison is between public agency costs for systems of different sizes and private contractor costs for contracted services of less than 25 vehicles and for more than 25 vehicles. The smaller contracted services can be reasonably compared to public agency operated systems of 250 or fewer vehicles, while the larger contracted services are best compared to the public agency services of 250 or more vehicles. This comparison is shown in Table 3-12, and indicates cost differences of 5 to 33 percent for systems of fewer than 250 vehicles, and 34 to 44 percent for systems of more than 250 vehicles.

TABLE 3-12

DIFFERENCES IN AVERAGE COST PER REVENUE VEHICLE MILE
BETWEEN PUBLIC AGENCY FIXED-ROUTE SYSTEMS
AND PRIVATELY CONTRACTED SERVICES OF DIFFERENT SIZES

Size of Privately Contracted Service	Number of Vehicles Operated by Public Agency Service				
	1-25	26-50	51-250	251-500	500 or More
1 - 25 vehicles	4.8%	23.5%	33.0%	NA	NA
26 or more vehicles	NA	NA	14.2%	33.6%	44.3%

3.6 THE ROLE OF COMPETITION IN MAINTAINING PRIVATE CONTRACTOR COST LEVELS

It is often suggested that periodic competition, not private sector operation per se, is the primary reason that costs for privately contracted services are typically below public agency cost levels (Cox, 1985; Morlok and Viton, 1985). Because a variety of contract award mechanisms (competitive bidding, negotiation, etc.) are employed by the public agencies which contract for transit service, it is possible to explore their impacts on cost levels for comparably sized transit operations. The results of this cost comparison are shown in Table 3-13 for both fixed-route and demand responsive services.

The results of Table 3-13 indicate that if competition is truly the mechanism which keeps contract costs low, it is both potential competition as well as actual competition for contracts which accomplishes this objective. As can be observed in the table, non-competitive contract awards, in the formal sense, are generally not associated with higher unit costs than the costs of operators which were selected on the basis of formal competitive

TABLE 3-13

CONTRACT AWARD MECHANISM VS. UNIT COSTS FOR COMPARABLE SERVICES

Fixed-Route Transit

	Competitive	Negotiation	Renewal w/o Competition
Cost per RVM			
1-25 vehicles	$1.91 (36)	$1.94 (32)	$1.94 (27)
25 or more vehicles	2.41 (6)	2.31 (9)	2.60 (3)
Cost per RVH			
1-25 vehicles	$28.69 (36)	$30.24 (32)	$30.12 (27)
25 or more vehicles	33.55 (6)	32.70 (9)	31.52 (3)

Demand-Responsive Transit

	Competitive	Negotiation	Renewal w/o Competition
Cost per RVM			
1-25 vehicles	$1.54 (52)	$1.54 (14)	$1.38 (31)
25 or more vehicles	1.37 (5)	1.92 (6)	1.36 (3)
Cost per RVH			
1-25 vehicles	$17.64 (54)	$17.24 (12)	$15.68 (30)
25 or more vehicles	21.62 (5)	16.76 (5)	15.39 (2)

bids. It would appear that it is the "contestability" of the contract market, not whether the sponsor actually uses competitive bidding, which determines whether costs are high or low. Based on the similar cost levels for competitive and non-competitive contract services, it would appear that most contract markets are contestable, even if formal competition does not occur.

CHAPTER FOUR

COST MODELS AND METHODOLOGY FOR ESTIMATING COST SAVINGS

This chapter presents a set of models to estimate potential service contracting cost savings. The models have been developed for the specific purpose of estimating the impact of contracting out a given quantity of existing transit service. Given current financial problems within the industry, any significant implementation of service contracting would require shifting existing services from transit agency to private provision; consequently existing services are of primary interest. Currently available costing approaches are least suitable for estimating impacts of this type of service change. If service which is new to the transit agency is considered for contracting, the more conventional and widely available cost allocation methods are appropriate.

4.1 PROBLEM DEFINITION

The problem addressed here is how to estimate the potential cost savings of contracting a portion of existing transit service. The organizational model of interest is the broker concept: the transit agency (e.g., the public operating entity) retains responsibility and control of the service, but shifts operation to the private provider. As the broker, the transit agency determines service characteristics, receives all service revenue, and monitors the private provider.

In order to estimate potential cost savings, it is necessary to determine how transit agency operating costs change when a portion of service is contracted, and to determine a basis for comparing public and private operator costs. Transit agency costs to be considered depend on the assumptions made regarding service contracting arrangements. For example, significant portions of overhead or administrative costs, such as planning and marketing, may not be reduced when service is contracted if the transit agency retains responsibility for these functions. The appropriate comparison is between the transit agency costs which are reduced as a result of service contracting (net of any additional costs generated by the contracting), and the costs incurred by the private operator in providing the service. These transit agency reduced costs are the incremental costs of <u>not</u> providing the service, and are termed "avoidable costs." Avoidable costs are the appropriate measure of the cost impact on public transit operators of relinquishing service provision responsibility to a private contractor. On the other hand, the private operator must incur the full costs of initiating a new service, and thus full costs are the appropriate measure for private operator costs.

It is important to distinguish between cost comparisons and the estimation of possible service contracting cost savings. Neither simple comparisons of public vs. private costs nor traditional cost allocation approaches are appropriate for the estimation of potential cost savings of existing services. Public-private comparisons give correct estimates of savings to a third-party funding agency, but fail to incorporate cost impacts on the public operating agency.

The use of fully allocated cost estimates are not appropriate for two reasons. First, if the transit agency retains some responsibility for the service, then certain costs will remain even in the long run, and cost allocation approaches will tend to overstate potential cost savings. Second, cost allocation models involve implicit assumptions that costs respond in the same manner to both service increases and decreases, and that all costs are affected proportionately (to output) by the service change. While these assumptions are conceptually reasonable, the nature of the transit service production process suggests this may not be the case. Specifically, the divisibilities of transit inputs (labor and vehicles), and the relationships of factor inputs in production processes are such that reductions in output may not result in corresponding reductions of all inputs. For example, if one mechanic services ten buses, then removing service equivalent to three buses will not reduce the number of mechanics required. On the other hand, if the mechanic is now underutilized, servicing only two buses, then that mechanic's position can be eliminated. Thus, for small service changes, divisibility problems exist, and all costs cannot be expected to decline proportionately. Cost estimations using cost allocation models are appropriate, however, for comparisons of public and private costs.

4.1.1 Transit Agency Costs

Which elements of transit operating cost can be expected to change as a result of service contracting? Direct service costs, including driver labor, fuel and oil costs, etc., are obvious. All operating costs directly related to revenue service should change, while several categories of non-operating costs will be unaffected, and a few categories may even increase (e.g., contract management).

The identification of avoidable costs requires two decisions: 1) identification of agency functions that will be affected by the change, and 2) time frame of the estimate. As discussed previously, some transit agency functions will not be affected by service contracting, since it is assumed that the agency retains responsibility for the service. Thus, the first decision is to identify all costs which are fixed with respect to contracting. Second, a distinction must be made between long-term and short-term impacts. The immediate impact of service contracting will be more limited, because it will take some time for the transit agency to make a full adjustment. Service contracting will have an immediate impact on direct costs, but a less immediate impact on indirect costs.

4.1.2 Private Operator Costs

Deleting service from an established system has entirely different cost implications than providing that service by private providers who must view it as a new service in terms of cost. For the private operator, then, the full costs of providing the service must be considered. Full operating cost, which includes all direct and indirect costs, is the appropriate cost. When the private operator must provide vehicles, their capital cost must be included as well. As with transit avoidable costs, private full costs are defined with respect to contracting arrangements. For example, if the transit agency retains responsibility for marketing, the private operator administrative cost will be correspondingly reduced.

On first examination, using the incremental cost of service reductions of the transit agency and the full costs of the private operator may seem inappropriate. However, costs of providing the same service by two different entities is being compared. Admittedly, this comparison favors the transit agency, because the full transit agency costs (including fixed facility costs) are not taken into account. It is conceivable that if a sufficient quantity of transit service were contracted, some fixed facility costs could be reduced. These fixed costs are inherent in the private operator costs, as all costs must be incorporated in the contract fee if the private operator is to break even and remain in operation. For the purpose of estimating potential cost savings, however, transit agency avoidable costs and private fully allocated costs are the appropriate costs to consider.

4.2 COST ESTIMATION PROCEDURES USED IN PREVIOUS RESEARCH

A number of studies estimating cost impacts of transit service contracting have been conducted. These studies have utilized a variety of methodological approaches and generated a wide range of results.

4.2.1 Cost Allocation Model Approaches

One of the first service contracting studies was conducted in response to expected severe fiscal problems for public transit operators in the Los Angeles region (Southern California Association of Governments, 1982). The study utilized a three-variable cost allocation model calibrated for each of the two major public transit operators in the region to estimate transit service costs. Private operator cost for the same service was based on the reported cost per revenue mile provided by some of the region's private bus operators. Comparison of the public and private cost estimates indicated a potential cost savings of about 50 percent. Use of the transit cost allocation model resulted in an overestimate of cost savings, however, because the model included overhead costs that would not change (e.g., planning, marketing).

A similar approach was used in a comparative analysis of a variety of commuter services (Teal, et al., 1984). Services included regular route express, subscription, buspool, and vanpool. A series of assumptions regarding service characteristics were established, and cost estimates were based on actual data provided by public and private providers. Estimation of both public and private costs were based on cost allocation models. Estimated unit cost differences between public and private express bus service ranged from -11 percent to 43 percent, depending on route length and vehicle utilization assumptions. Since cost allocation models were used, these are long-run, full-cost estimates which do not take into account contract service-related transit agency fixed overhead costs or any adjustment period.

4.2.2 Other Approaches

A Boston study examined the cost impacts of turning over twelve MBTA express bus routes to the private sector (Herzenberg, 1982). In this case, the cost comparison was between the direct (variable) transit agency cost and the full private agency cost. Two key assumptions were made in estimating transit service costs. The first was that labor cost must be estimated as accurately as possible, because it is the largest single transit cost and the most variable. The second assumption was that overhead will not change, because the proposed service package makes up such a small proportion of the transit agency's service. Driver cost was therefore based on the actual wages of the drivers operating the service. Maintenance and fuel cost were based on systemwide averages.

Herzenberg also argued that the private operator estimate must be based on full costs, since the service is new and would require the full incremental cost of maintenance, labor, vehicles, etc. Comparison of these costs indicated that there would be little or no savings resulting from the change from public to private provision if the private operator were required to furnish the vehicles. If the transit agency retains vehicle ownership, however, the Herzenberg study indicated that cost savings would be significant.

One of the most detailed studies of the service contracting was conducted by McKnight and Paaswell (1984). Its purpose was to determine possible contracting cost savings for the Chicago Transit Authority (CTA). A modified cost allocation approach which distinguished between fixed and variable costs was used to estimate CTA cost reductions. Unit costs were developed for selected inputs thought to influence marginal costs of service segments (e.g., labor, tires, fuel, and maintenance). The costing procedure distinguished between short- and long-run costs and incorporated a peak driver cost factor. Due to the marginal nature of the contracting options considered, all administrative and fixed facility costs were assumed fixed.

The cost model was used to analyze specific service reductions on actual routes. Several options were analyzed for cost savings: 1) peak service on both peak-only routes and all-day routes, 2) all-day service, and 3) owl service. The study found that in all cases the private providers could provide similar services at lower cost. The potential savings to the transit agency from contracting for fixed-route service of the selected service segments varied from several dollars per vehicle hour to $28 per revenue hour (up to 60 percent savings).

The research by Herzenberg and by McKnight and Paaswell provides guidance for a suitable modeling approach. Both studies distinguished between fixed and variable costs with respect to contracting, and both studies focused on driver cost as the most significant cost item. Herzenberg's work is an engineering-based, or cost synthesis, approach wherein inputs and their associated unit costs are aggregated to generate a total service cost. McKnight and Paaswell used a fixed/variable cost allocation model, where cost elements were designated as fixed or variable based on the assumed contracting magnitude and service arrangements. Variable costs were then allocated to a combination of inputs and outputs (drivers, miles, and peak vehicles).

In both of these studies, however, the issue of the response of overhead or indirect costs to contracting is avoided, as both deal with very small magnitudes of contracting. If more extensive contracting scenarios are considered, however, changes in overhead costs must be considered. There are two possible assumptions regarding overhead costs. The first is that in the long run, all overhead costs are proportional to output. This is the assumption implicit in cost allocation models. The other assumption takes into account the indivisibilities discussed earlier, and describes indirect costs as a step function, where indirect costs are fixed over a given range of output. Only one such model has been estimated (Morgan, 1978).

4.3 ISSUES RELATED TO SERVICE CONTRACTING ALTERNATIVES

Three issues are discussed in this section which are basic to the development of service contracting alternatives. The issues are: 1) assumptions regarding the organizational and institutional arrangements under which contracting occurs; 2) criteria for selecting the service to be contracted; and 3) the appropriate unit of analysis.

4.3.1 Organizational Arrangements

Opportunities for transit agency contracting are limited by existing labor/management contractual arrangements, as well as by federal legislative protection of the transit labor force (Section 13(c) of the UMT Act). Under federal law, transit employees cannot be replaced by private employees when federal subsidies are involved. Thus, contracting is effectively limited to new service or to the driver attrition rate. Turnover can be used to reduce the transit work force and to gradually shift service to private contractors. For the purpose of this research, it is assumed that the scope of contracting alternatives is limited by the employee attrition rate, estimated at approximately 5 percent per year. Thus, within a five-year planning horizon, a maximum of 20 to 25 percent of the agency's existing service could be contracted.

It is also recognized that efforts to contract existing service may encounter strong opposition from transit labor. Any measure which is perceived as threatening to existing transit jobs will likely be difficult to implement. In view of these labor issues, it is further assumed that service delivery options which minimize the need for cooperative action between the operating personnel of public and private operators are preferable to those which depend on such cooperation. In other words, contracting options which keep the contracted service as separate as possible from the remaining service are preferable.

Several additional assumptions are made to simplify the problem and focus on the important issue of estimating cost savings. It is assumed that all factors which affect demand remain constant, and that the service schedule is fixed. In addition, the transit agency retains all service revenue, so deficit reduction is simply a direct function of cost savings.

4.3.2 Choice of Service to Contract

From the perspective of the transit agency, the best contracting candidate is the most costly work, given that the purpose of service contracting is to reduce cost. How is "most costly work" defined? Since driver cost accounts for about 50 percent of transit operating cost, the most costly work is really determined by driver cost. Work which requires substantial pay penalties, such as overtime or guarantee time, is the most costly. Driver cost also varies more than other cost factors (e.g., maintenance, fuel). One of the best measures for identifying costly work is the ratio of driver pay hours to platform hours. Platform hours is the driving time, or actual work time, and pay hours is the total time for which the driver is paid. The pay hours to platform hours ratio, or "pay/plat," is a measure of the efficiency of the service schedule, given driver work rules. It reflects costs due to both work rules and the characteristics of the service schedule. All other things equal, the more stringent the work rules, the higher the pay/plat. Also, the more peaked the schedule, the higher the pay/plat, because it becomes more difficult to combine pieces of work to make up a regular eight-hour driver run. Any work which cannot be combined effectively will have a high pay/plat, reflecting the extra, non-productive time for which a driver must be paid. Thus, the criterion for selecting service to be contracted is the pay/plat ratio.

In an actual contracting decision, other factors would no doubt be taken into account. For example, the impact of removing a portion of service on the efficiency of the remaining schedule would be considered. Perhaps service from one garage would be chosen in order to maximize opportunities to reduce indirect costs. The geographic location of the service might also be considered. The pay/plat ratio serves as an appropriate guideline to service selection and is satisfactory for illustrative purposes, but would not be the sole criterion in actual application.

4.3.3 The Appropriate Unit of Analysis

The development of service contracting alternatives also requires the identification of the appropriate unit: the run or the route. From a purely theoretical perspective, the run is an appropriate unit. It is a straightforward task to identify the runs with the highest pay/plat and turn them over to contractors. Moreover, the run is an appropriate driver scheduling unit, so removing runs should have no impact on the rest of the schedule.

However, the result of contracting on the basis of runs would in effect be a two-tier driver system. Privately operated runs would require that contract drivers sign up for some subset of runs, just as part-time operators do now. The difference in cost would simply be the result of the differences between public and private average wage and benefit rates and work rules. If the purpose of service contracting is simply to use less costly drivers, it would be more direct to attack the work rules that make transit drivers expensive--e.g., spread penalty pay, guarantee, and make-up pay--and reduce wage and benefit costs. (In fact, this is the purpose of using part-time drivers.) It is thus concluded that contracting on the basis of runs is not organizationally feasible.

From a service demand perspective, the route is a more appropriate unit. The service schedule is designed in terms of routes which serve specific trip patterns. The route approach provides more flexibility in service delivery options, and many of the cooperation issues between public and private drivers are avoided.

Disadvantages of using the route are due to the operational characteristics of transit service. Service schedules tend to be highly integrated, and interlining is common. Many runs are shared between routes, and even bus blocks cross routes.[3] Thus, removing a route could affect the efficiency of the remaining service, and this must be taken into account in the cost estimation procedure. Using routes also could result in removing relatively efficient service, as in the case of an all-day route which provides extra peak service. On the whole, however, the route is the organizationally more appropriate unit of analysis, and is selected for this research.

4.4 THE COST ESTIMATION MODELS

Having developed the framework for the service contracting analysis and identified the basic assumptions used, the cost models are now described. A summary of the contracting decision process is an appropriate starting point.

The objective of service contracting is to reduce the cost of providing transit service. The problem for the transit agency is to identify the service package which provides the greatest potential for reducing service cost. The procedure is as follows:

1. Identify alternative service packages based on cost and service integration considerations.

2. Estimate short-run and long-run avoidable cost of the service alternatives.

3. Estimate private operator cost of the service alternatives.

4. Estimate transit agency administrative cost of contract service alternatives.

5. Compare costs. If net long-run savings are positive, select the package with the greatest potential savings.

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[3] Interlining is the practice of assigning driver runs to more than one route. A driver run is the driver's daily work assignment. A bus block is the daily assignment for a bus. Bus blocks and driver runs are developed in the scheduling process, which assigns buses and drivers to the service schedule.

4.4.1 The Transit Cost Model

The purpose of the transit cost model is to accomplish the second step in the contracting decision process: to estimate the short- and long-run impact of the proposed service change. As mentioned at the beginning of this chapter, the transit model applies to existing rather than new service. The same methodology can be used for service increases; however, the appropriate basis of comparison for service increases is transit agency fully allocated cost, since the agency would incur the full incremental cost of a new service.

The transit cost model is an engineering-type model and is based on factor inputs (e.g., labor, maintenance, administration). It is similar to the Adelaide cost model, which has been rated as the best among all types of agency-specific cost models (Cherwony, et al., 1981). Costs are allocated to input categories, and the change in cost due to a change in service is estimated from the resulting changes in input categories. This approach is in contrast to cost allocation models, which assign costs to output categories and use changes in output to estimate changes in cost. The input approach is more appropriate because it more accurately reflects the underlying production process, and the allocation of specific costs is less subjective.

The model is divided into two parts: driver cost and all other costs. The driver cost portion is very detailed and requires both schedule and wage data. The other portion is much less detailed, and utilizes Section 15 data. An overview of the model is presented here. A full description is available in Appendix B. The transit cost model estimates avoidable cost for both the short run and the long run. In the short run, only the direct service cost--driver cost, fuel and oil, and scheduled maintenance--is reduced. Other maintenance costs, applicable administration costs, and miscellaneous costs are reduced in the long run.

4.4.1.1 Driver Cost

The driver cost estimation begins with runcut data and is based on the average pay/plat ratio for each type of run operated (straight, split, tripper, and part time). The driver cost in pay hours for the contract service package is estimated by calculating the pay hours corresponding to the number and combination of run types in the service package. Average pay/plat ratios are used to offset the peculiarities of a specific runcut, as the particular combination of runs and pay hours making up a given route is likely to change with every runcut. The general form of the driver cost model is illustrated in Figure 4-1.

There are two complicating factors that are also incorporated in the costing procedure: interlining and part-time drivers. Interlining is used extensively, as it allows for more efficient scheduling. Thus, any given route chosen for contracting is likely to have interlined runs. If this service were contracted, the runs would have to be split up, leaving small, leftover pieces of work belonging to the remaining service. It is difficult to determine how interlining will affect the efficiency of the remaining schedule without rescheduling.[4] However, scheduling is a complex and time consuming process, and thus is not practical for planning purposes. As a second-best strategy, alternative assumptions are used in the model to bound the possible impact of interlining. Possibilities range from no impact (all of the leftover pieces can be recombined with no loss of efficiency) to severe impact (one-third of the leftover pieces cannot be recombined and must be operated as trippers).

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[4] Scheduling is the process of assigning buses and drivers to the service schedule.

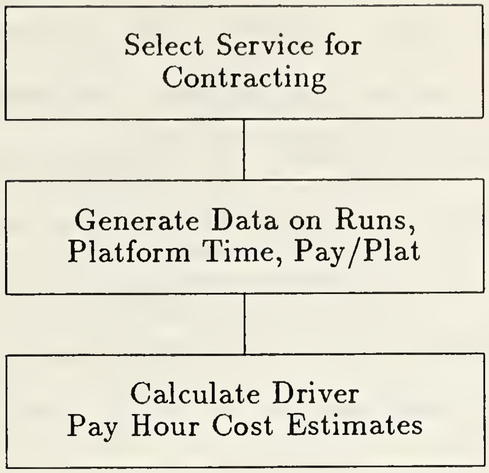

FIGURE 4-1

FLOW CHART FOR THE GENERAL FORM OF THE DRIVER COST MODEL

Part-time drivers also must be considered in the driver cost estimation. Part-time drivers generally have lower wage rates, receive fewer benefits, and are subject to less restrictive work rules than full-time drivers. Thus, part-time and full-time driver costs are calculated separately. Transit agency driver attrition policy is also taken into account. Alternative assumptions are employed to reflect whether the full-time and part-time drivers decline in proportion, or whether part-time drivers are retained and assigned to other service, thus reducing the cost of the remaining service.

Once the avoidable driver cost is estimated in pay hours, appropriate wage and benefit cost factors are applied to generate a dollar cost. These cost factors are derived from Section 15 data. The resulting driver cost estimate represents the scheduled cost of operating the contract service package. The cost of covering for driver absences, providing relief for vacations, etc., is not included. An unscheduled cost factor is added to account for these costs. The unscheduled cost is estimated using both schedule and Section 15 data, and the unscheduled cost factor is applied on the basis of platform hours.

A flow chart of the driver cost model is presented in Figure 4-2. To summarize, the driver cost model uses the pay/plat ratio for different types of runs, and the distribution of runs in different types of service to estimate the reduction in platform hours resulting from contracting a given quantity of existing transit service. The model considers the impact of the change on the remaining service schedule, and accounts for cost differences of full-time and part-time operators. Service cost in terms of pay hours is used as a basis for generating wage, fringe and unscheduled cost. The resulting sum is the total driver cost of the service.

4.4.1.2 Other Costs

Section 15 data are used to estimate all other costs. As discussed previously, the cost model is constructed on the basis of factor inputs or functional categories, rather than on an allocation of costs to output categories. The Section 15 expense data are classified by function and object class. The cost model categories are simply aggregations of the

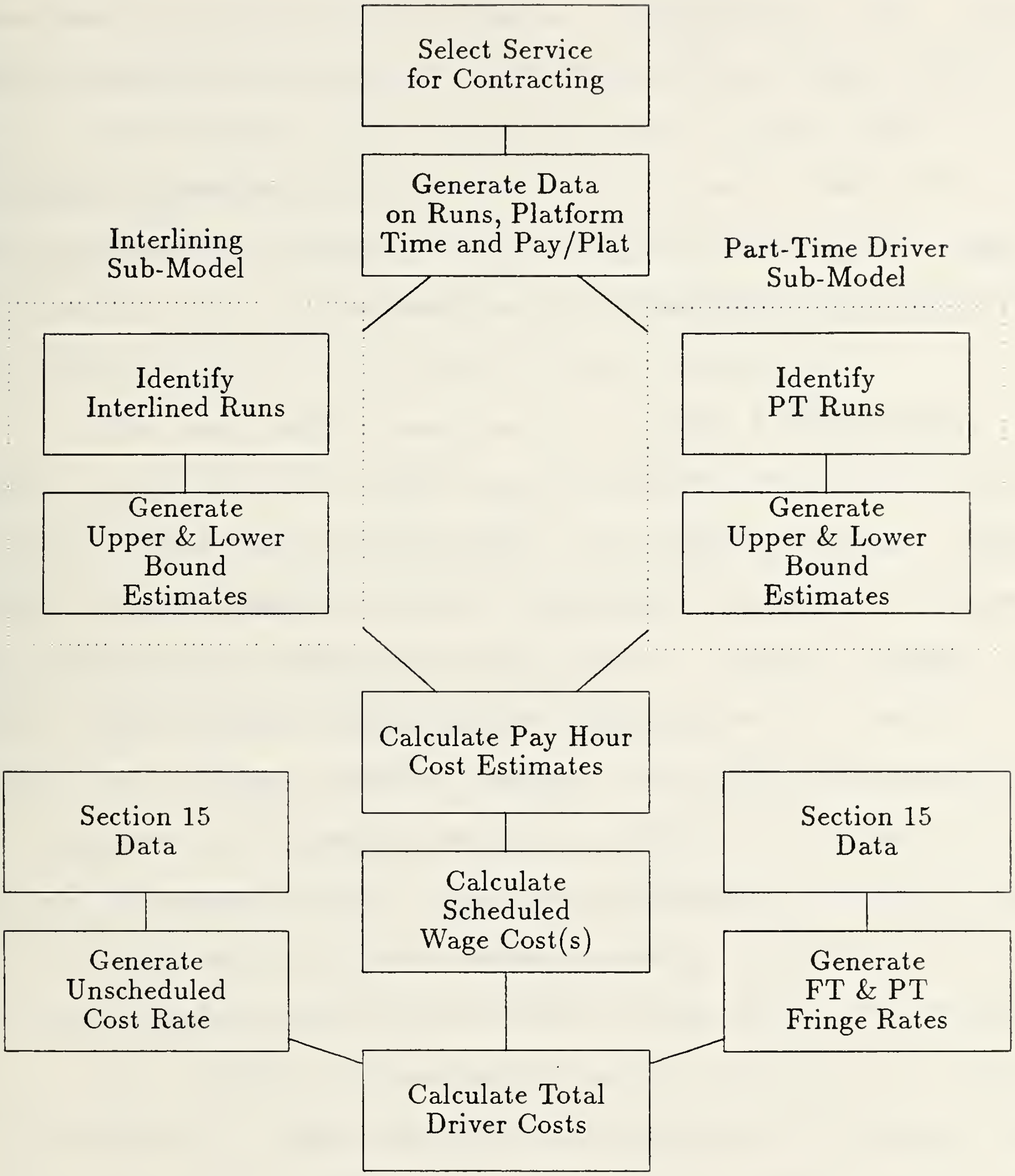

FIGURE 4-2

FLOW DIAGRAM FOR THE DRIVER COST MODEL

Section 15 functions with some minor adjustments.[5] Four additional cost categories were identified: direct operating cost, maintenance, administration, and other. These categories are reasonably homogeneous with respect to short-term vs. long-term effects and representative of actual transit service inputs. The Section 15 functions, the cost model category to which each was assigned, and short-run and long-run variability is included with the transit cost model description in Appendix B.

4.4.1.2.1 Direct Vehicle Cost

Direct vehicle cost includes fuel, oil, and tires, as well as scheduled maintenance and vehicle servicing. Using the same logic as with drivers, it is assumed that maintenance labor associated with these functions can also be reduced through attrition. However, it is also possible that the extra labor could be assigned to other tasks, or that maintenance labor needs are not strictly proportional to output. In order to develop avoidable cost estimates which are as realistic as possible, alternative assumptions are employed. The "optimistic" estimate assumes full attrition of related maintenance labor; the "pessimistic" estimate assumes that 50 percent of the related labor is fixed in the short run. Direct vehicle cost is calculated by developing a unit cost factor (cost per total vehicle mile) from the Section 15 data.

Only driver cost and direct vehicle cost are assumed to be variable in the short run; all other costs are fixed. For example, there is no reason to

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[5] The cost model was developed from the long form (Level A) of Section 15. However, not all transit agencies report at the A level. Corresponding categories were developed for the other reporting levels. Because the cost information is much less detailed, the correspondence is not exact.

believe that the transit agency's administrative staff, facilities staff, etc., would be immediately affected by a 5 percent reduction in service. The short-run cost model, then, consists of driver and direct vehicle costs.

4.4.1.2.2 Long-Run Costs.

Estimation of long-run cost is affected by service contracting arrangements. The distinction between fixed and variable long-run avoidable cost is based on the following service contracting assumptions:

1. **The transit agency supplies the vehicles.** Vehicle cost is much lower for the transit agency than for the private operator, and for existing service, transit vehicles are readily available. Since the transit agency retains ownership, depreciation need not be considered in the cost estimates. It is also assumed that the transit agency retains vehicle insurance.[6]
2. **The private operator maintains the vehicles.** All vehicle and related maintenance is therefore variable in the long run.
3. **The transit agency retains responsibility for service planning, marketing, and general administration.** The use of service contracting does not imply that the transit agency's responsibility for planning and developing service within its jurisdiction changes. Only the operating responsibility changes. Thus all

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[6] At the time this research was initiated, insurance costs had not yet begun to escalate dramatically. As of this writing, insurance has become a major problem for both private and public operators. No attempt is made here to estimate the increase in cost that could result from any changes in service arrangements, because no data were available from which reasonable estimates could be made.

expenses related to planning, marketing, and general administration (e.g. the general manager's office) are also fixed in the long run. The extra cost due to contract administration is not considered here; it is included as part of the private operator contract cost.

4. **The transit agency retains all fare revenue.** The transit agency continues to have responsibility for ticketing and fare collection activities; thus, related costs remain fixed in the long run.

5. **The transit agency retains public information activities.** Since the transit agency retains ultimate responsibility for all services, it is reasonable to keep these activities as well.

6. **The transit agency retains responsibility for all fixed facilities.** It is assumed that the transit agency retains ownership of stations, buildings, etc. Thus, maintenance of these facilities is also fixed in the long run, with the possible exception of routine maintenance of passenger stations.

It should also be noted that all fixed facility costs are assumed fixed in the long run. While a large amount of contracting could lead to the elimination of some fixed facilities, data are not available to accurately estimate the change in capital cost, and such changes would likely only occur in the very long run and at a scope of contracting beyond that considered in this research. This issue is further discussed in Chapter Five.

These assumptions generate a category of long-run fixed costs which are incorporated in the model. The remainder of the long-run costs are variable and assumed to be directly proportional to output measured in annual vehicle hours. While this is admittedly a strong assumption, data are not available on the long-run response to major transit service reductions. Long-run maintenance cost includes maintenance items related to service use (e.g., service vehicles, communications systems, garage and shop buildings). Long-run administrative cost includes service-related administration (e.g., personnel, accounting, transportation administration). Long-run fixed cost includes all functions related to the activities the transit agency is assumed to retain. Other cost includes miscellaneous items.

Given that the transit agency retains a number of activities associated with the contracted service, it difficult to determine whether certain costs are fixed or variable in the long run. These include items like station maintenance and system security. Alternative assumptions are again used to bound the avoidable cost estimate. The optimistic estimate assumes these costs are variable; the pessimistic estimate assumes they are fixed.

4.4.1.3 Summary of the Transit Cost Model

A flow chart of the short- and long-run transit cost model is presented in Figure 4-3. To summarize, the estimation of transit agency avoidable cost is a multi-step procedure, in which the various submodels are used sequentially to generate an avoidable cost estimate. First, the driver cost model is used to estimate driver cost. Second, short-run costs are computed by using Section 15 data to calculate direct vehicle costs and adding these to driver cost. Section 15 data is also used in the third step to calculate the long-run costs. Long-run cost change is estimated as a direct proportion of the service change. The purpose of the model is to estimate the short-run and long-run impact of service contracting as accurately as possible. Fixed and variable long-run costs as determined by contracting service arrangements are identified and incorporated in the model. The model is quite flexible, and can easily be adjusted to reflect different service contracting arrangements.

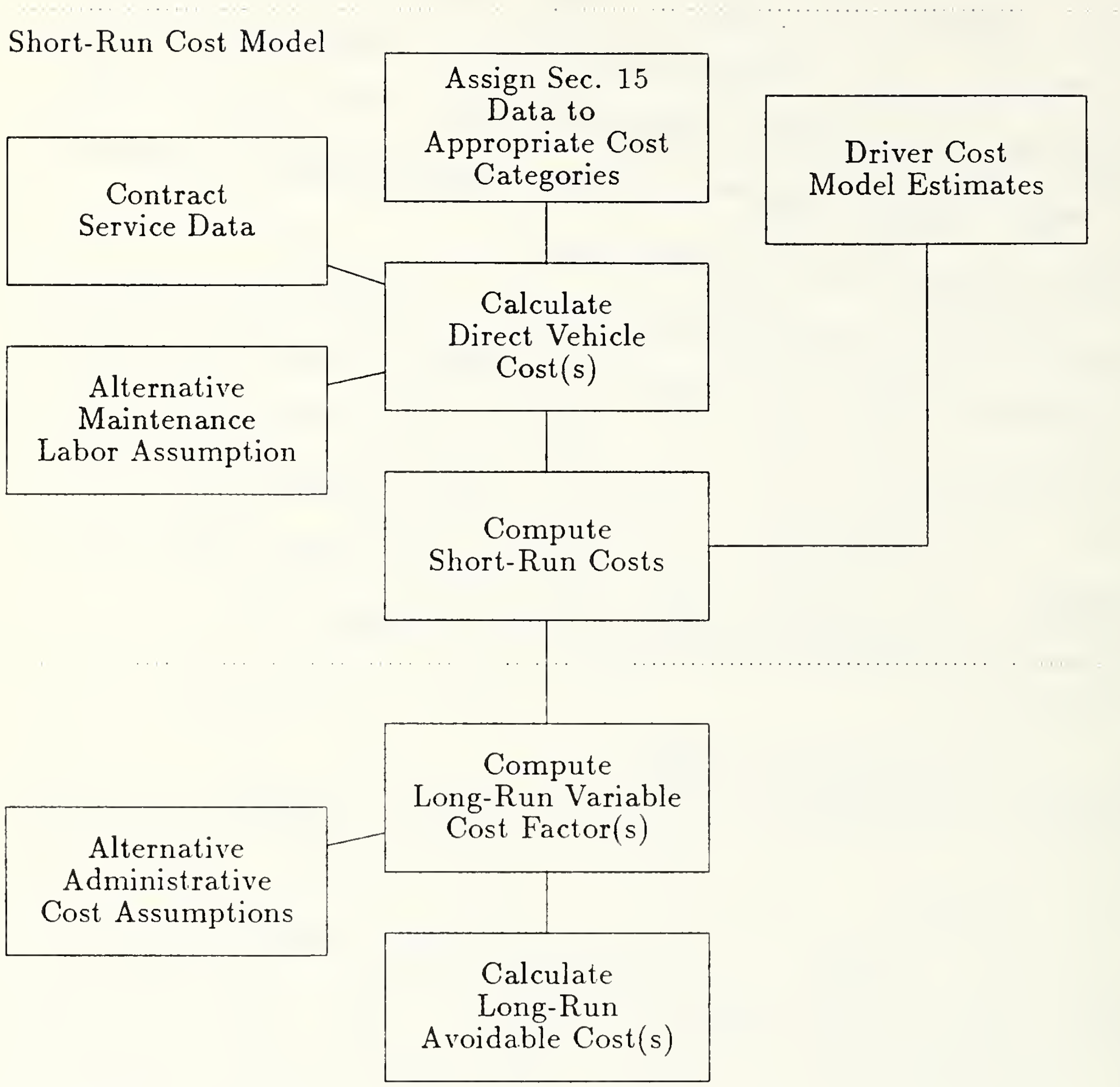

FIGURE 4-3

FLOW CHART OF THE SHORT- AND LONG-RANGE TRANSIT COST MODEL

A series of alternative assumptions are used to account for cost impacts which cannot be calculated directly and for possible alternative transit agency actions. These alternative assumptions are combined to generate three different avoidable cost estimates: optimistic (upper bound), pessimistic (lower bound), and most probable. The assumptions corresponding to each of the cost estimates are presented in Table 4-1.

4.4.2 The Private Operator Cost Models

In any actual implementation of service contracting, private operator cost would be determined by the bid prices received. However, in order to estimate potential cost savings in this research, private service cost must also be estimated. It should be noted that these estimates are made on the basis of the limited data available to the research team.

Like public transit service costs, private operator costs vary by type of service. Although private operator driver work rules are generally much less restrictive than those of public transit, service which requires vehicles and drivers for only a few hours per day is more costly than all-day service. Two different private operator cost models, one for express service and one for all-day service, are used to estimate private operator costs.

4.4.2.1 Peak Period Service

Estimates of peak-period service cost were derived from a fully-allocated cost model developed in conjunction with a previous UMTA study (Teal, et al., 1984). The cost model estimates the daily cost of serving a particular bus route based on the number of buses required, driver pay hours, and total service miles. The cost model includes both operating and capital costs. For the purpose of this research, the capital cost component of the

TABLE 4-1

ASSUMPTIONS USED TO GENERATE ALTERNATIVE TRANSIT AGENCY AVOIDABLE COST ESTIMATES

Cost Category	Optimistic: High Avoidable Cost	Pessimistic: Low Avoidable Cost	Most Probable Avoidable Cost
Driver Cost			
Interlining:	Assume all leftover pieces can be reincorporated in schedule with no loss of efficiency	Assume 1/3 of all leftover pieces must be operated as trippers	Assume all leftover pieces can be reincorporated in schedule with no loss of efficiency
PTO's:	Reduce only full-time drivers through attrition; retain current number of part-time drivers	Reduce both full-time and part-time drivers through attrition in proportion to use on contracted service	Reduce both full-time and part-time drivers through attrition in proportion to use on contracted service
Direct Vehicle Cost* (Short Run Only):	Maintenance labor declines in same proportion as amount of service contracted	Maintenance labor declines at 50 percent of proportion of amount of service contracted	Maintenance labor declines at 75 percent of proportion of amount of service contracted
Long-Run Cost**	Proportional reduction in cost of miscellaneous functions	No reduction in cost of miscellaneous functions	No reduction in cost of miscellaneous functions

* In all long-term scenarios, all direct vehicle costs are reduced in the same proportion as amount of contracted service.

** Includes administrative, maintenance, and other costs. In all short-term scenarios, there is no reduction of administrative costs.

model (including insurance costs) was removed, leaving driver costs, maintenance costs, direct operating costs, and administrative and overhead costs as the relevant service costs. A ten percent allowance for profit is also included. The cost model was calibrated on private operator cost data collected in the San Francisco, Los Angeles, and Houston metropolitan areas. Specific details on the model are provided in Rooney and Teal, 1986.

As with the transit cost model, alternative assumptions regarding driver utilization and maintenance cost were employed to generate upper and lower bound cost estimates. Three driver utilization assumptions were employed. In the most costly scenario (pessimistic), drivers were assumed to receive a four-hour pay guarantee per bus dispatch. Since an AM and PM peak service would require two dispatches, eight hours' driver pay per bus is necessary in this scenario. In the least costly (optimistic) scenario, drivers are paid only for hours worked (i.e., platform hours), as is the case with part-time drivers at some large transit agencies. The most probable assumption is that drivers are paid only for hours worked, but are guaranteed a minimum of two hours' pay per work assignment. These assumptions are based on informal surveys and previous research on private costs by the authors. In all cases, drivers are assumed to be paid $7.50 per hour, plus 25 percent fringe benefits, for a total of $9.38 per hour. This wage rate is multiplied by the number of (private operator) pay hours per day for a particular route to obtain the driver cost.

Maintenance labor costs are estimated per vehicle mile, and three different assumptions are employed: optimistic ($.30/mile), pessimistic ($.45/mile), and most probable ($.40/mile). These estimates were based on reported private operator cost data. All other direct operating costs (fuel, oil, tires, maintenance parts, etc.) are estimated at $.35/mile. A profit factor of 10 percent is added to all variable cost items. Administration and overhead costs are estimated at $10,000 per bus per year, plus a 10 percent allowance for profit. The cost factors and alternative assumptions of the peak-period service cost model are presented in Table 4-2.

TABLE 4-2

PRIVATE CONTRACTOR PEAK-PERIOD SERVICE COSTS

Cost Component	Optimistic: Low Operating Cost	Pessimistic: High Operating Cost	Most Probable Operating Cost
Driver Cost	Paid for platform hours only	4 hours per shift pay guarantee	2 hours per shift or platform hours, whichever is greater
Profit on Driver Cost	10%	10%	10%
Maintenance Cost	$.30/mile	$.45/mile	$.40/mile
Direct Operating Cost	$.35/mile	$.35/mile	$.35/mile
Profit on Mileage Related Costs	$.07/mile	$.07/mile	$.07/mile
Administrative/ Supervision/ Overhead Cost	$10,000/bus/year	$10,000/bus/year	$10,000/bus/year
Profit	10%	10%	10%

While the cost data used to generate the parameters of the private operator cost model were obtained from a variety of sources, it is possible to assess the reasonableness of the parameters by comparing them to public agency cost levels. One particularly illuminating comparison is with the costs of Pace, the public transit operator in the suburban area of Chicago. Pace represents a particularly useful comparison because its four operating divisions were all private bus operations (albeit subsidized operations) well into the 1970's; the cost levels of these divisions thus should be closer to private operator costs than to the cost levels of long-standing public transit agencies. Moreover, no systemwide marketing, planning, public information, or general administration costs are charged to the operating divisions. Therefore, the operating division's administration and overhead cost factors should be comparable to that of a contractor.

For 1986, the four Pace operating divisions had an average overhead cost (general administration plus non-vehicle maintenance plus leases and rentals) of $12,000 per bus, with two of the divisions having an overhead cost of $10,000 per bus. This indicates the $11,000 per bus administrative/overhead cost (including profit) used in the private operator cost model is quite plausible. These Pace divisions also had an average maintenance labor plus direct vehicle operating cost of $.80 per vehicle mile, with two of the divisions having a cost of less than $.70 per mile or less, and one division generating a cost of only $.55 per mile. The comparable cost in the private operator cost model was $.75 per mile (for the most probable cost level) without profit, or $.82 per mile with allowance for profit. This latter comparison indicates that the private operator cost levels for these parameters are not only realistic, but possibly overestimated. Overall, the comparison with Pace cost levels indicates the realism of the cost parameters used in the private operator cost model.

It is assumed that the service requirements (total vehicle miles and total platform hours) for a contract operator are the same as for the existing public transit operator. This is likely to be an incorrect assumption because public and private operator garage locations are no doubt different, and different amounts of deadhead would result from shifting service provision. However, since the location of the private operator is unknown, it is the only possible assumption that can be used.

4.4.2.2 All-Day Fixed-Route Service

A much simpler unit cost approach was used to estimate the cost of a private operator providing all-day fixed-route service. As before, it was assumed that the public agency provides the vehicles and pays for insurance. The nominal private operator cost is estimated on the basis of a flat rate per revenue vehicle mile (RVM), multiplied by the total number of revenue miles needed to serve the package of contracted service. The mileage rate is determined by the size of the service package to be contracted and the size of the transit agency. These rate differences account for the different sizes of private operators that could bid on the service. For transit agencies with more than 150 vehicles, the rate is $2.35 per RVM. The $2.35 figure represents the 1985 estimated average costs of 18 privately contracted fixed-route systems which operate more than 25 vehicles (Chapter Three). In a number of systems around the country fixed-route service is being supplied by contractors for <u>less</u> than $2.35 per RVM, so this figure appears to be reasonable and conservative.

As with the peak-only service, the costs for all-day service are bounded. The optimistic estimate is $2.00 per revenue vehicle mile, a cost threshold below which many small contracted services operate. The pessimistic estimate is $2.75 per RVM, a cost level exceeded by only a few private contractors, none of which obtained their contracts through competitive bidding. For transit systems with between 25 and 150 vehicles, the optimistic, pessimistic, and most probable estimates used are $2.00, $2.35, and $2.20 respectively. A flat rate of $1.88 is used for transit systems with less than 25 vehicles, as will be explained further in Chapter Five.

When an all-day service is heavily peaked (at least two times as much peak as base service), both methods are used. The peak portion of service is estimated with the peak service model, and the remaining service is estimated using the appropriate mileage rate. In most cases it is possible to disaggregate the service package into peak period and all-day service and to treat them as completely separate components for costing purposes.

It may be noted that none of the possible indirect cost savings due to private service provision are incorporated in the cost estimates. For example, private operators would pay vehicle registration and other fees and taxes that public agencies are exempt from paying, thus offsetting some of the transit subsidy requirements. While this approach may slightly underestimate potential cost savings, it maintains a consistent approach to both public and private cost estimates.

4.4.2.3 Public Agency Administrative Costs for Contract Services

For all service contracting scenarios, it was assumed that the public transit agency would incur significant additional administrative costs to monitor the contractor's performance and to assist in the service delivery process. The additional contract monitoring costs were estimated to be from 5 to 10 percent of the annual total private service operating costs, with minimum and maximum expenses depending on the amount of service contracted. Table 4-3 presents the alternative assumption for public agency monitoring cost.

4.5 COST COMPARISONS

The final step in the contracting decision process is the comparison of transit agency avoidable cost and private contractor operating costs. The comparison is made by identifying the service requirements of the contract

TABLE 4-3

TRANSIT AGENCY MONITORING COST ALTERNATIVE ASSUMPTIONS

Transit Agency Size	Optimistic: High Operating Cost	Pessimistic: Low Operating Cost	Most Probable Operating Cost
Less than 25 vehicles	5% of contract cost; $30,000 minimum	10% of contract cost; $75,000 minimum	7.5% of contract cost; $50,000 minimum
25 to 150 Vehicles	5% of contract cost; $50,000 minimum	10% of contract cost; $100,000 minimum	7.5% of contract cost; $75,000 minimum
Greater than 150 Vehicles	5% of contract cost; $75,000 minimum $300,000 maximum	10% of contract cost; $100,000 minimum $1,000,000 maximum	7.5% of contract cost; $100,000 minimum $500,000 maximum

service package and calculating the optimistic, pessimistic, and most probable cost for the transit agency and the private operator. These calculations yield a total of six different cost estimates (three for each operator). The entire range of cost differences is captured by comparing the pessimistic estimates and the optimistic estimates. That is, the lowest possible transit avoidable cost is compared with the highest possible private operator cost, yielding the cost comparison least favorable to contracting. Similarly, the highest possible transit avoidable cost is compared with the lowest possible private operator cost, yielding the cost comparison most favorable to contracting. Finally, the most likely estimate of cost differences is obtained by comparing the most probable transit and private service cost estimates. These comparisons can be made for both short-run and long-run cost estimates. The cost comparison scenarios are summarized in Table 4-4.

TABLE 4-4

CHARACTERISTICS OF COST SCENARIOS

Cost Scenario	Transit Agency Cost	Private Contractor Cost
Optimistic	High avoidable cost	Low operating cost
Pessimistic	Low avoidable cost	High operating cost
Most probable	Most probable avoidable cost	Most probable operating cost

The complete set of cost models were used to conduct a series of case studies. Service contracting scenarios were developed for a total of 22 transit agencies. Model application results are presented in the following chapter.

CHAPTER FIVE

ANALYSIS OF COST SAVINGS FOR TWENTY-TWO TRANSIT SYSTEMS

This chapter describes the results of an application of the models described in Chapter Four to data from twenty-two case study agencies. The Chapter begins with a brief description of the agencies participating in the study and a discussion of the methodology used for their selection. Because of the sensitivity of this research, the agencies are not identified by name in the discussion of research results.

5.1 DESCRIPTION OF CASE STUDY TRANSIT SYSTEMS

5.1.1 Criteria for System Selection

The first task in the case study applications was the selection of a sample which would be reasonably representative of the nation's transit industry in terms of size and geographic location. A mix of small, medium, and large agencies was desired; diversity was necessary to capture regional differences in wage rates, climate, and transit operating conditions. Practical considerations were also important. The transit systems selected had to be both willing to participate in this study and capable of providing extensive, accurate data. A sample size of twenty systems was sought. In order to increase the representation of small systems without reducing the number of large systems selected, two systems of 25 or fewer vehicles were added, bringing the total sample size to twenty-two systems.

The systems originally selected for case study analysis were located in the following cities:

Santa Rosa (CA)	Oshkosh (WI)
Altoona (PA)	Reno (NV)
Bridgeport (CT)	Tucson (AZ)
Memphis (TN)	Madison (WI)
Louisville (KY)	Hartford (CT)
Nashville (TN)	Indianapolis (IN)
Salt Lake City (UT)	Cincinnati (OH)
Milwaukee (WI)	Denver (CO)
Dallas (TX)	Houston (TX)
San Jose (CA)	Pittsburgh (PA)
Seattle (WA)	Minneapolis - St. Paul (MN)

Agencies in Nashville, Indianapolis, and Milwaukee were unable to provide sufficient driver schedule data and were thus excluded from the sample. They were replaced by Long Beach (CA), San Diego (CA), and Portland (OR), respectively. The final sample, which is presented by size categories in Table 5-1, has something of a Western bias. The three systems which were dropped from the sample due to data limitations were from the Eastern half of the country; to ensure timely reporting of the results of this study, they were replaced by systems located on the Pacific Coast.[7]

5.1.2 Operating Characteristics of the Systems

The twenty-two systems selected for analysis featured a wide range of costs, service profiles, wages, and work rules. Excluding the three smallest systems, operating cost per revenue vehicle hour ranged from $29 to $71. Even

[7] Given the time constraints of the study, it was judged to be more important to obtain data from systems of similar size already known by the researchers than to seek a rigorous geographic balance. These agencies were all located on the West Coast.

TABLE 5-1

CASE STUDY SAMPLE AGENCIES BY SIZE CATEGORY

Size Category	# Peak Vehicles	Agencies	
Small	0 to 25	Santa Rosa, Altoona, Oshkosh	(N=3)
Medium	26 to 150	Bridgeport, Tucson, Memphis, Madison, Reno, Long Beach	(N=6)
Large	151 to 500	Louisville, Portland, Hartford, San Jose, Cincinnati, San Diego, Salt Lake City	(N=7)
	Over 500	Dallas, Seattle, Pittsburgh, Houston, Denver, Minneapolis-St. Paul	(N=6)

the larger systems (those of more than 250 vehicles) demonstrated a wide range of operating costs, from $39 to $71 per revenue vehicle hour. Peak-to-base ratio ranged from 1.0 to 2.9 for the entire sample; for the larger systems, peak-to-base ratio ranged from 1.3 to 2.9. Operating speeds varied from 11.6 MPH to 16.9 MPH. Driver wages plus fringe benefits ranged from $10.54 per hour to $19.70 per hour, although only four of the nineteen systems had total driver compensation rates of less than $15 per hour. Work rules also varied considerably, with some agencies precluded from employing part-time drivers, and others permitted to employ from 7 to 45 percent of their driver force as part-timers. Maximum spread times varied from 11.5 hours to 13.5 hours. The systems in our sample were thus quite diverse in both cost and operating characteristics.

This diversity is significant in terms of the reliability of our results. It was not possible to choose a large sample because of the time and expense this would entail, or even a truly random sample, due to the difficulty in obtaining sufficient data from many transit agencies. Every attempt was made, therefore, to choose a representative sample. Results for a representative sample of systems would, presumably, have a high level of confidence associated with them. The diversity of cost, work rules, and operating characteristics in the sample chosen does not guarantee representativeness, but it does indicate that there is a relatively high likelihood that the systems of 25 or more vehicles are broadly representative of the public transit industry.

5.2 RESULTS OF THE COST ANALYSIS

The cost models described in Chapter Four were used to conduct case study analyses of the twenty-two transit systems. This section summarizes and explains the case study results. Full results of the case studies for each system are presented in Appendix C.

The case study transit systems were divided into three size categories: small (less than 25 peak vehicles), medium (25 to 150 peak vehicles), and large (150 or more peak vehicles). The 150 vehicle cutoff was selected for two reasons. First, our national survey of transit service contracting (Chapter Three) revealed a significant difference in cost between private operations of less than 25 vehicles and those with more than 25 vehicles. For an agency operating 150 vehicles, contracting of 20 percent of existing service--the maximum possible under the assumptions used here--would result in a service package of roughly 25 to 30 vehicles. The costs reported for the private operations of 25 or less vehicles might not be applicable for the potentially larger service packages developed by transit systems operating more than 150 vehicles.

Second, there are size-related differences among public transit agencies. A range of 150 to 250 vehicles seems to be the limit for a one-garage operation, and multiple garages imply a different service production process. Agencies of less than 150 vehicles, on average, also provide very little peak-only service, and therefore have a potentially more efficient service schedule. Finally, four of the six case study agencies within this size category report Section 15 data at the less detailed "R" level, necessitating some adjustments of the transit avoidable cost model.

For the smallest systems, it was assumed that service contracting would be an "all or nothing" decision, as there would be no incentive to incur the burden of monitoring a contractor while continuing to operate some small amount of service. In addition, it would be very difficult to remove a significant portion of service without adverse effects on the remaining schedule. Thus for the smallest systems, it was assumed that the whole system would be contracted.

For each transit agency with more than 25 vehicles, at least two service packages were identified, comprising 5 percent and 20 percent, respectively, of the agency's existing service. The 5 percent package corresponds to the first year of contracting, and the 20 percent package represents the maximum possible for a five-year planning horizon given the assumptions presented previously.

The service packages selected consisted of fixed-route service only; no DRT or other special services were included. The unit of service was the route. Routes were selected by calculating the pay hour to platform hour ratio for each route, and choosing routes in rank order of the pay/plat ratio. This procedure selected predominantly peak-oriented routes first, as would be expected. For a few of the largest agencies, an all-day service package was also selected in order to generate comparisons for both peak and non-peak service. This was not necessary for the medium and smaller systems, as peak service was exhausted long before the 20 percent limit was reached.

5.2.1 Small System Results

Case studies of three systems with less than 25 peak vehicles were performed. All were municipal systems, each located in a different region of the United States. Operating and cost characteristics of these systems are given in Table 5-2. Costs of Systems B and C are low, as is typical of small systems. System A is located in a high-cost region and has somewhat less favorable work rules than Systems B or C. System B pays a very low overtime rate, can hire up to 40 percent part-time drivers, and has no 8-hour per day guarantee for extraboard drivers. System C provides a 40-hour per week guarantee for drivers and uses part-time drivers with a wage rate of $4.25/hour for the extraboard.

It was assumed that the entire system would be contracted. The cost estimation method was adjusted to reflect the entire system contracting alternative, the much less detailed Section 15 data provided by the small systems, and the lower costs of small private systems. It was assumed that vehicle insurance would become the responsibility of the private contractor, as the public agency would have no reason to retain insurance if it were no longer an operating entity.[8] Costs are long run only, and account for the fixed monitoring, planning, and administrative responsibilities of the transit agencies. Private operator costs are estimated at a flat rate of

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[8] Vehicle insurance costs have risen dramatically during the past year (1986). The insurance cost estimates used here reflect a midpoint of a wide range of estimates gathered via an informal telephone survey of private operators.

TABLE 5-2

CHARACTERISTICS OF THREE SMALL SYSTEMS

System	No. Peak Vehicles	Ave. Cost/RVH	Driver Wage Rate	Peak/Base
A	12	$37.00	$9.48	N/A
B	24	29.00	8.94	2.5
C	21	27.80	9.08(4.25)[a]	1.5

a = Part-time operator wage

$1.88/RVM, the national average (increased by 5 percent from the actual 1984 average to account for higher costs in 1985) for small privately contracted fixed-route systems as indicated by our survey data (Chapter Three). An estimate of insurance costs plus monitoring costs of 5 to 10 percent are also added to the contract cost.

Results are presented in Table 5-3. Differences between the optimistic, pessimistic, and most probable estimates are due to the alternative contract monitoring cost assumptions. Since private operator costs are calculated at a constant rate, possible cost savings are directly related to transit systems costs. System A could realize small but significant savings, while System C would incur higher costs. System B would realize very limited savings from contracting. These results are reasonable, considering the characteristics of these systems. Given the level of efficiency of System C, the difference in private operator cost is not enough to offset the fixed administrative and monitoring costs associated with the contracting option. The opposite is the case for System A.

The limitations of the analysis of small systems must be emphasized. These systems are included in the analysis for illustrative purposes only.

TABLE 5-3

COST SAVINGS FROM PRIVATE CONTRACTING FOR THREE SMALL SYSTEMS

System	Optimistic	Pessimistic	Most Probable
A	10%	6%	8%
B	6	2	4
C	-5	-10	-7

Due to the small sample, the less detailed Section 15 data, assumptions about insurance costs, and the difficulty of precisely determining the amount of overhead costs which are eliminated when the entire system is contracted, the results cannot be considered definitive. Three agencies is obviously much too small a sample from which to generalize results, given that several hundred transit systems of this size (25 or fewer vehicles) exist in the United States. Moreover, the cost assumptions used were deliberately chosen to be conservative. For example, many small competitively contracted fixed-route systems had 1984 operating costs of less than $1.79/RVM. In addition, because the entire service is contracted for small systems, the public agency will be able to save money by disposing of fixed facilities, an eventuality not considered in the cost analysis. The inaccuracies in predicting savings are likely to result in underestimating the savings from contracting.

5.2.2 Medium Size System Results

A total of six case studies were performed for systems of 25 to 150 peak vehicles. Descriptive characteristics of the case study systems are presented in Table 5-4. The driver compensation rate includes wages and benefits and is

TABLE 5-4

CHARACTERISTICS OF MEDIUM SIZE CASE STUDY SYSTEMS

System	# Vehicles	$/RVH	Driver wage + Benefits/Hr[a]	Peak/ Base Ratio	Pay/Plat Ratio
D	31	$29.26	$10.54	1.0	1.060
E	40	49.51	14.91	1.1	1.130
F	120	39.29	12.22	1.8	1.054
G	130	43.02	17.00	1.4	1.110
H	142	42.14	15.21	2.0	1.073
I	144	45.02	16.50	1.4	1.178

[a] Full-time drivers only.

calculated from Section 15 data. The "pay/plat ratio" is the ratio of scheduled pay hours to platform hours (actual driving hours) for the weekday schedule. It is a measure of schedule efficiency, and depends on both the service profile (e.g., peak/base ratio) and driver work rule constraints. A value of about 1.04 is the absolute minimum, since drivers receive 5 to 10 minutes of paid report or check-in time at the beginning and end of each assignment. The pay/plat ratio is calculated from schedule (runcut) data.

The medium size transit systems are less complex operations than the larger systems for which the costing methodology was developed. All are one garage operations; four of the six report Section 15 data only at the "R" level, and four systems had only limited schedule data available. Because of data limitations, a much simpler method of estimating avoidable cost was employed. Simplifying assumptions used are: 1) interlining impacts are not considered (implying that service contracting will not have any impact on the remaining schedule), 2) all maintenance cost (including maintenance administration) is variable in both the short run and long run, and 3) a flat

50 percent of administrative cost is fixed in the long run. (The remainder is assumed to represent such items as planning, marketing, and general management, expenses which do not vary with the level of contracting.) Private contractor cost estimates were also simplified; all estimates were calculated on the basis of revenue miles, since so little peak service was involved. As indicated in Chapter Four, the optimistic, pessimistic, and most probable private contractor costs are, respectively, $2.00, $2.35 and $2.20 per RVM. Since only one estimate of transit agency avoidable cost is made, the difference in the optimistic, pessimistic, and most probable estimates are the result of the alternative private operator cost assumptions. Also, the difference between short-run and long-run transit agency avoidable cost is the indirect administrative cost.

The service packages were constructed by selecting routes in rank order of pay/plat ratios. Table 5-5 gives short-run and long-run results for the 5 percent service packages. The 5 percent packages include all of the peak-only service provided by the transit agency, but in most cases also contain all-day service. The short-term results correspond to the first year of implementation, when only the direct transit service cost is assumed avoidable. The long-term results correspond to total adjustment of the transit agency. Cost savings are calculated as a percent of avoidable cost.

The results in Table 5-5 indicate that for most medium size agencies, significant cost savings are likely in the long run, but that cost reductions will be much smaller, and possibly non-existent, in the short run. The much smaller (and potentially negative) short-run savings are attributable to the assumed absence of administrative cost reductions by the transit agency in the first year of implementation, as well as by the different private operator cost assumptions. These represent conservative estimates, in that actual

TABLE 5-5

ESTIMATED COST SAVINGS FOR 5 PERCENT SERVICE PACKAGES
FOR MEDIUM SIZE SYSTEMS

System	Short Run			Long Run		
	Optimistic[a]	Pessimistic	Most Probable	Optimistic	Pessimistic	Most Probable
D	-18%	-45%	-23%	-5%	-30%	-10%
E	12	-11	6	25	5	19
F	-10	-32	-25	-4	-26	-18
G	33	19	24	43	31	35
H	-4	-25	-18	15	-3	3
I	24	8	13	30	15	19

[a] Optimistic estimates give the difference between the highest transit agency avoidable cost and the lowest private cost. Pessimistic estimates compare the lowest transit agency avoidable cost and the highest private cost. The most probable estimate uses the most probable cost for both transit system and private operator.

first-year expense reductions could be greater than the minimum assumed. Moreover, the short-run pessimistic results represent a truly "worst case" scenario, as they assume the highest level of private costs and the lowest level of public avoidable costs. It is highly unlikely that these results would occur in the average case.

In the long run when all variable cost elements have been reduced proportionately, four of the six agencies save money by contracting according to the most probable scenario. The two agencies which are not predicted to save money have much lower wage rates and more favorable work rules than the other four systems. An example is a 40-hour per week guarantee rather than 8 hours per day, which effectively eliminates daily guarantee time and overtime. It should be noted that these are long-term annual estimates corresponding to full adjustment, and do not take into account possible short-term losses.

The 20 percent service package provides a more representative indication of the cost impact of large-scale service contracting on transit agencies, since a broader range of services are included and all impacts are long run. It is assumed that this magnitude of contracting could occur only after a number of years. Table 5-6 gives the results for the 20 percent service packages. As before, cost estimates for these systems are based on the simpler costing approach. The results of the 20 percent analysis indicate substantial cost savings in four of the six cases. As with the 5 percent package, the negative results for Systems D and F are reasonable given the low wage rates and apparently efficient scheduling practices employed by these

TABLE 5-6

ESTIMATED LONG-RUN COST SAVINGS FOR 20 PERCENT SERVICE PACKAGES FOR MEDIUM SIZE SYSTEMS

System	Optimistic	Pessimistic	Most Probable
D	-14%	-40%	-16%
E	35	20	27
F	5	-12	-5
G	37	23	31
H	23	6	16
I	35	20	29
Average	20%	2.8%	14%

agencies. Moreover, the most probable results for System F are within the range of likely error of a most probable break-even outcome. Savings are greatest for Systems G, H, and E. Systems G and I have the highest driver wages, and the highest and third highest pay/plat ratios. System E has the highest average hourly cost, as well as a comparatively high pay/plat ratio, given its low peak/base ratio. The average savings for the most probable scenario is 13.5 percent for the group, with a range from -16.1 percent to 31.0 percent. The median saving is somewhat higher, at 21.1 percent.

It may also be noted that 20 percent savings are greater than 5 percent (long-run) savings for five of the six systems. This result appears to be counterintuitive, as routes with the highest pay/plat ratio were chosen first. The difference, however, is due to the assumption of a minimum contract monitoring cost. The contract monitoring cost represents a larger proportion of private operator cost in the 5 percent service package because of the smaller total cost of the service package.

5.2.3 Large System Results

A total of thirteen case studies were conducted for systems with more than 150 peak vehicles. Descriptive statistics for these systems are presented in Table 5-7. As can be seen, there is substantial variation in size, average unit costs, driver costs, peak/base ratio, and pay/plat ratio. As a group, these are higher cost agencies with higher pay/plat and peak/base ratios than the medium size systems. Many of these agencies use part-time drivers, but with one exception, they are limited to a maximum of 15 percent of the number of full-time operators.

The avoidable costs for these systems were calculated using the full cost models described in Chapter Four. The full range of alternative

TABLE 5-7

CHARACTERISTICS OF LARGE SIZE CASE STUDY SYSTEMS

System	# Peak Vehicles	$/RVH	Driver wage + Benefits/Hr[a]	Peak/ Base Ratio	Pay/Plat Ratio
J	199	$40.00	$15.78	2.2	1.202
K	521	58.41	14.99	2.9	1.213
L	762	64.00	16.30	2.0	1.150
M	800	58.49	19.31	2.9	1.211
N	320	54.84	16.19	2.1	1.095
O	402	69.30	19.70	1.7	1.130
P	441	62.40	18.96	1.9	1.120
Q	231	40.48	15.34	2.3	1.160
R	844	50.69	18.26	1.9	1.130
S	659	62.72	14.63	2.3	1.150
T	1029	70.73	18.86	1.8	1.090
U	275	39.19	11.28	1.3	1.059
V	246	44.67	18.15	1.3	1.123

[a] Full-time drivers only.

assumptions were employed for both transit agency avoidable costs and private operator costs. However, alternative costing assumptions for part-time drivers are used in significant numbers on the service to be contracted and when their wage (plus benefits) rate is significantly different from the full-time driver rate.

Case study results are shown in Table 5-8 for the 5 percent service package and in Table 5-9 for the 20 percent service package. In some cases (System L for the 5 percent package, Systems J and M for the 20 percent package), alternative service packages were selected to test the effects of different service configurations on estimated cost savings. For the remaining systems, all service packages are made up of routes chosen on the basis of the pay/plat ratio. As a result, the 5 percent packages are made up primarily of heavily peaked routes.

Table 5-8 shows that short run savings are extremely variable. Pessimistic results, in which only driver costs and a portion of vehicle operating costs are eliminated and the interlining penalty is applied, are consistently negative. Large losses--up to 80 percent--are estimated in several cases. While the validity of the short-run estimates may be questionable due to the assumptions which had to be made, they do suggest that if only a small portion of the system is contracted, immediate savings may be negative. That is, agency short-run costs could increase.

TABLE 5-8

ESTIMATED COST SAVINGS FOR 5 PERCENT SERVICE PACKAGES
FOR LARGE SIZE SYSTEMS

	Short Run			Long Run		
System	Optimistic	Pessimistic	Most Probable	Optimistic	Pessimistic	Most Probable
J	9%	-58%	-3%	23%	-23	14%
K	20	-25	N/A	35	2	30
L (EXPRESS + REGIONAL)	19	-49	<1	37	1	26
L (EXPRESS)	16	-75	-6	33	-17	21
M	40	-43	15	49	2	33
N	0	-80	N/A	33	2	25
O	28	-60	N/A	51	26	45
P	12	-56	N/A	31	4	21
Q	5	-56	N/A	11	-29	<1
R	30	-10	N/A	41	12	34
S	25	-21	N/A	31	7	26
T	10	-46	N/A	36	13	24
U	N/A	N/A	N/A	15	-19	<1
V	18	-16	N/A	30	12	20

TABLE 5-9

ESTIMATED COST SAVINGS FOR 20 PERCENT SERVICE PACKAGES
FOR LARGE SYSTEMS

System	Optimistic	Pessimistic	Most Probable
J - EXPRESS + ALL DAY	27	-18	17
J - ALL DAY	33	-9	19
K	36	10	28
L	38	19	27
M - EXPRESS	46	16	37
M - ALL DAY	51	29	42
N	41	16	35
O	54	35	49
P	36	16	29
Q	22	5	15
R	43	17	36
S	36	20	33
T	43	24	35
U	15	-15	2
V	33	6	22

Long-run estimates are more positive. The average for the most probable estimates is 22.9 percent, and none are negative. Only System U shows no savings. Three of the pessimistic estimates are negative, and all of the optimistic estimates are positive. The optimistic estimates range from 11 percent to more than 50 percent, with an average of 32.4 percent.

The long-run 20 percent scenarios indicate that savings will occur as all cost elements respond to contracting (Table 5-9). Again, these are annual estimates. Among the large systems, estimated long-run cost savings are often very large. For Systems M and O, most probable savings exceed 40 percent, and six of the thirteen systems have calculated savings of 30 percent or more. Savings are smallest for the system with the lowest wage rate, System U, which also has extremely favorable work rules (for example, extraboard drivers start at $6.00 per hour with no guarantee).

Average most probable savings for the 20 percent scenario for this group is 27.9 percent, significantly higher than for the medium size systems. Estimated savings also cover a wide range, from 2.3 percent to 48.9 percent, implying that cost savings are a function of many factors. It is interesting to note that cost savings from contracting tend to be somewhat greater for the all-day service packages than for the express or peak-only packages. This is largely the result of the procedure used to develop private costs, with alternative driver pay guarantees and overhead based on the number of vehicles employed. When the peak service consists of short pieces of work, private costs are high. Conversely, all-day service estimates tend to better reflect the difference between private and public wage rates.

5.2.4 Overall Results

The contracting cost savings estimates generated in the model applications span a wide range. Figure 5-1 summarizes the results for the 20 percent most probable scenario for the nineteen systems with more than 25 vehicles. In cases where more than one 20 percent scenario was tested, the express-oriented service package value is used. Average most probable savings is 13.5 percent for the six systems of under 150 vehicles and 27.9 percent for the larger systems. The distribution for the two groups clearly overlaps, with the less than 150 vehicle group representing the minimum savings and the more than 150 vehicle group showing the maximum savings. The average savings for the entire sample is 23.4 percent, the median is 27.9 percent, and twelve of the nineteen systems fall into the range of 20 to 40 percent.

It is significant that the systems with more than 150 peak vehicles, which were calculated to realize an average savings of 27.9 percent, represent about 80 percent of the transit industry's operating expenditures on bus

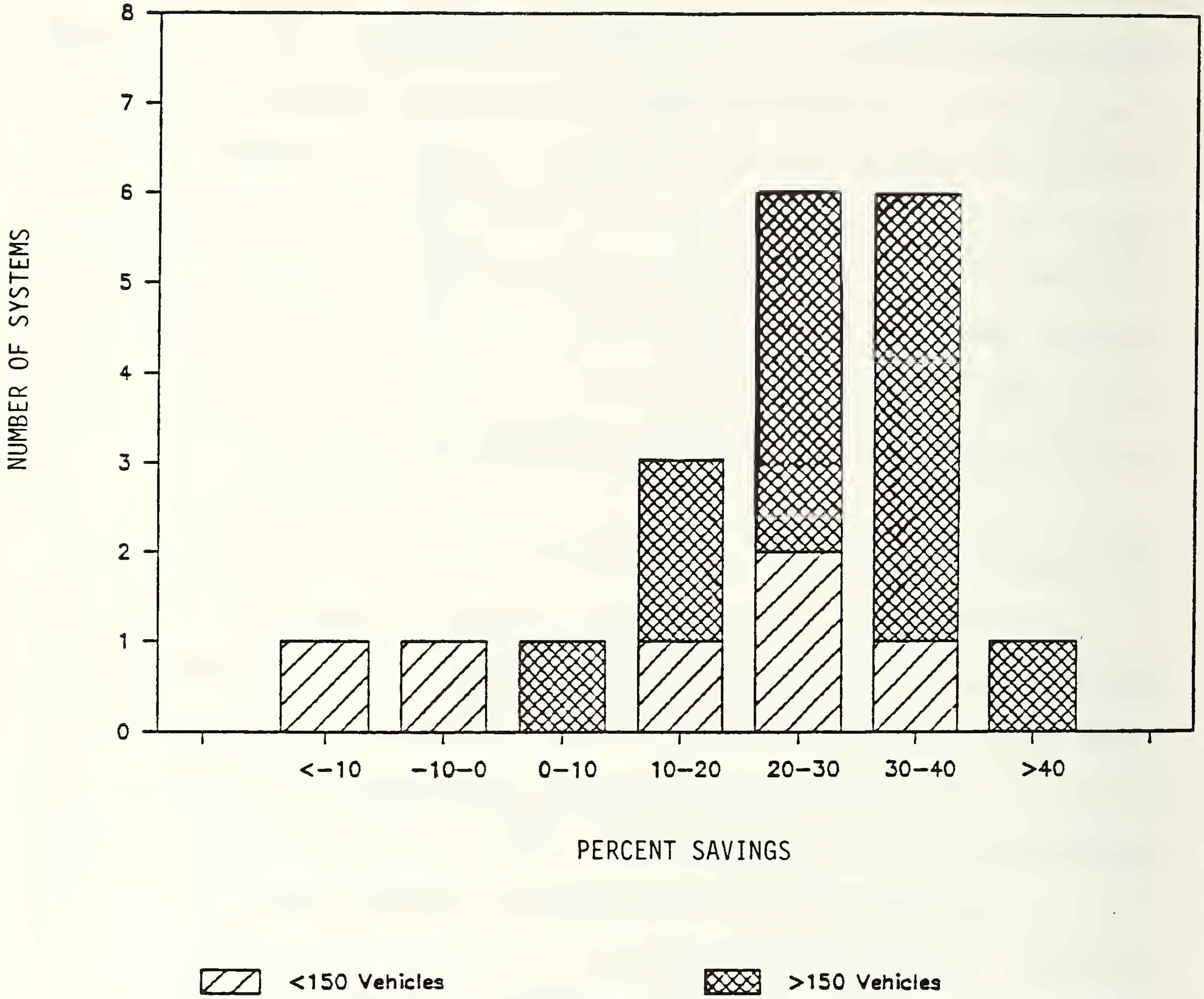

FIGURE 5-1

DISTRIBUTION OF SAVINGS FOR 20 PERCENT MOST PROBABLE SCENARIO, ALL SYSTEMS WITH GREATER THAN 25 VEHICLES transit reported in Section 15 data, while the medium-sized systems represent approximately 17.5 percent of bus transit operating expenditures.

5.2.5 Savings in the Context of Transit Operating Costs

It is also useful to place these estimated cost savings in context. Figure 5-2 gives a frequency distribution of cost savings as a percent of total agency operating cost for the nineteen systems with more than 25 peak vehicles. The estimate corresponds to the 20 percent most probable scenario. In cases where more than one 20 percent scenario was tested, such as System M, the results for the peak-oriented service package estimate were used in the frequency distribution in Figure 5-2. Cost savings as a proportion of total operating cost when 20 percent of the services are contracted, range from -2.5 percent (System D) to 9.0 percent (System O), with an average savings of 4.2 percent. A total of nine systems have indicated cost savings of more than 5 percent of the total operating expense. Savings of this magnitude are significantly greater than the potential savings of more conventional strategies such as the use of part-time drivers. Of these nine systems, all but two have fleets of 250 vehicles or more, and the two systems with the greatest savings, Systems O and M, have fleets of 402 and 800 vehicles respectively. A total of fifteen of the nineteen systems (about four-fifths of the sample) have estimated savings equal to 2.5 percent or more of total operating cost, implying that service contracting of only 20 percent of an agency's services can generate savings of at least the same magnitude as more conventional strategies for the vast majority of U.S. systems.

These results indicate that potential cost savings benefits are greatest for the larger agencies, and are particularly large when high transit agency service costs coincide with service characteristics which are relatively

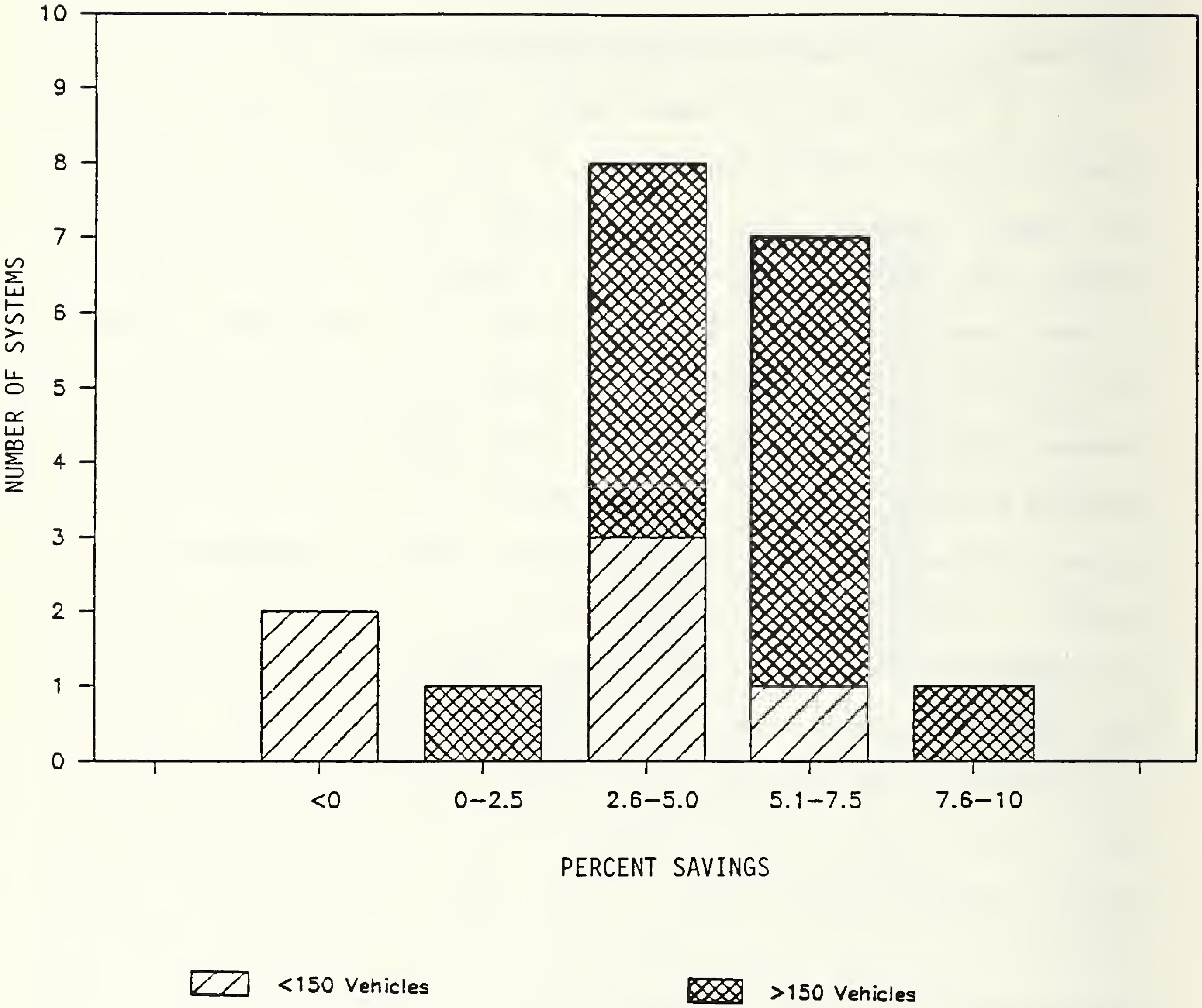

FIGURE 5-2

DISTRIBUTION OF SAVINGS AS A PERCENT OF OPERATING COST, ALL SYSTEMS WITH GREATER THAN 25 VEHICLES favorable to private operator provision, such as long pieces of work for peak-only services (which avoids payment of minimum hour guarantees). For smaller agencies with low service costs, less controversial cost reduction strategies, such as the use of part-time drivers or other work rule changes, may be equally as effective as a low level of service contracting. An important advantage of contracting, however, is that competitive contracting is likely to create strong cost containment pressures within the transit agency and lead to improved internal cost efficiency. This is a spillover effect which has not been taken into account in this analysis.

5.2.6 Explaining the Results

The wide range of savings estimated by the model suggests that many factors affect potential cost savings. In part, these differences are a function of the assumptions and parameters used in the models, and in part, a function of adjustments made to reflect size-related cost differences. It may be recalled that different methodologies were used to generate the private operator cost estimates. A flat mileage rate was used for all service packages for the medium size agencies, whereas a three-variable cost allocation model was used for peak service in the service packages for the larger systems. Thus, for the larger system case studies, the alternative driver cost and overhead cost assumptions employed for peak service made private operator costs very sensitive to service characteristics (e.g., length and timing of driver runs and number of buses required to operate the schedule). Furthermore, since it was assumed that the contract package was "stand alone" for the private operator, service packages which contained short, difficult to combine pieces of work tended to be rather costly, because there were no opportunities for interlining with other service.

Transit agency cost savingings estimates were also affected by the simplifying assumptions made to accommodate the level of Section 15 data reported by medium-sized systems. Only one estimate of transit agency avoidable cost was made for these systems, and the differences between the optimistic, pessimistic, and most probable estimates were due to private operator mileage costs and contract monitoring costs. For this reason, the case study estimates should be viewed as having limited comparability between transit agency size categories.

The wide range of cost savings estimates is also due to transit agency cost and service characteristics. A rough correspondence between transit agency operating costs and driver costs can be observed in the case study results, but the relationship is certainly not sufficiently consistent for these factors to be used to predict cost savings. Service characteristics, interlining, and the relative proportions of fixed and avoidable costs are also important.

Service characteristics are important because of their impact on the estimation of private costs. Interlining is an important factor in determining transit avoidable costs. The interlining penalty obviously affected the pessimistic avoidable cost estimates, implying that if schedule impacts are significant, potential cost savings will be affected. The impact of interlining is clearly an issue for further research, given the extent and variability of interlining practices within the industry.

The relative proportion of fixed and avoidable costs is also important in estimating potential cost savings. The general administration and other functions which are assumed to remain unchanged as a result of service contracting make up the fixed portion of long-run costs. The greater the proportion of these costs to total operating cost, the smaller the cost savings, all other things being equal. A high-cost agency may realize only modest cost savings if a large share of its operating cost is fixed. Conversely, a lower cost agency may realize large cost savings if a correspondingly smaller share of its operating cost is fixed. In other words, service contracting strategies attack the service-related costs of productivity inefficiencies in public transit, not the non-service or overhead inefficiencies.

The case study results also indicate that a key factor in transit agency cost savings is the rate at which indirect costs can be reduced. The large differences between short-run and long-run results show that net savings over a five-year planning horizon are highly dependent on how long it takes to reduce maintenance and other indirect, but variable, long-run cost items.

Finally, it should be noted that the magnitude of cost savings estimated here would not necessarily hold for contracting larger proportions of transit agency service. Because the most costly service is selected first, the marginal change in cost savings should decline (albeit not substantially) as the quantity contracted increases.

5.3 LIMITATIONS OF THE ANALYSIS

The results presented above are based on the best available information and the most appropriate methodology from the point of view of the research team. However, the research results are subject to limitations. This section discusses the appropriateness of the costing methods used and the possibilities for bias in the results. Three different issues are discussed: 1) private operator cost levels, 2) structure and limitations of the transit avoidable cost model, and 3) the nature of the service package selected for contracting.

5.3.1 Private Operator Costs

The private operator costs used in this analysis were derived from several sources. For commuter service, the cost model was based on actual private operator cost experiences in Houston and San Francisco, where private bus companies provide commuter service under contract to a transit agency. These data were supplemented with national data on direct operating costs and overhead costs for relatively small private bus operations. The model developed from these data was applied to specific bus routes in Houston, San Francisco, and Los Angeles and used to estimate the costs for serving these routes. These costs were then compared to actual private operator prices charged to public agencies for operation of this service. The model demonstrated an acceptable degree of accuracy when used for this purpose (Rooney and Teal, 1986).

The driver cost (wage plus fringe) used in the model was $9.38 per hour. Subsequent research by the Urban Institute found somewhat higher wages--$9.93 per hour--for a small 1985 national sample of non-unionized private operators, excluding New York City (Peterson, Davies, and Walker, 1986). If this wage rate had been used, the peak service private operator cost estimates would have been about 2 percent higher, reducing average savings from 27.9 percent to 25.1 percent. Thus, for peak service, the research results may have <u>underestimated</u> private operator costs by about 2 percent (and thus overestimated transit agency savings by 3 percent).

As noted previously, the maintenance cost, direct vehicle operating cost, and overhead cost parameters were compared to similar operating cost items for the Pace system in Chicago's suburban area. The relatively good match indicates these cost parameters are probably accurate to within 5 to 10 percent of actual private operator costs in typical cases.

Because the commuter service model is composed of hour and mile parameters as well as a fixed-cost component, it is not possible to translate its results into a single cost per revenue vehicle mile (RVM) or per hour. The cost per RVM depends on the specific service parameters as well as the assumptions made about private operator driver work rules. In general, however, the cost per revenue vehicle mile for the most probable assumption ranges from $2.75 to $4.00, depending on speed, deadhead mileage, and the number of vehicles required to service the route. The information on private costs for commuter services is not sufficient to determine how these estimates may be biased.

The simple one-variable model for all-day, fixed-route service was derived from two sources. The national survey data presented in Chapter Three indicate an average cost per revenue mile of $2.29 for the twenty-one privately contracted services of more than 25 vehicles. These are primarily 1983-84 data, although some of the systems supplied 1984-85 data. In addition, an excellent benchmark for private contractor cost levels is provided by Phoenix Transit, the largest contracted fixed-route system in the continental United States for which adequate data is available. In 1983-84, Phoenix Transit's cost per RVM was $2.35. Phoenix Transit is also a good benchmark because it has a service profile which is strongly characteristic of the all-day services which were included in the service packages used here: low peak-to-base ratio, limited Saturday service, no night or Sunday service. Thus, the Phoenix Transit cost seems quite reasonable as a most probable estimate for contract services.

The mileage rate calculations do not seem to be subject to bias from underestimation of driver costs. If driver costs comprise 30 to 35 percent of the total service costs, the all-day cost of $2.35 per RVM is consistent with a total driver compensation of approximately $10 per hour, assuming a speed of 14 MPH and a ratio of revenue miles to total vehicle miles of 90 percent.

An attempt was made to verify these private operator cost assumptions by surveying five private contractors, some local and some regional/national in orientation, to obtain costs for representative bus routes. Unfortunately, only two of these contractors responded to the survey, and the responses had too many internal inconsistencies and dubious assumptions to be considered reliable. Nonetheless, the limited response to the survey did not invalidate the cost assumptions employed.

5.3.2 Structure and Limitations of the Transit Avoidable Cost Model

There are two issues related to the appropriateness of the transit avoidable cost model: 1) treatment of overhead, and 2) comparability of the results with a fully-allocated cost model.

5.3.2.1 Treatment of Overhead

The avoidable cost model was developed on the assumption that the long-run adjustment of overhead is strictly proportional to the amount of service contracted (as measured in vehicle hours). Traditional cost allocation models assign overhead to peak vehicles, implying that the magnitude of indirect cost is determined by the number of vehicles. Vehicles that operate only a few hours per day contribute as much to indirect costs as vehicles that operate many hours per day. From a cost allocation standpoint, then, using vehicle hours to calculate overhead cost will cause an underestimation of avoidable cost (and eventually an underestimation of savings), because much of the contracted service is peak service. That is, contracting peak service reduces vehicles relatively more than service hours.

In order to estimate the difference resulting from the two methods of treating indirect costs, the Adelaide bus costing method was applied to the case study data (Morgan, 1978). The Adelaide model is similar to the model developed in this research except that it allocates non-driver expenses to both hours and vehicles. Results indicated that the avoidable cost model estimates are 5 to 16 percent less than the Adelaide model estimates. Thus, the costing approach used here is conservative, and will underestimate cost savings compared to the traditional cost allocation approach.

Another issue related to overhead costs is the concept of threshold effects. As discussed in Chapter Four, it seems reasonable that indirect costs are "lumpy," i.e., they do not vary continuously with output. Thus, small changes in output may have no impact on indirect costs. The Adelaide model, which represents the only known attempt to incorporate these threshold effects, used thresholds of 6 to 35 vehicles for various cost elements for a transit agency with approximately 500 vehicles. For changes which affect fewer than 6 vehicles, the Adelaide model assumed that no indirect cost effects occur, and that various indirect cost effects came into play at higher threshold levels. The existence of threshold effects suggests that the results for some of the 5 percent service packages may overestimate long-run transit avoidable costs. For the 20 percent service packages, threshold effects may still offset some of the possible underestimation of indirect costs, particularly for the smaller systems. On balance, however, it is likely that transit avoidable costs are slightly underestimated here, and thus savings are underestimated.

5.3.2.2 Comparability with Fully Allocated Cost Models

UMTA's current policy is that the fully allocated costing approach should be used when comparing public and private service costs. Accordingly, it is important to assess how the results of our analysis would change if a fully allocated costing methodology were utilized. Such an assessment is also important for an equitable comparison of the total service costs of both public and private operators, even though it probably overestimates the actual operating cost savings which can be generated by service contracting. The fully allocated cost approach will overestimate savings when the public agency cannot shed indirect costs within a reasonable length of time, when, for example, the agency is unable to sell or rent part of a garage, move to smaller administrative offices, or reduce staff by a fraction of an employee.

In making this assessment, certain cost elements were excluded from both the fully allocated and avoidable cost approaches, consistent with UMTA's cost guidelines. First, we excluded all administrative and overhead costs which do not vary with the amount of service directly operated by the transit agency (i.e., expenses for planning, marketing, and customer information). Second, we excluded capital costs for buses based on our assumption that buses will be provided by the transit agency to the private contractor at no cost. Third, we excluded public liability costs (not vehicle damage insurance) because of the assumption that these would remain the responsibility of the transit agency. Thus, the results of this analysis cannot be generalized to situations in which the private operator must provide vehicles and insurance, as cost savings could be either higher or lower depending on the specific circumstances.

Having excluded these cost items from the analysis, the difference between the avoidable cost and fully allocated cost approaches centers on two types of cost items. The first are operating costs which, in the avoidable cost approach, are not assumed to change despite contracting: (1) maintenance administration; (2) maintenance, operation, and security for fixed facilities; (3) general management; and (4) insurance for and damage to buses (depending on whether the public agency or the contractor was assumed to be responsible for this expense). All of these cost elements are assumed relevant in the fully allocated approach. The second major source of difference is the treatment of depreciated capital costs for fixed facilities, which are included in the fully-allocated approach but are not considered relevant in the avoidable cost approach. To compare the results of this study with the fully allocated approach, adjustments to the avoidable cost results must be made in both of these areas.

Based on a detailed analysis of the larger transit agencies' Section 15 expense reports, it was determined that the avoidable cost methodology resulted in transit agency operating costs which were 1.5 to 4.0 percent lower than would have been calculated with a fully allocated cost model of the same structural type as that used for the avoidable cost model. The range reflects different assumptions about vehicle-related insurance and damage responsibility and assumptions about whether the general management expense was truly variable. (It is not clear whether UMTA's recommended costing approach would exclude general management from relevant fully allocated costs, as it states that costs "attributable" to the service are relevant. It does not specify what criteria are to be used to determine what is properly attributable.)

The differences are similar in magnitude for depreciation costs for capital facilities. The average medium/large agency reported total depreciation charges of 11.5 percent of the operating plus depreciation budget, with a median value of 10.0 percent. Much of this depreciation is for buses, however, and they have been excluded from the analysis. Only one agency provided information on the relative worth of its buses and other capital facilities. Its buses constituted 71.4 percent of total capital assets. Because buses probably depreciate more rapidly than the other capital facilities, this is likely to underestimate the portion of depreciation expenses which should be attributable to buses. However, because of the paucity of data, a conservative assumption is in order, and it was assumed that 30 percent of depreciation is attributable to fixed facilities for the average agency. Using the 30 percent figure yields an additional depreciation charge of 3.0 to 3.5 percent to be added to the results of the avoidable cost methodology.

The total adjustment for the avoidable cost approach for the agencies studied here is thus 4.5 to 7.5 percent. That is, the avoidable cost methodology underestimates fully allocated total cost by 4.5 to 7.5 percent, and underestimates fully allocated operating costs by 1.5 to 4.0 percent. In other words, if the avoidable cost methodology estimated that the transit agency's cost for a particular service package was $100,000, then a fully allocated approach would estimate a cost of $104,500 to $107,500. These results imply that potential cost savings estimates would increase 3 to 5 percent if a fully-allocated cost approach were used, e.g., the average 27.9 percent savings for large systems would increase to a range of 31.0 percent to 32.9 percent.

5.3.3 Characteristics of the Service Packages

Another potentially valid criticism of the results of the analysis is that the research team chose service packages which maximized an agency's avoidable cost per unit of service, but which could not realistically be contracted out. As a result, avoidable cost would be overestimated. (This does not mean that savings would necessarily be overestimated, as private operators also had higher costs for the expensive transit agency services.) Service packages which maximized avoidable cost by contracting out an agency's most expensive services first (presumably peak-only service) were deliberately selected on the theory that an agency would wish to follow such a contracting strategy. However, service selection proved to be the most frequently criticized aspect of our research among the transit agencies who participated in this study.

Some transit agency officials felt that their agency would be more likely to contract on a geographic basis, and that a 20 percent service package would consist of more all-day service and less peak-only service concentrated in one area of the region and corresponding to the service area of one of the agency's divisions. They also correctly noted that the pay-to-plat ratio selection criterion guaranteed that the most expensive all-day services would also be included in the service package. If more realistic selection criteria were used, the pay-to-plat ratios of the selected routes would more likely be close to the system average.

These concerns are valid, in that any selection of services which creates a service package with a pay-to-plat ratio higher than that of an implementable service package will overestimate avoidable costs. In actuality, however, the overestimation of savings will be small. To illustrate, consider the case of System R, a large agency with several divisions which might select a service package using several different criteria. The 20 percent service package used in the case study had a pay-to-plat ratio of 1.18, about 4.5 percent greater than the system average of 1.13. In this system, driver costs make up 45 percent of the avoidable service costs. Thus, a service package with the agency's average pay-to-plat would have about 2 percent lower avoidable costs than the package chosen strictly on the basis of pay-to-plat ratio. Moreover, private operator costs would be lower for a service package consisting of more all-day service. Therefore, while the choice of the service package does potentially have an effect on the estimated cost savings, the impact is small and may not result in any reduction in savings when both public and private costs are considered.

5.3.4 Summary

The possible inaccuracies and sources of bias in the avoidable cost model have been presented in the preceding section. Possible biases in both directions may be present. Potential service contracting cost savings may be less than estimated here due to underestimates in private driver costs, threshold effects in transit overhead costs, and selection of service packages on the basis of the pay-to-plat ratio. Potential cost savings may also be greater than estimated here due to costing transit overhead only on the basis of hours, and not including transit fixed facility capital costs. Yet none of these sources of bias affect results by more than a few percentage points. It can therefore be concluded that the costing approach developed here is an adequate and suitable planning tool for estimating potential service contracting cost savings.

CHAPTER SIX

ESTIMATING NATIONAL COST SAVINGS FOR COMPETITIVELY CONTRACTED SERVICE: PENN MODEL AND APPLICATIONS

6.1 OBJECTIVES

The overall objective of this research was to estimate the savings that can be expected from the competitive contracting of fixed-route bus transit service in the United States. Particular emphasis was on the savings to be expected from competitively contracting a specific, relatively small percentage of service in larger metropolitan areas. This emphasis is appropriate for four reasons. First, the larger systems comprise most of the operating deficit; thus, cost savings in these systems would have the largest impact on the overall national transit deficit. Second, it is likely that only a relatively small percentage of service could be contracted out in the near future (i.e., one to three years), considering the expansion needed in the private sector and the need to develop organizational expertise. Third, integration and control of contracted service might present problems if a considerable amount of service were contracted (although there is no current evidence of such problems in existing contracted systems). Fourth, contracting out even a small amount of service will increase pressure to reduce costs in the remaining service provided directly by the transit authority. To the extent that these costs are reduced, the necessity to contract out even more service in order to reduce costs further is diminished, and there may be a slackening of new contracting.

To be realistic, any estimate must recognize that there is a range of possible levels of savings, and that each has a certain probability of occurrence. To state that the savings may range from 10 percent as a conservative estimate, to 40 percent as an optimistic estimate, with 25 percent more likely than other values, is less useful than saying the probability is 98 percent of savings at least 10 percent, the probability is 60 percent of savings being at least 20 percent, etc. Even weather forecasts are made with probabilities. Thus, the possible levels of savings would ideally have probabilities associated with them.

The savings estimate is defined as the net reduction in the cost of providing a given transit service, considering the reduced cost of actually operating the service and any increase in other public agency costs resulting from the administration and monitoring of contracted service. Transition costs, such as severance pay (if any) to employees, are not included. The savings estimates presented in this chapter have several important features. First, assessing the potential national savings, it is important to take into account differences between the private and public sectors in the treatment of some costs, including grants for vehicles and other capital stock, taxes, and user fees for roads and other public services. A second important feature of this estimate of savings is that it is based primarily on the actual experience of transit systems that are contracting competitively, rather than on hypothetical contracting. However, the final estimate will not be simply the result of data analysis, but will also integrate the results of a number of prior studies of the relative costs of private firms and public monopolies producing government services in competitive environments. Thus, results of the modeling effort will be tempered by judgment regarding anticipated features of future contracted services.

The major tasks in this effort were to:

1. Survey those systems that are competitively contracting service.
2. Determine the actual pattern of bids, savings, etc.
3. Develop a model for estimating savings for a given system from characteristics of the service competitively contracted and the area in which service is provided.
4. Apply the model to estimate national savings, adjusting the savings to reflect the effect of capital subsidies, taxes, etc. so that the cost savings are comparable with respect to costs included.

6.2 THE SURVEY

The national survey of transit contracting described in Chapter Three identified all U.S. transit systems engaged in competitive contracting for fixed-route transit service. At the time the survey of cost savings was undertaken, forty-one such systems had been identified in the larger national survey. A second, more detailed survey was then mailed to each of these agencies and supplemented by telephone contact to explain the survey and ensure that respondents understood the questions. In a few cases, interviews were also conducted. Data were collected on the following items:

- service operating and traffic characteristics
- number and amount of bids
- winning bid
- contract management, monitoring, and related costs
- vehicle characteristics and ownership.

Responses were received from thirty-one of the forty-one systems, including systems in metropolitan areas from the largest (New York area) to very small ones, and from most of the United States (Table 6-1). Table 6-2 shows the distribution of fleet size for the thirty-one systems in the sample.

TABLE 6-1

LOCATION OF COMPETITIVELY CONTRACTED FIXED-ROUTE BUS SYSTEMS BY STATE

State	No. of Systems Surveyed	No. Responding
Alaska	1	1
California	13	10
Connecticut	1	1
Illinois	1	1
Indiana	1	1
Iowa	1	1
Kansas	1	1
Massachusetts	1	0
Michigan	2	2
Minnesota	3	2
Missouri	2	2
New Hampshire	2	1
New Jersey	1	1
New York	1	0
Ohio	1	1
Oregon	3	2
Pennsylvania	1	0
Texas	1	1
Virginia	3	2
Washington	1	1
Total	41	31

TABLE 6-2

DISTRIBUTION OF NUMBER OF VEHICLES USED IN COMPETITIVELY CONTRACTED SERVICE
(n = 30)

Number of Vehicles	Number of Systems
1 - 5	11
6 - 10	10
11 - 15	4
16 - 20	2
21 - 25	3

6.2.1 Bid and Cost Experience

Responses to the survey yielded considerable data on the degree of competition, the pattern of bids from private firms, and the cost savings experienced by the systems in our sample. These data provided valuable insight into patterns of competition in the industry and the range of cost savings possible under competitive contracting.

6.2.2 Competition

Competition is generally felt to be an intrinsically important factor in achieving cost savings. As discussed in Chapter Two, prior studies of cost savings from privatization of public services of all types affirm the importance of competition as a source of pressure to keep costs as low as possible. Competition between service providers is critical to the maintenance of low costs. Given the potential for collusion between

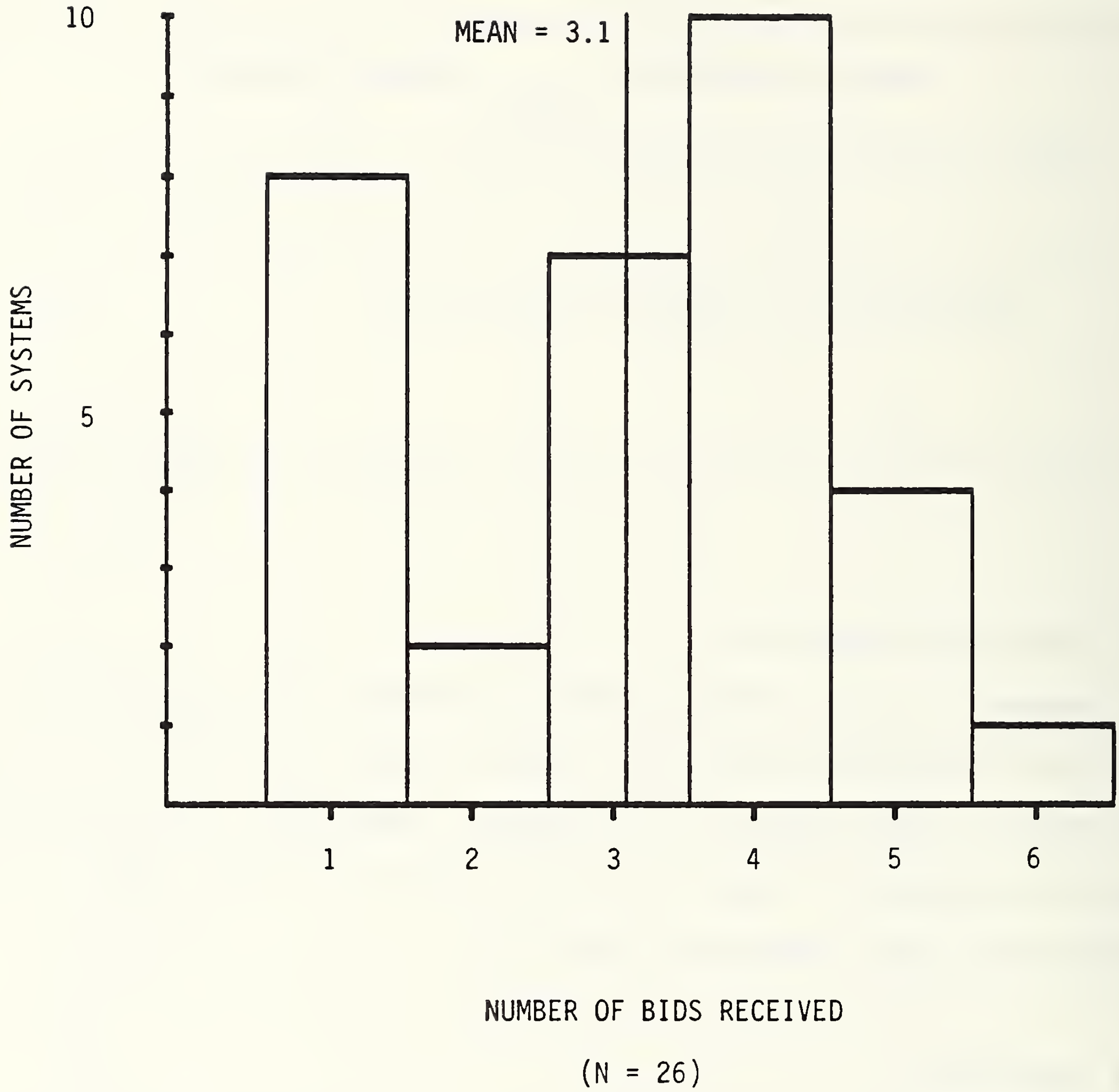

FIGURE 6-1

DISTRIBUTION OF BIDS RECEIVED

contractors and the contracting agency, special effort must be exercised to engender and maintain competition; otherwise a "lobby for waste" will develop and the cost-saving benefits of contracting could be lost.

One measure of the degree of competition experienced is the number of bids; the larger the number of bidders, the less likely is collusion. Figure 6-1 presents the distribution of number of bids received by twenty-six systems in our sample. The average is 3.1 bids, and the range is from one to six. Overt competition between bidders, in the form of two of more bidders, was present in 70 percent of all cases.

It is important to recognize, however, that competition may still be present with only one bid. The reason is simply that there may be other firms on the "sidelines," ready to bid if the single bidder's bid is high. These other firms may not bid for a variety of reasons, such as the fear that they may have slightly higher costs than those of a known bidder. But once it appears that they may have a chance of being awarded the contract, they may bid. If the single bidder knows this, that bidder will be encouraged to keep the bid low. Thus, pressure to keep costs low can be present even with only one bidder. Of course, the same applies to cases of more than one bidder; each active bidder may feel pressure from other firms not actually bidding. This concept is known as contestability of the market; unseen competitors act to prevent a firm from exerting monopoly power.

In the bus transit case, the portability of the means of production--the buses and drivers--from one area to another increases contestability. Also, the ease of entry and exit from a market, through changes in the number of employees, purchasing standard vehicles that are easy to resell, leasing of vehicles, and other features, all act to increase the potential for real competition. Assuming that contract specifications are not written to limit bidding on transit operations to one firm, that awards are based on merit, and that the sponsor has made a credible commitment to contracting for an extended period, competition should not be a problem. Features that could restrict the number of bidders include large contracts requiring many vehicles, requirements for a particular type of vehicle when any of many types would be satisfactory, and a sense among private operators that contracting with public agencies may have an uncertain future.

6.2.3 Bid Uniformity

A related feature of the bids is the distribution of relative values. One way to assess uniformity is to compare the bids on a service with the mean bid for that service. Thus for service j the value of each bid i can be expressed as a ratio to the mean bid for that service. With b_{ij} as the bid and $\bar{b}_j$ as the mean, the ratio is:

$$r_{ij} = \frac{b_{ij}}{\bar{b}_{ij}} \qquad (1)$$

The distribution of the values of r_{ij} for all bids is presented in Figure 6-2. The range is quite large, from 0.6 to 1.5, and visually follows a bell-shaped (possibly truncated Normal) distribution. The wide range of bids indicates that local transit systems have considerable discretion in choosing the cost of contracted service through the choice of which bid to accept.

6.2.4 Implications for Private Operator Costs

The range of bids shown in Figures 6-2 and 6-3 is significant, and deserves some discussion, particularly with reference to underlying private

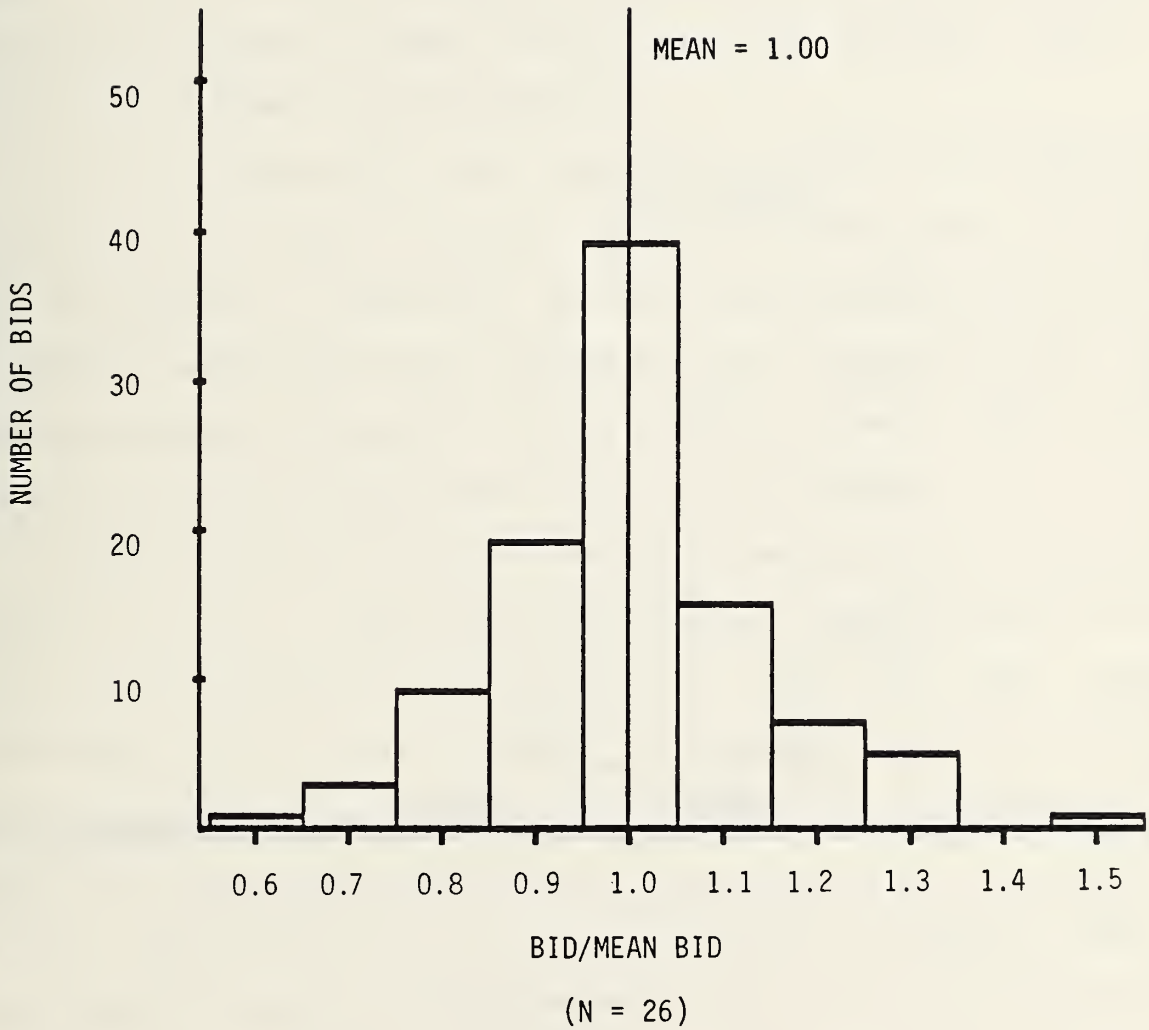

FIGURE 6-2

DISTRIBUTION OF BID VALUES RELATIVE TO THE MEAN BID FOR THE CORRESPONDING SYSTEM

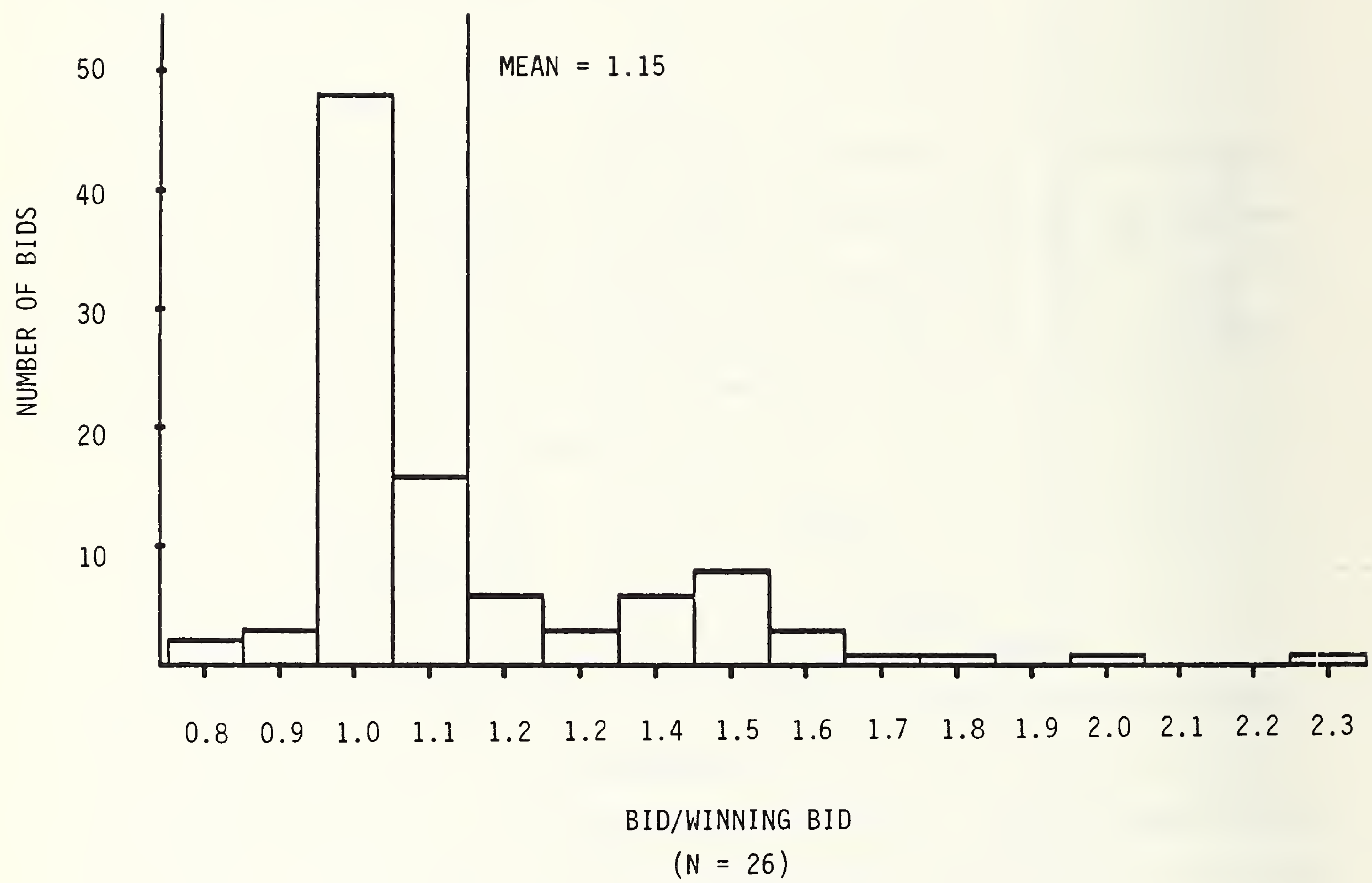

FIGURE 6-3

DISTRIBUTION OF BID VALUES RELATIVE TO THE WINNING BID FOR THE CORRESPONDING SYSTEM operator costs. First, it is important to recognize that bids and actual costs are distinct. A formal bid may reflect to only a limited degree the actual underlying cost of the bidder to produce the service. There are basically three reasons why formal bids might vary so greatly: (1) each bidder added a "profit" which varies greatly among them, (2) many bidders do not know their actual costs until revenue service has been initiated, and (3) the actual costs of bidders vary considerably.

Given the relatively short experience with bus service contracting and the wide variety of types of companies (charter bus, taxi, etc.) that might bid, some errors in estimating the cost of operating services are possible. The bids may reflect such errors. Similarly, these conditions could lead to varying "markups" for profit and contingencies. However, these two factors alone would not seem to explain the wide variations in bids.

Thus, the question of variation in costs among operators also warrants attention. This is a difficult area to examine, because the costs of any one service in the totality of operations of a bus firm are inherently unobservable except in very unusual circumstances. However, if firms pay differing amounts for the various resources needed to produce the service, then it is likely that cost would vary considerably, too. In the case of bus service, a large portion of total costs are payments to drivers. Morlok and Krouk (1983) examined the wage rates of firms which operate over-the-road, for-hire passenger vehicles in the Philadelphia area. This included firms that operate taxicabs, vans, paratransit vehicles, buses in specialized transit-like services, conventional transit service, airport limousine service, intercity service, and charter service. The variation in the actual wage and benefit rate was substantial. The pattern of predicted average wages and benefits in the firm as a function of two variables that explained most of the variance--average vehicle size and size of firm--is presented in Table 6-3. Variations of the order of two to one are evident. Similar variations have been noted in other industries. Wage variations, thus, clearly provide one reason why substantial differences costs would exist among bidders for transit service contracts.

Other factors are also present. One is the proximity of the contracted route to the bidder's garage, which will determine the nonrevenue miles that need to be operated. Another is the alternative uses for buses and drivers when they are not needed in transit service, e.g., between peaks. A third is the degree of flexibility in work rules vis-a-vis the transit work pattern, such as the freedom to hire part-time workers, penalties for spread shifts,

TABLE 6-3

DRIVER COSTS AS A FUNCTION OF FIRM SIZE AND VEHICLE SIZE
(In Dollars per Vehicle-Mile)

	Firm Size: Total Operating Revenue, $1,000/Year		
Vehicle Size	$400	$100,000	$275,000
5 passengers (taxi)	0.22	0.33	0.52
11 passengers (van)	0.24	0.35	0.54
25 passengers (minibus)	0.28	0.39	0.59
45 passengers (charter bus)	0.35	0.46	0.66
66 passengers (transit bus)	0.43	0.54	0.73

Source: Calculated from Equation 3.2 in Morlok and Krouk (1983).

etc. Many more variations could be listed. The important point is that there are many factors that contribute to variations in the costs of the bidders to operate any given service. While cost is not the sole basis for a bid, variations in cost presumably would be reflected in variations in bids.

6.2.5 Cost Savings

The distribution of savings, as a percent of the transit system's estimate of the cost of public sector operation of the service (or of contracting to the local transit operating agency if different from the sponsor), is shown in Figure 6-4, for the seventeen systems that provided such estimates. The average (or mean) saving is 28.7 percent with a standard deviation of 17.6 percent. The range is from essentially zero (0.1 percent) to just over 50 percent. Especially noteworthy is the substantial variation in savings, and the relatively uniform distribution over the entire range.

The smallest savings are for small systems in small communities. These savings are all net of the additional costs of administering and monitoring the contracted service which, in almost all cases, were less than ten percent of the total cost of the contracted service. They represent the savings that apply to local agencies and governments, and are not adjusted to reflect, for example, federal grants for vehicle purchase. Thus, these may underestimate the true cost differences.

6.2.6 Assessment of Survey Data Results

Since the number of transit systems known to be competitively contracting for fixed-route bus service is small and cost savings estimates are available for only some of these, it is important to compare these levels of savings with evidence from other public services of relative public and

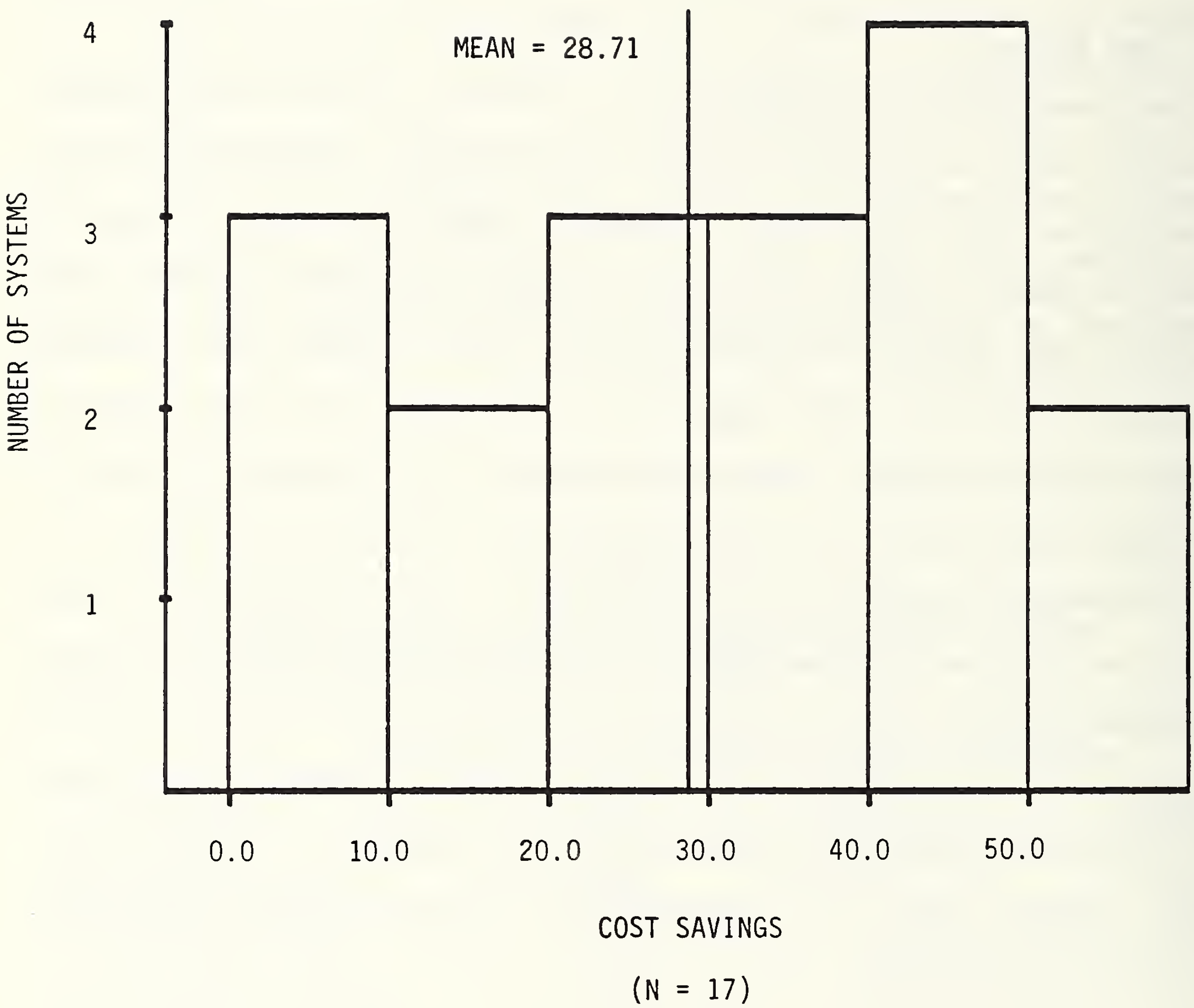

FIGURE 6-4

DISTRIBUTION OF COST SAVINGS

private costs under competitive conditions. If these other public-private comparisons support the savings estimates found from the survey, then the expectation of similar savings in other transit systems is reinforced. If evidence from other public services is inconsistent with these savings, then there is greater uncertainty about realizing such savings.

The literature review of public service contracting contained in Chapter Two provides one source of comparative data. The average savings reported by relevant public services (i.e., those for which output can be easily specified in quantitative terms) was about 30 percent, which compares favorably with the 28.7 percent for systems in this survey. The spread of savings for other public services was large, again consistent with the results of this survey.

Another check of the validity of these findings comes from an examination of the cost items of public transit transit providers versus the costs of private firms that might be (or in some cases are) service contractors. Because bus transit is very labor intensive, labor costs warrant particular attention. A detailed study of the wage and benefit rates of the various over-the-road, for-hire carriers of passengers in the Philadelphia area (Morlok and Krouk, 1983) revealed that small private operators had predicted driver costs for minibus and bus service as low as one-half those of the regional transit agency (see Table 6-3 above). This wage pattern was also confirmed in a study of potential contractors conducted by the Tri-Metropolitan Transportation District of Oregon (Jarigese, 1984). Similar relationships have been reported in other studies of the transit industry (see, for example, Morlok and Viton, 1985; Herzenberg, 1982). In San Diego, the transit union agreed to a wage rate that is about one-half the regular driver wage rate for small vehicle services where the authority is a competitive bidder (Cox, 1984). Similarly, the drivers' union at the New

Jersey Transit Corporation has recently agreed to allow the agency to use part-time drivers at a reduced wage rate on routes for which the agency is a competing bidder.

There have many other studies of the comparative costs of private monopoly and public monopoly arrangements. Data bases, methodological approaches, and results have varied. However, most authors have concluded that private costs are either the same or less than those of public agencies (see, for example, Anderson, 1983; Morlok and Viton, 1985). To the extent that private monopolies are less costly than public monopolies, costs under competitive contracting would be expected to be less than costs under full public monopoly.

In summary, the unadjusted levels of savings reported for the competitive contracting of bus transit compared to the typical public monopoly arrangement are consistent with the levels that would be expected based on both theoretical and empirical evidence.

6.3 FACTORS INFLUENCING COST SAVINGS

On the basis of prior studies of the cost structure of bus transit and studies of savings from contracting of other public services, four factors likely to influence the long-term cost savings for public transit agencies who contract for service were identified: (1) service area characteristics, (2) transit system characteristics, (3) characteristics of the contracted service, and (4) division of tasks between the service sponsor and the contractor. Discussion of each of these follows.

The geographic area in which service is provided can clearly influence public operator costs, and thereby influence the savings an agency may achieve through contracting. An area that is heavily dependent on transit is likely to be more tolerant of high public operator costs because of widespread recognition of the benefits of transit, heavy union involvement, and greater pressure to avoid strikes. The lessened pressure on cost control is likely to manifest itself in higher wages and benefits, larger management and planning staffs, higher salaries and benefits for such personnel, work rules and craft job restrictions that increase pay and number of drivers and mechanics, etc. Therefore this situation presents a greater potential for cost savings.

One measure of dependence on transit is the percentage of work trips made by transit. Another indicator, though not as direct, is area population, since transit usage is positively correlated with population density. A final measure is applicable to situations in which the transit agency may serve only a portion of the metropolitan area, such as a suburban county. This measure would be the distance of the area served by the agency to the center of the metropolitan area. Presumably the greater that distance, the less the dependence on transit, and hence the less the savings.

A second group of factors relates to the transit authority itself. In general, the larger an organization, the higher its wages and benefits for a given task and skill level of employee (Levinson, 1967; Masters, 1969). This would lead to greater potential savings in larger transit systems. Also, the larger the organization, the greater its potential for gaining needed political and financial support for costly operations. A variety of measures might be used to characterize organizational size and influence, such as total employees, total budget, or vehicle-miles operated.

The division of responsibility for providing the various parts of the total transit service package will affect the contractor's cost and hence the potential savings. Most important are items of capital stock (vehicles, maintenance and storage facilities) as these are often essentially "free" of capital recovery costs if publicly owned. If the public agency provides them, the cost is correspondingly low or nonexistent. But if these are provided by the contractor, the savings as seen at the local level would diminish. Appropriate measures here are the percentage of vehicles provided by the contractor and a similar variable for maintenance/ storage facilities.

It is often stated that savings are likely to be greatest for certain types of services such as peak-period express services and low-volume all-day routes (Cox, 1985) and for services which utilize small vehicles (American Road and Transportation Builders Association, 1986). Indeed, systematic differences in costs among different service types are widely recognized in the industry and well documented in cost studies. This suggests that cost savings will vary by the type of service contracted. The purpose of including service variables is to determine whether or not the data support the hypothesis that savings will vary systematically with service type. Therefore, four variables to be considered in the model are:

1. Average vehicle size (seats and places for standees)
2. Peak-to-base ratio
3. Average speed
4. Vehicle-miles of contracted service.

The general form of a model for estimating savings based on these four types of characteristics is:

$$TS = F(SC, AC, MC, DT) \qquad (2)$$

where:

TS = Total savings

F = The function relating the variables

SC = Service characteristics

AC = Transit agency characteristics

MC = Metropolitan area characteristics

DT = Division of tasks between sponsor and contractor.

6.4 MODEL DEVELOPMENT

The model described above was developed as an operational model using linear multivariate regression. The dependent variable is the percent savings, unadjusted at this point for taxes, etc. Nine variables, representing the four categories of characteristics likely to influence cost savings, were selected to be used in model development. The nine independent variables are:

V1 = Average bus capacity (seats and standees).

V2 = Ratio of buses used in the base to buses used in the peak. This is the inverse of the usual transit peaking ratio. The inverse is used because its natural range is from 0 to 1, in contrast to the usual measure which ranges from 1 to infinity.

V3 = Average speed (vehicle miles/vehicle hours), expressed in MPH.

V4 = Vehicle miles contracted [thousands].

V5 = Distance from metropolitan area of influence [miles]. This distance is measured from the center city of the area of influence, which is:

- CSA if the transit agency is contained in a consolidated statistical area,
- MSA if the transit agency is contained in a metropolitan statistical area,
- 0 miles input distance, if the transit agency is not included in either a CSA or an MSA.

V6 = Population of the metropolitan area of influence [thousands]. The area of influence is the same as for V5.

V7 = Percentage of work trips by transit for the metropolitan area. This is found by dividing the number of work trips by public transit by the number of workers over age 16 and multiplying by 100 to get the value as a percent.

V8 = Ratio of the number of buses owned by sponsor to the number of buses owned by contractor used for contract service.

V9 = Per capita income for the metropolitan area [thousands].

Values for V5, V6, V7, and V9 were taken from the 1980 U.S. Census.

The objective is to develop the "best" model for estimating the percent of savings from these variables. The term "best" in this context refers to two distinct model features. One is that the relationship makes sense on the basis of a priori knowledge. The second is that the model fits the data well. As the former was discussed in the prior section, the latter will receive more attention in this description.

The basic approach was to develop and evaluate, using standard statistical tests, all models that seemed plausible considering the phenomena being modeled. These models would differ by: (1) the independent variables included, (2) any transformation of each variable, e.g., to its square, and (3) the value and sign of the coefficients of each variable. Well over 100 alternative models were examined. In all cases the dependent variable was the percentage of savings.

The order of development of models was from the simplest to the most complex, initially starting with single (independent) variable models (in order to become familiar with the data), then two-variable models, etc. With the possibility of various transformations of each variable at each stage, the number of models to be explained increases dramatically with an increase in the number of variables. As the number of variables increases, the contribution of additional variables to a better fit of the data decreases, providing a basis for limiting the number of variables in the model.

At each stage of the analysis, the selection of variables to be included in the model was guided both by a priori assumptions regarding the effect of variables and statistical measures of fit to the data. Model quality decisions were based on three general types of criteria.

One such criteria consisted of the statistics developed from the regression procedure and from conducting an analysis of variance. The first group of indicators consists of the percent of explained variance (R^2) and the estimate of variance of the error of the estimate about the function (S^2). Generally, a high explained variance and a low error are sought. The statistic from the analysis of variance is the F-value and the associated tail area. The tail area is the probability of all of the coefficients in the model being zero. For instance, a tail area of 0.1 indicates that there is a probability of 10 percent that all of the coefficients in the model are zero. Obviously, a low value is preferable. All the above tests reflect the strength of the model as a whole, and all were considered.

In addition to the quality of the entire model, it is also important to know the value of each of the individual variables to the model. The partial F-value and tail area associated with each variable indicates the significance of that variable in the model. The statistic is calculated for each independent variable and represents the probability that the coefficient of that variable is zero. In the case of two models having similar statistics for each model taken as a whole, the partial statistics become important. As an example, assume we have two models, each consisting of three independent variables. R^2, S^2, and the tail areas are identical. At this point the partial tail areas of both models are examined. All three variables of the first model have a tail area less than 0.1; while two of the variables in the second model are also below this level, the third has an area of 0.26. Considering these statistics would lead one to accept the first model over the second.

Another decision criterion was the quality of the variables used in the model. Some variables, such as the distance from the metropolitan area, may be subject to a variety of interpretations by others using the model. A different interpretation of the variable, however, may yield different estimates of cost savings. Recognizing the potential problem, slightly better statistics were required of these variables in order for them to be chosen.

The third criterion was initial assumptions as to the effect of a variable on savings. Since the function is linear, the sign of its partial derivative with respect to that variable is the same as the sign of the variables' coefficient. A difference in sign, or the relative magnitude of the coefficient, from expected values, would cause the model's validity to be suspect.

Models consisting of one, two, three, and four variables were developed and evaluated as described above. In each case, transformations of each variable were also considered. These included logrithmic, quadratic, and shifting transformations.

Three variable models generally had better regression statistics than those composed of two variables. R^2 values with three variable models were approximately twice as high, and S was typically in the vicinity of 12 percent of the mean value. Tail areas were in the range of 0.004 for the better of the three variables models.

A fourth variable was added to these better models to ascertain if each could be improved. Slight improvements in the correlation coefficient, standard error and in some instances the tail area, were obtained. The partial tail areas of one or more of the variables, however, increased substantially (to well over 10 percent). This led us to believe a three-variable model would be more reliable.

After applying all the decision criteria, the following model was selected:

$$P = -22.101 + 0.593(10V2-5)^2 + 0.91(V3) + 4.011(\ln(V6)) \qquad (3)$$

where:

P = Percent savings (unadjusted)

V2 = Buses in base/buses in peak

V3 = Average vehicle speed [MPH]

V6 = Population [thousands]

This model has an R^2 of 63.36 percent and a standard error equal to 11.8 percent. An F-value of 7.494 was calculated and the associated tail area is 0.004. The largest partial tail area, that of variable V2, is 0.08.

It is noteworthy that the data did not support the inclusion of one service characteristic expected to be a significant factor: the percent of contract service vehicles provided by the service sponsor. Given the federal capital grant program, it had been assumed this would be an important cost factor, increasing the savings if the sponsor provided the vehicles. However, the cost disadvantage of private firms providing vehicles may be decreased by opportunities to use the vehicles in other services, and such opportunities may enhance the ability to share drivers and other costs as well. Moreover, the complexities of tax and depreciation rules may offset much of the superficial public advantage, as in other public works facilities (Hendrickson and Au, 1985). More research on this phenomenon is clearly needed.

6.4.1 Adjustments

Two additional adjustments to the model were also made: one for supplementary variance, and one correcting for different treatment of capital costs, taxes, and user changes.

Supplementary variance refers to variance in addition to the variance that is internal to the model as it is estimated based on the data available. Generally, data available do not reflect all of the possible sources of variation in results. Accounting for those additional factors is important in providing realistic estimates, even though this usually must be done by judgment (see, for example, Mosteller and Tukey, 1977, pp. 129-131).

In this study, three characteristics of the sample data were especially relevant to such supplementary variance:

1. The sample of competitively contracting systems was small and neither random (a random sample of such systems would be too small to be of use) nor essentially the entire population.
2. Systems which engage in competitive contracting are not randomly distributed among all transit systems.
3. Features that were not included in the analysis could influence the savings, for example, the local political climate toward government cost reduction.

To take these factors into consideration clearly requires the use of judgment, and other researchers may draw different conclusions regarding the proper magnitude of this adjustment. The approach used here was to adjust the model by: (1) reducing the estimate of mean value by 20 percent; i.e., a mean of 25.0 percent would be reduced to 20.0 percent; and, (2) increasing the standard deviation by 20 percent (or increasing the variance by 44 percent).

The inclusion of adjustments for capital grants and taxes is clearly quite important. Private firms pay a variety of taxes and user charges that public bodies typically do not, including: (1) income taxes; (2) property taxes; (3) special business taxes and franchises; and (4) user charges for the use of public roads (such as fuel taxes and excise taxes on vehicles and parts) and other government services and facilities.

Two basic approaches exist for making these latter adjustments. One is to adjust by increasing the public operator's costs to include taxes, user charges, and capital costs that would be paid if such agencies were treated like private firms with respect to such payments. The other is to reduce private operator bids (which in turn become the sponsors' costs) for these items. Both approaches have attendant problems. First, in principle, changes in the responsibility for these cost elements would lead to a change in the means of production used by a cost-minimizing operator. In theory, transit authorities receiving "free" buses might curtail or defer vehicle maintenance to reduce the costs for which they are they are responsible, anticipating that they would receive replacement vehicles at essentially no charge. Detecting and then correcting for such production process changes, where they occur, is extremely difficult and not feasible in a project of this nature. Secondly, cost theory and methodology provides a sound basis for associating only incremental costs with a particular line of business. If incremental costs are the basis for bids (and incremental costs are not to be confused with marginal costs), then where fixed costs are present they will lead to total revenue being less than total cost. The firm would go bankrupt with such a bidding or pricing policy. Many taxes and user charges have fixed components; buses represent a substantial fixed cost as well. If fixed costs are to be part of the adjustment, the allocation to various services will have to rely on judgment. Despite these difficulties, adjustment for these costs is extremely important.

If the public operator costs were to be adjusted upward to reflect these costs then, at least, historical data from the period when transit was largely a tax paying private sector enterprise could be used. To delete these costs from private firms would seem to be far more difficult, for the firms encompass a wide variety of types, in terms of their basic line(s) of business. Thus the approach of adjusting public costs to reflect the addition of taxes, user charges, and capital costs appeared more feasible.

The adjustments can be accomplished in the following manner. Let C_C be the cost of the contracted service as seen by the local transit agency, composed of the winning bid (contract) price B_C and contract management and related costs C_M :

$$C_C = B_C + C_M \tag{4}$$

The corresponding local cost for public authority provided service would be C_{AO} . In addition, there is the cost of vehicles (and other capital stock) C_{AC} , and taxes and user charges C_{AT} , which would be incurred if the authority were treated in the same manner as private firms. Thus the total cost of authority-operated service would be:

$$C_A = C_{AO} + C_{AC} + C_{AT} \tag{5}$$

The true percentage savings would be:

$$P_T = \frac{C_A - C_C}{C_{AO}} \tag{6}$$

The data that we have, however, are for:

$$P = \frac{C_{AO} - C_C}{C_{AO}} = 1 - \frac{C_C}{C_{AO}} \tag{7}$$

Considering the difficulties mentioned earlier, the adjustment for C_{AC} and C_{AT} should be on the conservative side, i.e., erring on the side of understating the savings. The approach was to use factors of a type that could be estimated from historical data, to estimate C_{AC} and C_{AT}. Thus C_{AC} is taken as a factor α times C_{AO}, and C_{AT} is taken as a β factor, multiplied by total costs before taxes and user charges, i.e., $C_{AO} + C_{AC}$:

$$C_{AC} = \alpha C_{AO} \quad (8)$$

$$C_{AT} = \beta (C_{AO} + C_{AC}) \quad (9)$$

Thus

$$C_A = (1 + \alpha)(1 + \beta) C_{AO} \quad (10)$$

This leads to

$$P_T = 1 - \frac{C_C}{C_A} \quad (11)$$

$$= 1 - \frac{C_C}{(1 + \alpha)(1 + \beta)C_{AO}} \quad (12)$$

$$= 1 - \frac{1}{(1 + \alpha)(1 + \beta)} (1 - P) \quad (13)$$

The factors α and β were estimated from historical reports. α is the ratio of annual recovery costs of capital stock to the annual operating cost. In 1983, assuming that buses had an average cost of $120,000 and had a 20-year life, that the relevant interest rate was 10 percent per year and that other capital stock items (e.g., parts, maintenance equipment) increased the annual cost for buses alone by 20 percent, the value of α would be:

$$\alpha = \frac{(.1175)\ (\$120{,}000)}{\$97783}\ 1.2 = 0.173 \qquad (14)$$

For our calculations, we took α = 0.085, about one-half of this value, clearly a conservative assumption.

β is the ratio of taxes and user charges to total operating costs. Taxes are virtually nonexistent in transit today, largely due to public ownership. In 1983, only 0.5 percent of total operating expenses (excluding depreciation and amortization) consisted of taxes. In 1965, the entire transit industry (rapid rail, streetcar and bus) paid taxes to all levels of government equal to 9.3 percent of total operating expenses including depreciation and amortization (American Transit Association, 1966, pp. 4-5). This remained roughly constant for the entire industry in the late 1950's and early 1960's. A detailed financial study of the bus segment of the industry, using 1960 data, revealed that operating taxes and licenses in that year were 7.91 percent of total revenue (Wells, et al., 1972, p. 3-17). This does not include federal income taxes. Using the 1965 ratio of income taxes to other taxes for the entire transit industry, this translates into 10.2 percent of total bus system expenses as taxes and other payments to government. Thus, a β in the vicinity of 9 percent to 10 percent seems appropriate. We used half this to be on the conservative side. Thus total savings will be adjusted using β = 0.045 and α = 0.085.

The net effect of these three adjustments is to shift the distribution of total national savings upward slightly, despite the conservative assumptions on capital costs and supplementary variance.

6.5 ESTIMATION OF NATIONAL SAVINGS

National savings will, of course, depend on the types and characteristics of services which are competitively contracted. Obviously, many combinations of contracted services and system characteristics are possible. However, the variation in the percentage savings found from a variety of possible contracting scenarios is not very great and can be represented well with a few examples.

A possible scenario is one in which a specific amount of service, e.g., 10 percent, is competitively contracted in each system. This would presumably apply only to systems of at least a certain size, for it would not make sense to contract out a small portion of a service which operates only a few vehicles. Therefore, our examples will be for the larger systems. Since the percentage savings are the least in small metropolitan areas, where the systems are also very small, the overall estimate of national savings is not affected appreciably by this assumption.

6.5.1 Aggregate National Savings

To estimate potential national savings from competitive service contracting, we applied our model to data from the 89 publicly owned and operated U.S. transit agencies which operate over 100 vehicles. Collectively, these systems represent the vast majority of bus service in the U.S. In 1983, these systems represented 89.5 percent of total bus operating expenditures, 75.8 percent of federal operating assistance, and 84.4 percent of total public operating assistance (U.S. Urban Mass Transportation Administration, 1986).

If the contracted service in each system possessed characteristics (peak to base ratio and average speed) identical to that system's average, then the expected average value of the savings, after adjustments as described above, is 28.1 percent, with a standard deviation of 12.7 percent of this value. The appropriate distribution to be used for these savings is the Normal distribution. With this distribution there is a 98 percent probability that the savings will be at least 20.7 percent, a 90 percent probability that they will be at least 23.5 percent, and a 50 percent probability that they will be at least 28.1 percent. The cumulative probability density function curve for this distribution is shown in Figure 6-5.

The cumulative density functions for two other conditions are shown in Figures 6-6 and 6-7. These are two situations particularly favorable for savings from contracting: higher speed services and services with high peak-to-base ratios. The expected value of savings increases somewhat, to savings of 30 percent or more. The entire curve is shifted toward higher percentages, so the value of savings that can be expected with a 90 percent probability is greater, as is that for other probabilities. The range of expected value of savings from a variety of scenarios is 25 percent to 32 percent, and the overall distributions are similar to those shown in Figures 6-5 through 6-7. Furthermore, the results are quite insensitive to changes in assumptions, e.g., reducing the tax adjustment by one-half reduces the expected value of savings by only about 2 percentage points.

6.5.2 Savings for Individual Systems

Underlying the aggregate national savings discussed above are savings estimates for individual systems. These consist of two estimates for each system in each scenario: the mean and the standard deviation. Some discussion of these estimates is warranted.

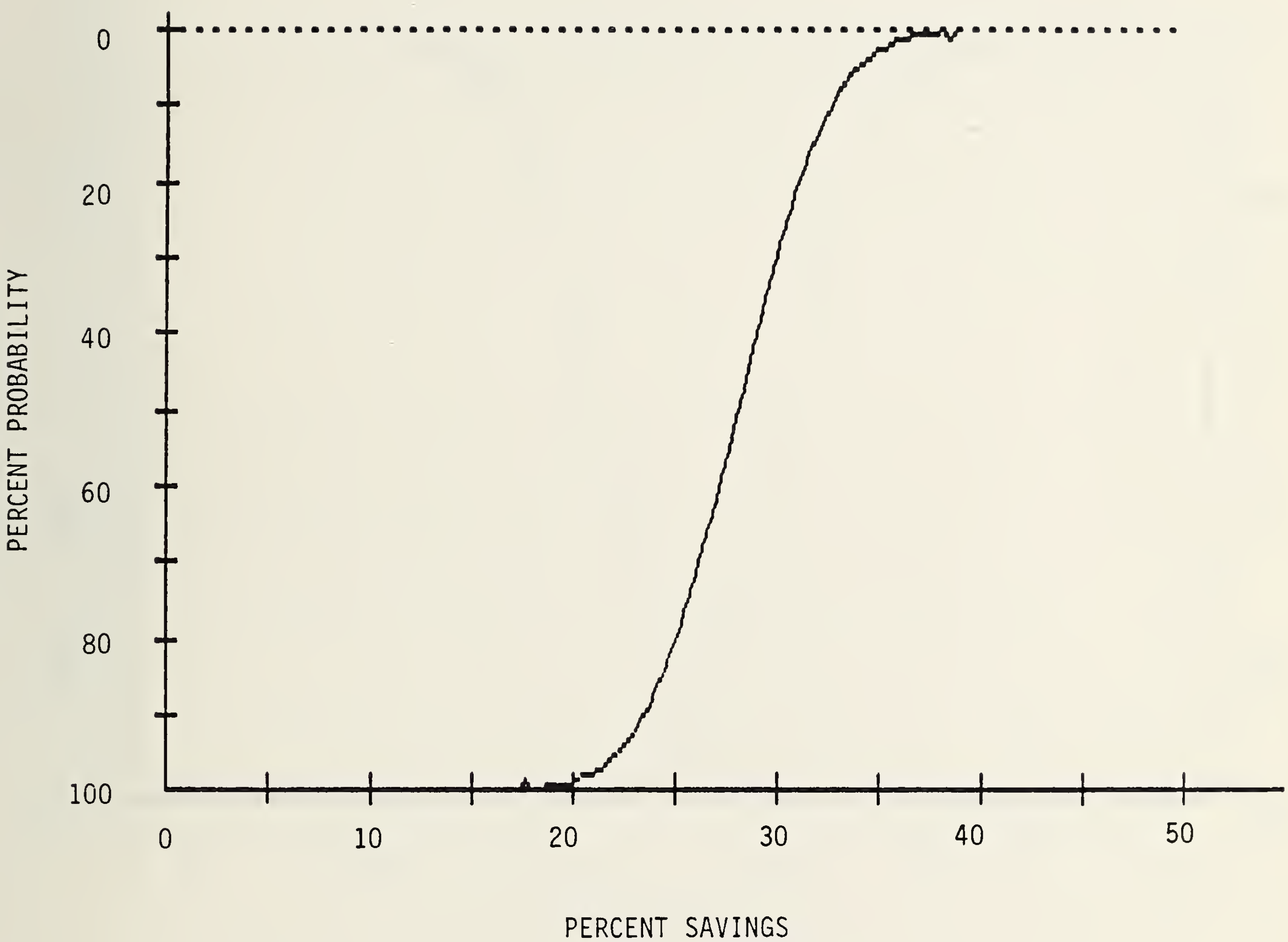

FIGURE 6-5

PROBABILITY OF SAVINGS AT LEAST AS GREAT AS INDICATED, COMPETITIVELY CONTRACTED AVERAGE SERVICE

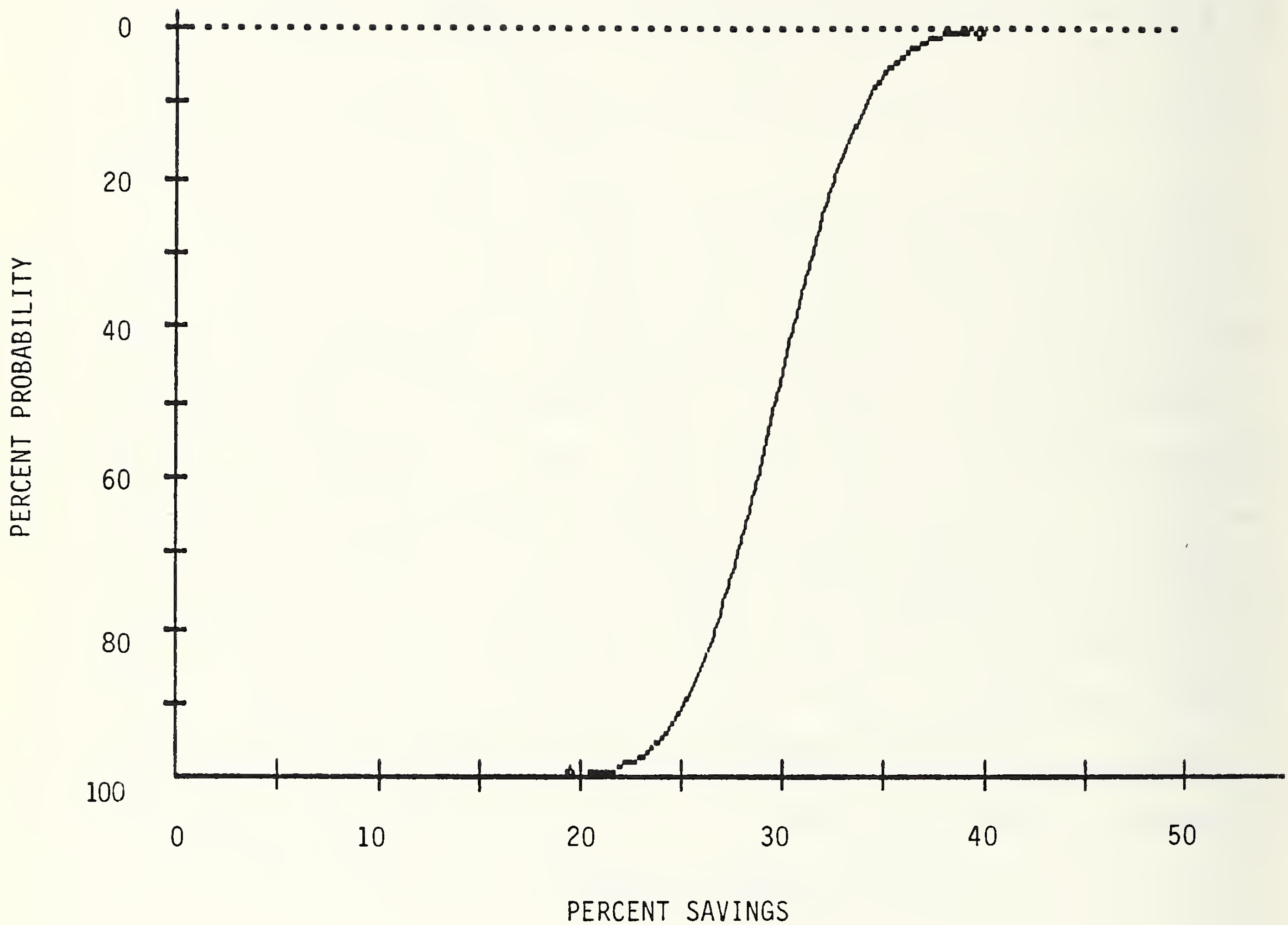

FIGURE 6-6

PROBABILITY OF SAVINGS AT LEAST AS GREAT AS INDICATED, COMPETITIVELY CONTRACTED PEAK/BASE = 4.0

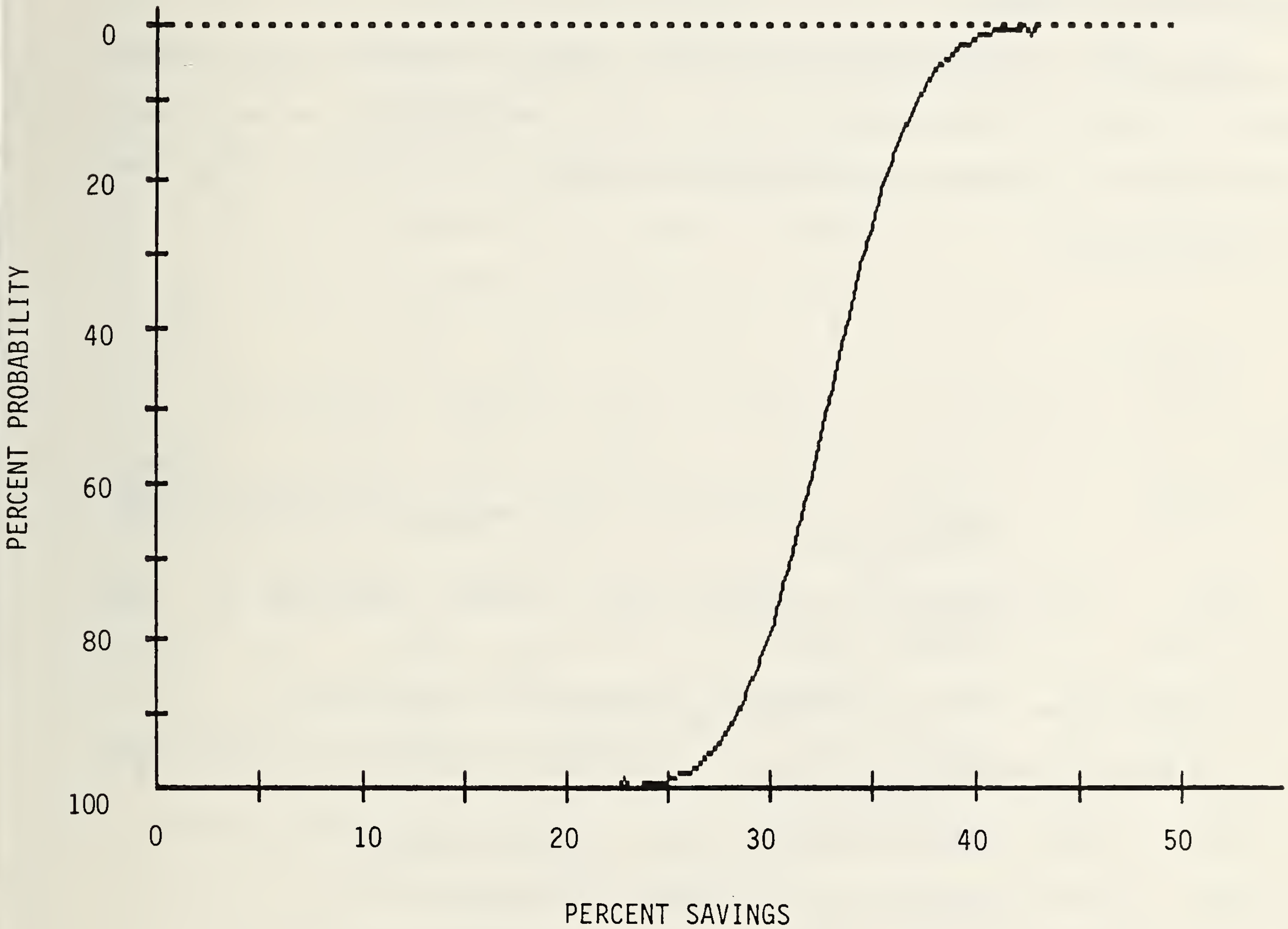

FIGURE 6-7

PROBABILITY OF SAVINGS AT LEAST AS GREAT AS INDICATED, COMPETITIVELY CONTRACTED PEAK/BASE = 4.0, 5 MPH SPEED INCREASE

The mean is estimated simply by applying the equation for P_T presented earlier, Equation (13), with P as given by Equation (3), and multiplying by 0.8 to reflect the external variance. This is routinely done in analyses using regression models.

Less common is the estimate of variance. This is included in this study because we are as interested in the overall distribution as we are in the single estimate of the mean. The unadjusted variance is estimated using the following equation:

$$\text{var}\ (P_k) = \hat{\sigma}^2 \left[1 + 1/n + \sum_i \sum_j (x_{ik} - \bar{x}_i)(x_{jk} - \bar{x}_j)\, c_{ij}\right] \qquad (15)$$

where:

$\text{var}(P_k)$	=	Variance of unadjusted cost savings percentage for the k^{th} observation
P_k	=	Estimate of unadjusted cost savings percentage for the k^{th} observation
x_{ik}, x_{jk}	=	Value of independent variables for observation k
$\bar{x}_i$, $\bar{x}_j$	=	Average values of independent variables in the data used to estimate model
n	=	Number of data sets used to estimate model
$\hat{\sigma}^2$	=	Standard error of estimate of the model
c_{ij}	=	Element of corrected sum of squares matrix

A dollar savings and variance is then calculated for all 89 systems. The expected savings and variance, in dollars, at the national level is simply the sum of the individual savings and variance (in dollars) determined from the model. Equations for this are:

$$Y = \sum_{i=1}^{N} Y_k = \sum_{i=1}^{N} \frac{C_{Ak}}{100} A_k \qquad (16)$$

$$\mathrm{var}(Y) = \sum_{i=1}^{N} \mathrm{var}(Y_k) = \sum_{i=1}^{N} \left(\frac{C_{Ak}}{100}\right)^2 (1.2)^2 \; \mathrm{var}(P_k) \qquad (17)$$

where:

A_k = Adjusted percent savings estimate for system k

C_{Ak} = Total expenditure by authority on service to be contracted in system k

Y = Expected national dollar savings

Y_k = Expected dollar savings in system k

$(1.2)^2$ = Adjustment for external variance.

The national average percent savings is calculated by dividing the expected national dollar savings by the total expenditure on the contracted services and multiplying by 100.

A significant feature of these results is that, although the variance of savings for a single system may be large relative to the mean savings estimate, the variance is a much smaller percentage of the mean after summing over many individual values. This effect on the variance allows us to make statements about national savings, even though the savings outcome in any one system is somewhat uncertain. Indeed, the variations in bids and the ability of a system to choose high or low bids underscores the true uncertainty in any one system. The model is consistent with such uncertainty, but takes it a step further so that national savings can be estimated within a relatively narrow range.

The predicted mean or estimated savings in each of the 89 largest publicly owned and operated bus systems vary widely, from a low of 13.3 percent to a high of 38.4 percent. The standard deviation varies among systems from 12.2 percent to 14.3 percent. This wide variation is reasonable, given the actual savings pattern observed in the data.

It bears emphasizing that it is not possible to state what the probability distribution for any one system looks like. The method requires no assumption regarding this distribution for any one system, and there is no empirical basis for assuming any particular standard probability distribution. Strong probability statements are reserved for the national estimates alone.

6.6 CONCLUSIONS

The results of the analysis of the actual savings reported by transit systems that are currently contracting fixed route bus service suggest that potential savings from greater use of competitive contracting are substantial. The potential savings from competitive contracting were estimated by a model developed using data from these systems. The results from contracting a percentage (e.g., 10 percent) of service in all systems of at least 100 vehicles were that the expected value of overall national savings, after adjusting for supplementary variance and adjusting public operator costs to include taxes, user charges, and capital costs to make their costs comparable to private sector operators, would be in the vicinity of 25 to 30 percent of the total costs.

Of course, future savings cannot be predicted with certainty, as a variety of unpredictable factors will influence savings, such as the amounts of the bids and which bid is chosen for each contract. The model explicitly takes this into account, using the data to estimate the probability of different levels of savings. Thus, the results also include estimates of the probabilities of various levels of savings. Generally, the probability is 90 percent or more of at least a 20 percent savings. Hence, substantial savings are possible with proper implementation of competitive contracting.

Furthermore, before the model was used it was compared with other information on savings from contracting transit and other similar public services, and appropriate adjustments made, resulting in more prudent or conservative estimates than would otherwise be the case. This further increases confidence in the results. Thus, while there remain many unanswered questions with respect to the impact of competitive contracting (such as the likely reduction in costs of the service that remains operated by the transit authority), it seems clear that the cost savings on just the contracted service would be substantial.

CHAPTER SEVEN

CONCLUSIONS AND POLICY IMPLICATIONS

7.1 CONCLUSIONS FROM STUDY RESULTS

The results of the varied components of this study support a common conclusion: large transit systems can realize cost savings of 20 to 30 percent or more from privately contracted services. This is the major conclusion of this study, and it is convincingly supported by all the available information and analysis. For medium and small transit agencies, the magnitude of the likely savings is smaller, and in some cases no savings will occur.

Table 7-1 summarizes the results of the 20 percent scenario cost analyses for our twenty-two case study systems. As the table indicates, typical (mean or median) most probable cost savings are approximately 28 percent for the large case study transit agencies. The medium-sized transit operations were estimated to save 13 percent (mean savings) to 21 percent (median savings) of avoidable service costs in the most probable cost scenario.

Small systems were estimated to save less than 10 percent in all cases, with mean and median savings of less than 5 percent in the most probable scenario. It bears emphasizing, however, that the results for the small systems cannot be generalized with confidence due to the small sample size and the many assumptions made about public and private costs for these systems.

The distribution of savings is also important. Some small and medium-sized transit operations may not be able to achieve any appreciable cost savings by contracting. Others, however, may be able to achieve above average savings. For example, three of the six medium-sized agencies had

TABLE 7-1

CONTRACTING SAVINGS FOR 20 PERCENT SCENARIOS

Number of Peak Buses Operated	Optimistic		Pessimistic		Most Probable	
	Mean	Median	Mean	Median	Mean	Median
1 - 25 (n=3)	4%	6%	-1%	2%	2%	4%
25-150 (n=6)	20%	29%	3%	13%	14%	21%
150+ (n=13)	36%	36%	11%	16%	28%	29%

estimated most probable cost savings of more than 25 percent. Moreover, several large agencies achieved high cost savings. Five of the ten agencies with 250 or more peak buses had predicted cost savings of 33 percent or more.

In addition, the two different methods of determining estimated cost savings used in this research both indicate a high probability that significant savings will occur for most medium and large systems. Based on the Penn Model, there is at least 90 percent statistical confidence in the prediction that aggregate national level cost savings for systems of 100 or more buses will exceed 20 percent for the amount of service contracted. For similar sized systems (100 or more vehicles) the University of California, Irvine, cost model predicted savings for fourteen of seventeen systems for the 20 percent pessimistic ("worst case") scenario. Even in this worst case scenario, the median savings for the fourteen agencies which would save money was 16 percent.

This study has also provided the first definitive analysis of the current scope and characteristics of transit contracting. Our national survey of transit contracting revealed that service contracting is a widespread practice, with 35 percent of all public agencies that provide transit service engaging in contracting for all or part of their service. The survey also revealed that contracting is heavily concentrated among small transit systems; when used by larger transit systems, contracting is typically employed for only a small fraction of the agency's services. Nationally, only about 5 percent of the operating expenditures and about 8.5 percent of all vehicle miles of service for bus transit (including demand-responsive transit) are accounted for by contracted services. Consequently, there is an enormous untapped market for service contracting, particularly among large transit agencies. The survey also revealed that where transit service is provided through private sector contracting, the average costs of contracted services are lower than those of public agency operated services of similar size. Although the difference is relatively small for small transit systems, it increases with the size of the transit operation.

The results of this study are consistent with the findings of other research on the relative costs of public and private sector provision of a range of non-transit public services. These studies have found that private providers can typically supply the public services analyzed (refuse collection, school bus transportation, fire protection, and other services) at lower cost than public agencies. A range of cost differences from 0 to 50 percent have been found, with an average cost difference of about 30 percent. These cost savings are of the same magnitude as those reported in this study of transit service contracting.

An obvious question is the sensitivity of our research findings to the methodologies and assumptions used. As discussed in Chapters Four, Five, and

Six, this issue was carefully considered in both the formulation of the methodologies and in the reporting of the results. Neither costing approach claims to give precise estimates of potential savings from contracting. The Penn results have explicit probability confidence levels associated with them, and the University of California, Irvine, approach involved calculation of savings for three different sets of assumptions, ranging from favorable to unfavorable for contracting. It would not be unreasonable to assume that the estimated cost savings could be inaccurate by 5 percent in either direction. Moreover, the methodology developed for the University of California, Irvine, cost model considers only the avoidable costs of the transit agency, and was explictly formulated to err on the side of underestimating transit agency peak period service costs, leading to conservative results for cost savings (i.e., underestimating cost savings). Similarly, the Penn model estimates deliberately err on the conservative side as a result of adjustments of variables. Thus, even the pessimistic model results lead to the conclusion that most large transit agencies will realize savings on the order of least 15 percent on any contracted service. The inverse, of course, is also possible: cost savings of 30 to 40 percent or more could result from favorable contracting situations.

7.2 POLICY IMPLICATIONS

This research indicates that service contracting can potentially generate significant cost and subsidy savings for the public transportation industry. An estimate of aggregate national savings can be obtained through the following procedure: (1) assume that over the next several years transit agencies of 100 or more vehicles contract 20 percent of all their service to private operators; (2) assume that the average savings for each transit system is 25 percent of the avoidable cost of the contracted service (the mean mostprobable savings from the case studies for systems of this size was 26 percent and the median savings was 29 percent); (3) assume that avoidable costs are 92 percent of total operating costs (the average of the case study systems); (4) apply the above factors to that segment of the transit industry which operates at least 100 buses, and accounts for approximately 88 percent of all bus operating expenditures of the total industry expenditure of approximately $6.5 billion annually; and (5) apply a subsidy factor of 63 percent--the 1983 average--to this segment of the bus transit industry.

This procedure yields an estimated aggregate cost savings of approximately $265 million annually at current (fiscal year 1985) expenditure levels. This represents approximately 4 percent of total operating cost for the entire bus transit industry, and approximately 6.5 percent of total subsidy requirements of the entire bus transit industry. For that portion of the bus transit industry which operates 100 or more vehicles, these savings represent 4.6 percent of total operating costs and approximately 7.4 percent of current subsidy requirements. Assuming that savings could average as little as 20 percent (the 90 percent confidence estimate from the Penn cost model results) or as much as 33 percent (the median most probable savings for the case study systems with 250 or more vehicles, which account for 89 percent of operating expenditures among bus transit systems of 100 or more vehicles), the estimated national savings of a 20 percent contracting scenario would be $200 million to $365 million. This represents 3.5 to 6.5 percent of operating costs for these bus systems, and 5.5 to 10 percent of their subsidy requirements, at current levels of costs and subsidies.

These estimated cost and subsidy savings reflect only direct impacts of a significant level of service contracting. There is ample reason to believe, however, that significant indirect cost impacts will also result from a substantial increase in the level of service contracting. In a recent econometric analysis of the costs of the Tidewater Transportation District in Virginia, the only medium or large transit agency known to have contracted out existing services, Talley and Anderson (1986) found that increases in the amount of service Tidewater contracted out were associated with reductions in the cost of the services operated in-house by the transit agency. This occurred because Tidewater was able to win important concessions on wage rates and work rules when its drivers' union became concerned about the loss of jobs from additional service contracting. Thus, indirect cost benefits of contracting have been shown to occur at a transit agency which has engaged in service contracting for existing services.

The experience of the deregulated airline industry also provides evidence of the indirect impacts of bringing less costly providers into the market on labor compensation. Since deregulation, virtually every major airline has adopted a two-tier wage scale for major labor categories (such as flight attendants and pilots), and many airline employees have been forced to accept less favorable work rules and reductions in wages. These actions have resulted from the entrance into the market of new airlines which pay much lower wages and have less rigid work rules than established companies. Thus, competition has resulted in major gains in labor productivity (employee output per cost) in the deregulated airline industry. Similar although less dramatic effects have also occurred in the deregulated trucking industry.

It seems reasonable to expect that increased competition in the transit industry will also encourage the establishment of wage and benefit levels more in line with those in the private sector. These private sector wage rates have been reported in a recent study by the Urban Institute, which examined labor compensation rates for public and private sector bus drivers and mechanics in eight large cities (Peterson, et al., 1986). The study found that private bus company annualized compensation levels (wages plus fringe benefits) for unionized drivers were an average of 21 percent lower than those for public transit bus drivers; compensation for non-unionized bus drivers was 45 percent lower than for transit drivers. A similar pattern was found in compensation for mechanics. Unionized mechanics in private bus companies had a compensation level 32 percent lower than public transit mechanics, and non-unionized bus mechanics were compensated at an annual rate of only 50 percent of transit mechanics. It is apparent, therefore, that the labor compensation paid by large transit agencies is well above the market levels prevailing in the private sector.

If increased competition through service contracting has an indirect impact on labor cost levels of the transit agency, as shown by the study of Tidewater Transit, then the magnitude of the differences in labor compensation levels cited above implies that such indirect cost impacts could be quite substantial. Since any such cost impacts would apply to that 80 percent of the agency's service which, in the 20 percent contracting scenario, is not contracted out, these impacts could well have a greater effect on overall agency cost and subsidy requirements than the cost savings from contracting itself. It must be emphasized, however, that without a transit agency's commitment to a significant level of service contracting--which interjects competition into the service delivery system by forcing the agency's own workforce to improve its cost efficiency in order to secure the rights to operate services--such indirect cost impacts are unlikely.

An important policy implication of this study is that transit service contracting is not a novel practice among local governments, but in fact is "business as usual" for cities and counties which sponsor relatively small transit operations. Thus, service contracting is not an untested concept which must prove its feasibility. Transit service contracting is only novel for the fixed-route services of large transit agencies; elsewhere in the transit industry it is standard operating procedure. The widespread use of private sector contracting for small transit services, where the cost difference between public and private sectors is less pronounced than for larger transit operations, is a strong indication of the importance of institutional resistance in explaining the limited adoption of service contracting by medium and large transit agencies. If there were more objective reasons for opposing the use of private sector contracting for transit service, it is highly unlikely that nearly 300 public agencies would opt to provide at least some of their transit service in this way, and that 200 public agencies would contract for all of their transit service.

The fact that the barriers to a significant increase in transit service contracting are essentially institutional in character does not make them any less formidable. Both transit labor and, in many cases, transit management have economic, political, and ideological reasons for attempting to maintain the current system of monopoly service delivery. Moreover, many transit boards are reluctant to create controversy by altering the status quo of the service delivery system; the political costs, such as confrontation with labor, are usually perceived to outweigh the economic benefits to the transit operation. While there has been increased receptivity toward service contracting on the part of many transit agencies, the major interests in the industry do not appear to be on the verge of enthusiastically embracing this mode of service delivery. Substantial institutional resistance remains to be overcome before UMTA's policy initiative in this area can achieve its full intended impact.

The results of this study indicate the importance of dismantling the existing barriers to service contracting. Direct cost savings of 20 to 30 percent on contracted services, and possible indirect cost savings of a similar magnitude, are compelling reasons for pursuing the contracting option. No other actions available to transit agencies can generate cost savings of this magnitude without a reduction in service levels. Widespread adoption of a significant level of service contracting by medium and large transit agencies is thus the key to reducing operating costs and subsidy requirements without adversely affecting service levels or fares.

APPENDIX A

SURVEY INSTRUMENT

UNIVERSITY OF CALIFORNIA, IRVINE

INSTITUTE OF TRANSPORTATION STUDIES
IRVINE, CALIFORNIA 92717

TRANSIT CONTRACTING SURVEY

Name of Public Agency (Sponsor) ____________________

Type of Organization ☐ Transit Agency ☐ City Govt. ☐ County Govt. ☐ Other ____________

Contact Person ____________________ Phone ( ) -

CHECK ONE BOX FOR EACH TYPE OF SERVICE

Type Service	Provided by Public Operator	Provided by Private Contractor	Not Provided
Fixed Route, Regular	☐	☐	☐
Weekend/Evening	☐	☐	☐
Commuter Service Only	☐	☐	☐
Demand responsive, General Public	☐	☐	☐
Demand Responsive, Specialized	☐	☐	☐
Other ____________	☐	☐	☐

PROVIDE INFORMATION FOR THE ENTIRE SYSTEM

Vehicles ________ Annual Operating Costs ________ Annual Revenue Veh. Hrs. ________

Annual # Pax ________ Annual Fare Revenues ________ Annual Revenue Veh. Mi. ________

Source of Funds: ☐ Local ☐ State ☐ Federal ☐ Other ____________

IF YOU CONTRACT FOR SERVICES PLEASE COMPLETE THE REST OF THIS SURVEY

How long has your agency been involved in contracting for transportation services? ____________

ANSWER FOR EACH SERVICE WHICH IS CONTRACTED

Type Service	# of Veh Owned by:		Annual Operating Costs*	Annual Revenue Veh Hrs	Annual Revenue Veh Mi	Annual Annual # Pax	Annual Fare Revenues
Fixed Route, Regular	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____
Weekend/Evening	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____
Commuter Service Only	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____
DRT, General Public	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____
DRT, Specialized	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____
Other ____	____	☐ Sponsor ☐ Contractor	☐Yes ☐No	____	____	____	____

*DOES THIS INCLUDE VEHICLE CAPITAL COSTS? (Check Yes or No)

Contractor's Name and Phone	Address	Type Service Provided	Contract Selection Process	Length of Contract
____ ( ) -	____ ____	____	☐ Competitive Bid ☐ Negotiation ☐ Renewal	____
____ ( ) -	____ ____	____	☐ Competitive Bid ☐ Negotiation ☐ Renewal	____
____ ( ) -	____ ____	____	☐ Competitive Bid ☐ Negotiation ☐ Renewal	____
____ ( ) -	____ ____	____	☐ Competitive Bid ☐ Negotiation ☐ Renewal	____

(Attach additional sheets if needed)

APPENDIX B

THE TRANSIT COST MODEL

The transit cost model is designed to estimate the short-run and long-run change in transit agency cost resulting from a reduction in the quantity of service provided. Specifically, the model estimates avoidable costs associated with contracting out some given quantity of existing service. The model assumes that the transit agency retains responsibility and control of the service. Additional costs associated with monitoring a contract operation are incorporated in the estimation of private contractor costs.

The transit cost model is an an engineering type model and is based on factor inputs (e.g. labor, maintenance, administration). Cost are allocated to input categories, and the change in cost due to a change in service is estimated from the resulting changes in input categories. The model is divided into two parts: driver costs and all other costs. The driver cost portion requires both schedule and wage data; the other portion utilizes Section 15 data.

B.1 DRIVER COST

The driver cost estimation begins with runcut data and is based on the average pay hour to platform hour ratio (pay/plat) for each type of run operated (e.g. straight, split, tripper and part-time).[1] The pay/plat ratio is a measure of schedule efficiency; it gives the number of driver pay hours required to produce one platform hour of service. The pay/plat ratio is

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[1] See Appendix D for definition of terms.

different for each run type, and unique to each agency as it reflects the impact of both work rules and service characteristics. For example, split runs have a higher pay/plat than straight runs because drivers are compensated for the long break between driving shifts and the long time between the start and end of their daily work.

The scheduled driver cost of any given route or service package can be estimated with a high degree of accuracy by using the pay/plat ratio. The cost in pay hours of operating some quantity of service is:

$$PH\ TOT = PLT_{st}\ (P/P_{st}) + PLT_{sp}\ (P/P_{sp}) + PLT_{tr}\ (P/P_{tr}) + PLT_{pt}\ (P/P_{pt}) \qquad (1)$$

where

$PH\ TOT$ = total pay hours

PLT_{st} = platform hours of straight runs

PLT_{sp} = platform hours of split runs

PLT_{tr} = platform hours of trippers

PLT_{pt} = platform hours of part-time runs

P/P_{st} = system average pay/plat for straight runs

P/P_{sp} = system average pay/plat for split runs

P/P_{tr} = system average pay/plat for trippers

P/P_{pt} = system average pay/plat for part-time runs

This equation simply multiplies the platform time of each run type by the appropriate factor to generate total scheduled driver pay time. Any quantity of service can also be expressed as a combination of runs, and the schedule efficiency of the runs can be used to estimate driver cost, as expressed in the following equation:

$$PH_{TOT} = \sum_{i=1}^{5} [R_i\ PLT_i\ (P/P_i)] \qquad (2)$$

where

R_i = number of runs of type i

PLT_i = average platform time for type i runs

P/P_i = average pay/plat for type i runs

For example, if a route is made up of five straight runs, two splits and six trippers, the total driver pay hours would be the sum of pay hours calculated over the three types of runs.

The system average pay/plat ratios are used instead of the actual scheduled platform and pay time in order to minimize the effects of a specific runcut. The particular combination of runs and pay hours making up a given route or service package is likely to change with every runcut. By using averages, the cost estimates are somewhat conservative. In addition, conducting the analysis on the basis of runs makes it possible to examine the effects of alternative driver attrition policies. There are two complicating factors that also must be incorporated in the costing procedure: interlining and attrition policy with respect to full-time and part-time drivers. These are discussed in the following sections.

B.1.1 Interlining

It is common practice in scheduling to interline runs. Interlining allows the scheduler more flexibility in combining pieces of work, and thus improves efficiency of the schedule. When estimating service contracting cost savings, the extent of interlining must be considered. If the service schedule is highly integrated, removing a portion of service may have a negative effect on the remaining service schedule.

Any given route chosen for contracting is likely to have interlined runs. Empirical research showed that all types of runs (including trippers) are interlined. If routes with interlined runs were contracted, the runs would have to be split up, leaving small pieces of work belonging to the remaining service. How do these leftover pieces affect driver costs? The only accurate way to estimate the interlining impact is to recut the schedule. However, experimental runcutting is not feasible for most transit agencies.

The interlining impact in this model is addressed by establishing upper and lower bounds. The upper bound assumption is that interlining does not have a negative effect on the remaining schedule; all of the leftover pieces can be recombined with no loss of efficiency. (Upper bound is defined as that which generates the greatest transit agency cost reductions). In the driver cost model of equation 2, then, interlined runs are counted as partial runs for the upper bound estimate. The lower bound estimate assumes that one-third of the leftover work cannot be recombined, and consequently must be operated as trippers. This is accomplished by estimating the total platform time of interlined service and multiplying by the tripper pay/plat factor. The difference between the upper and lower bound estimates must be subtracted from the avoidable cost estimate to reflect the additional cost imposed on the remaining service schedule. The extra cost is subtracted because the model estimates cost reductions. The process is shown graphically in Figure B-1.

B.1.2 Part-Time Drivers

Most transit agencies now have part-time drivers. There is generally a significant difference between full-time and part-time driver cost. Although part-time drivers are usually paid on the same wage scale as full-time drivers, their wages are lower because of their shorter tenure and slower progress up the wage scale. Part-time drivers also receive fewer fringe

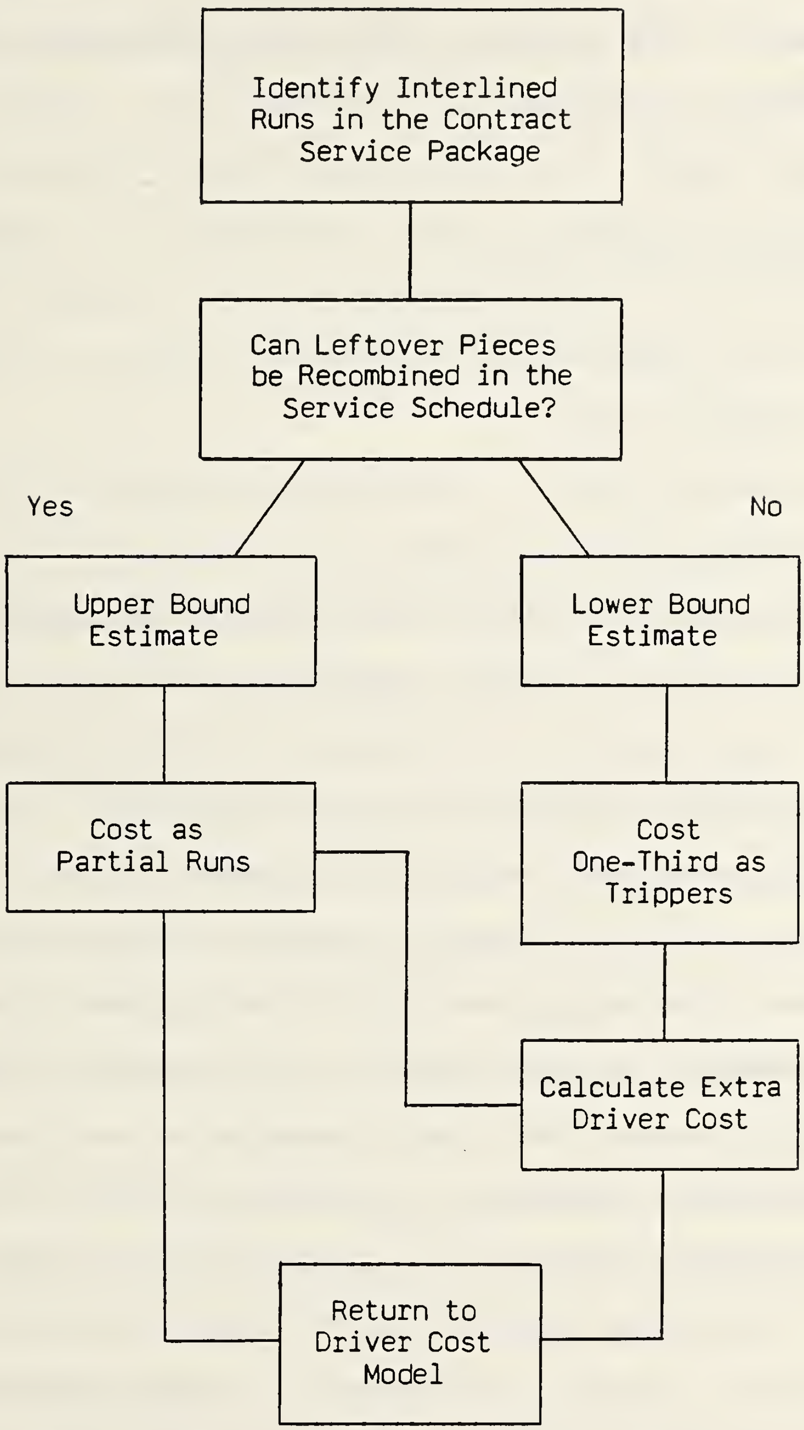

FIGURE B-1

FLOW CHART OF THE INTERLINING SUB-MODEL

benefits than full-time drivers, and are subject to less restrictive work rules. In order to take part-time driver cost differences into account, equation 2 is modified as follows:

$$PH_{tot} = PH_{ft} + PH_{pt},$$

$$PH_{ft} = \sum_{i=1}^{4} (R_i PLT_i\ (P/P_i)],\ \text{and}$$

$$PH_{pt} = R_{pt}\ PLT_{pt}\ (P/P_{pt}), \qquad (3)$$

where PH_{ft} = full-time pay hours

and PH_{pt} = part-time pay hours.

The attrition policy the agency follows with respect to part-time and full-time drivers will also affect cost savings. When avoidable costs are calculated as in Equation 3, the implicit assumption is that full-time drivers and part-time drivers decline in proportion to their representation in the service to be contracted. However, the transit agency can also choose to reduce only full-time drivers and keep the part-time drivers, or reduce only part-time drivers. From a cost standpoint, keeping the part-time drivers is obviously the best alternative. Part-time drivers assigned to the contracted service can be reassigned to other service, thus reducing overall service cost. In practice, however, the other alternatives may be implemented due to labor pressure or contract requirements. In order to account for alternative driver attrition policies, upper and lower bounds are again utilized.

The lower bound cost reduction assumes both full-time drivers and part-time drivers are reduced in proportion to their representation in the service to be contracted. Again, lower bound means least effective in reducing service cost. In this case, driver cost is estimated directly from the model (Equation 3). In effect, it is assumed that the part-time runs associated with the contracted service are eliminated. The upper bound cost reduction assumes that part-time drivers are retained, so any part-time runs on the contracted service will be used to replace tripper runs on the remaining service. The additional cost savings (i.e., increase in avoidable cost) is calculated by costing all of the part-time runs in the contract service package as tripper runs. That is, driver cost is estimated as if the service were operated only by full-time drivers. A flow chart for the part-time driver sub-model is presented in Figure B-2.

B.1.3 Converting Pay Hours to Driver Cost

Thus far, the driver cost model has estimated scheduled pay hours for the contracted service. These must be converted to driver cost. In order to do so, three elements must be added: wage cost, fringe cost, and unscheduled cost.

Wage cost. Wage cost simply transforms the pay hours figure to a dollar cost figure. Average effective wage rates are generally maintained by the transit agency, since they are frequently used in budget planning. If actual data are not available, wage rates can be estimated from Section 15 data. The average full-time driver wage can be approximated by the top wage, since it usually takes about three years to reach the top of the wage progression, and the average tenure of full-time drivers is generally three years or more. The national average part-time driver wage is 81 percent of the top wage (Chomitz, Giuliano, and Lave, 1985), and this estimate can be used in the absence of actual transit agency data.

Fringe Cost. Fringe benefits include vacation and holiday pay, sick leave, medical insurance and retirement contributions. Again, transit agencies frequently maintain current estimates of fringe costs. Fringe benefits paid to operators are reported in Section 15; the annual Section 15

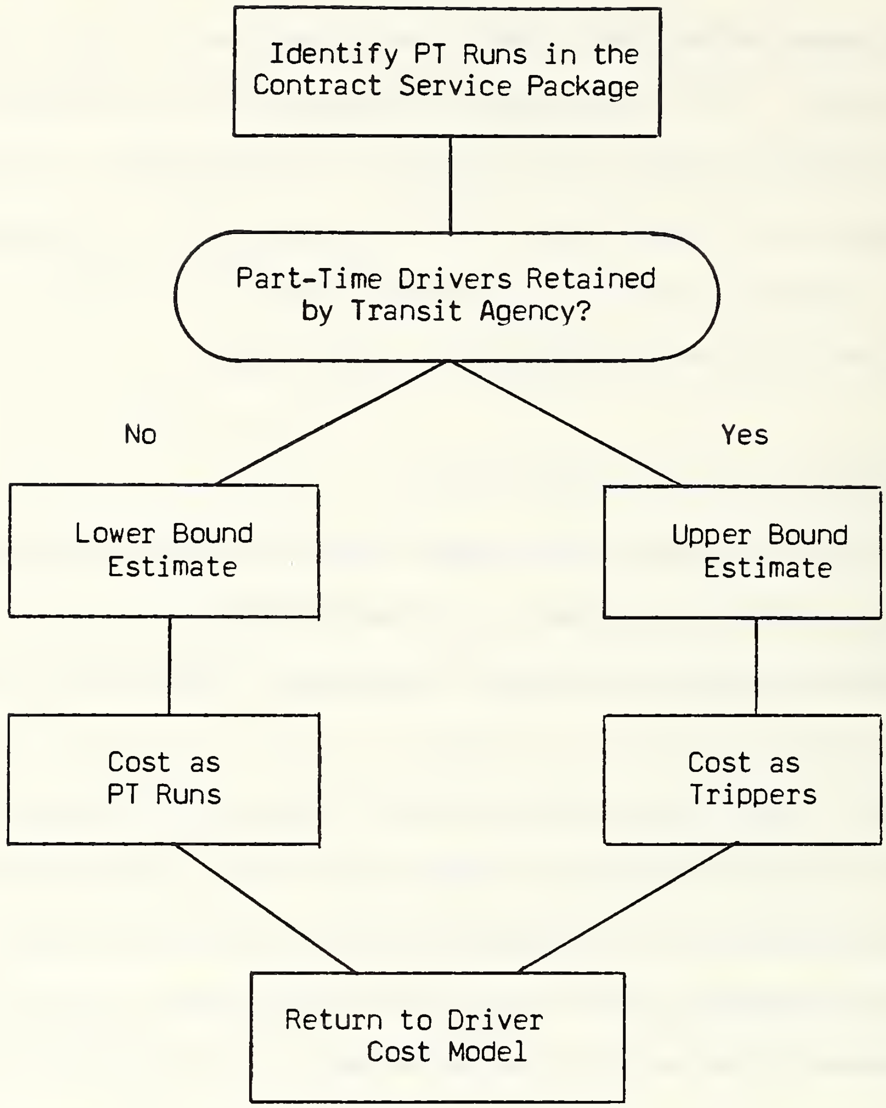

FIGURE B-2

FLOW CHART OF THE PART-TIME DRIVER SUB-MODEL

figure can be used to develop an hourly rate for full-time drivers. Fringe benefits to part-time drivers average about 20 percent of the full-time rate. Part-time benefits can be estimated by calculating the average hours worked per part-time driver and prorating the full-time rate accordingly.

Unscheduled Cost. So far only the <u>scheduled</u> cost of operating the contract service package has been considered. The cost of covering for driver absences, providing relief for vacations, and of providing replacement vehicles in the case of breakdowns have not been considered. These functions are covered by the extraboard drivers. Extraboard drivers perform all unassigned work. If service is reduced, extraboard cost should also be reduced; that is, the attrition principle applies to all operators. Unscheduled cost can also be estimated from Section 15 data by calculating the annualized scheduled cost for the entire service schedule and subtracting this from the total compensation paid to drivers. Dividing the remainder by total platform hours gives the unscheduled cost rate per platform hour.

Incorporating wage, fringe and unscheduled cost into the full-time driver cost equation, gives the following:

$$DC = (W + F) \left(\sum_i [R_i \, PLT_i \, (P/P_i)] \right) + U \left[\sum_i (R_i \, PLT_i) \right] \quad (4)$$

where DC = Driver cost

W = Hourly wage rate

F = Hourly fringe rate

U = Hourly unscheduled cost rate.

For agencies with part-time drivers,

$$DC = (W_{ft}+F_{ft}) \left(\sum_{i=1}^{4} [R_i PLT_i (P/P_i)] \right) + (W_{pt}+F_{pt}) [RptPLTpt(P/Ppt)]$$

$$+ U \left(\sum_{i=1}^{5} R_i PLT_i \right) \quad (5)$$

where W_{ft}, F_{ft}, W_{pt}, F_{pt} are wage and fringe rates for full-time drivers and part-time drivers respectively. The unscheduled cost rate, U, is the same in both equations because all unscheduled work (both part-time and full-time) is covered by the same extraboard. Note that unscheduled cost is calculated on the basis of scheduled platform hours.

To summarize, the driver cost model uses the pay/plat ratio for different types of runs to estimate the reduction in platform hours resulting from contracting a given quantity of existing transit service. The model considers the impact of the change on the remaining service schedule, and accounts for cost differences of full-time and part-time drivers. Service cost in terms of pay hours is used as a basis for generating wage, fringe and unscheduled cost. The resulting sum is the total driver cost of the service. A flow chart of the entire driver cost model is presented in Figure B-3.

B.2 MODELING OTHER COSTS

All other costs are estimated using Section 15 data. The impact of the contract-related service changes is identified for the short-run (1 to 2 years) and the long-run (3 to 5 years), in which a total adjustment has been made. All cost elements are identified by functional categories, and by short-run and long-run variability. Cost categories are established to correspond to major inputs (labor, fuel, maintenance and administration), and to be homogeneous with respect to short-run effects.

The Section 15 expense data are organized in a two-dimension classification system, by "object class" and "function." An object class is " . . . a grouping of expenses on the basis of goods or services purchased . . . ," for example, labor, services, materials and supplies (UMTA, 1977, Vol. 2, p. 7.2-1). Functions are groupings of activities which describe a particular aspect of transit system operation, for example, revenue, vehicle operation, personnel administration, etc. (UMTA, 1977, Vol. 2, p. 7.4-1). Expenses are listed by function and object class, and are broken down

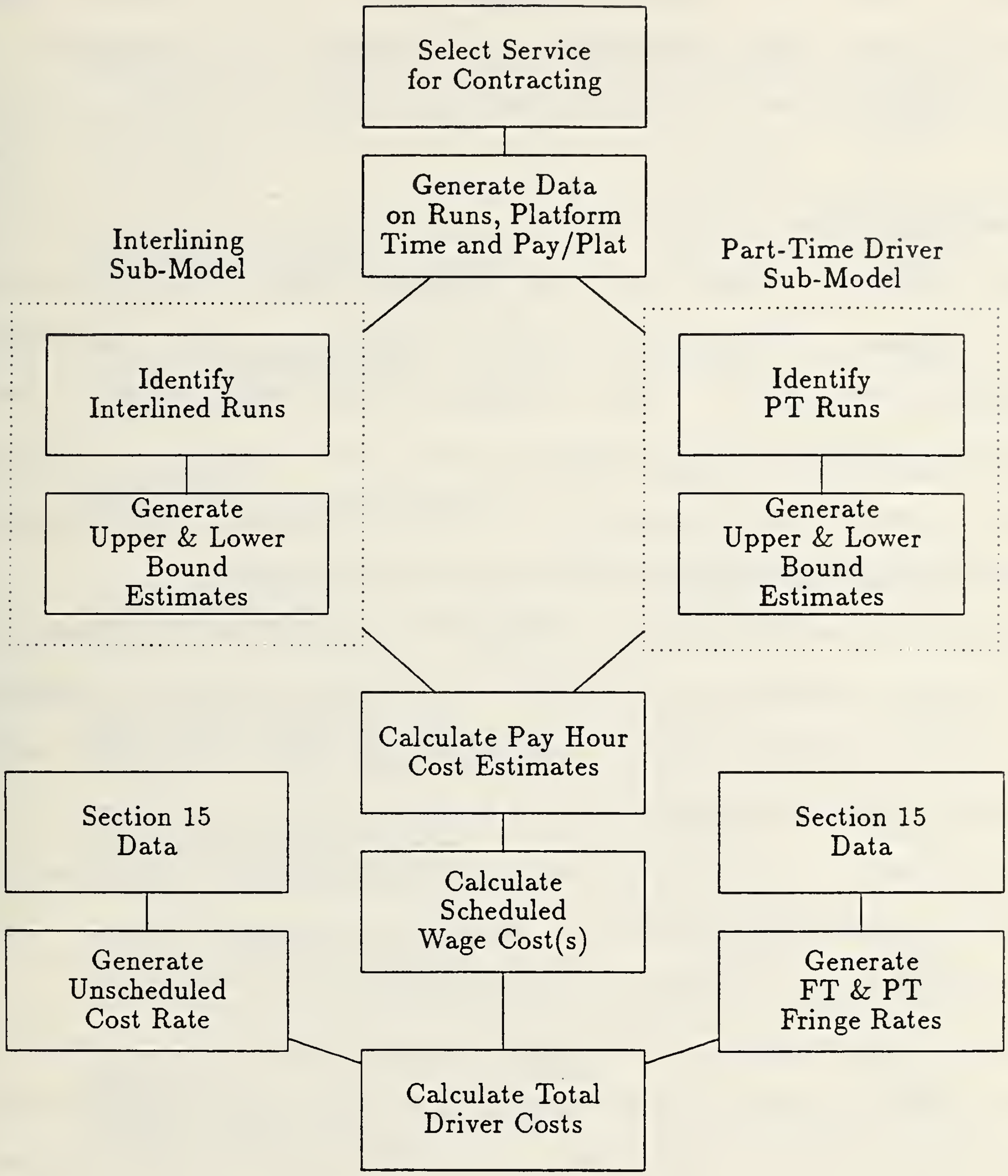

FIGURE B-3

FLOW DIAGRAM FOR THE DRIVER COST MODEL

accordingly. Since the function categories are for the most part highly specific, the cost model categories can be built by aggregating the appropriate functions, and by adjusting the object classes as necessary.

B.2.1 Short-Run Costs

The following function or input categories were generated from the Section 15 data: driver cost, direct operating cost, maintenance, administration, and other. Table B-1 gives the cost model category to which each function is assigned, and indicates whether the function is fixed or variable in the short-run and long-run. Long-run variability is determined by the assumptions used to develop service contracting arrangements.

The short-run model consists of driver and direct vehicle costs; all other costs are assumed to be fixed. For example, there is no reason to believe that the transit agency's administrative staff, facilities staff, etc., would be immediately affected by a 5 percent reduction in service.

Driver Cost. The Section 15 driver cost data are used only to generate the fringe and unscheduled cost data as described in Section B.1.4. Driver cost is variable both in the short run and long run.

Direct Vehicle Cost. Direct vehicle cost includes fuel, oil and tires, as well as scheduled maintenance and vehicle servicing. Using the same logic as with drivers, it is assumed that maintenance labor associated with these functions can also be reduced through attrition. However, it is also possible that the extra labor could be assigned to other tasks, or that the relationship of maintenance labor to vehicles is such that the attrition process would not begin immediately. In order to develop avoidable cost estimates which are as realistic as possible, alternative assumptions are again employed. The upper bound estimate assumes full attrition of related

TABLE B-1

DESCRIPTION OF SECTION 15 FUNCTIONS AND COST MODEL ASSIGNMENTS

Function Number	Description	Category	Short Run	Long Run
011	Transportation Administration. Supervisory and misc.; includes report, turn in and standby	ADMIN	FIXED/[a] VAR	VAR
012	Vehicle Movement Control. Dispatching and related control activities	ADMIN	FIXED	VAR
021	Scheduling. Transportation operations, all scheduling activities	ADMIN	FIXED	VAR
031	Vehicle Operation. Service production; includes labor and fuel, oil, etc.	DRIVER COST/ DIRECT OP[b]	VAR	VAR
041	Maintenance Administration. Vehicle administration activities related to vehicle maintenance	ADMIN	FIXED	VAR
042	Maintenance Administration. Facilities administration related to fixed facilities	ADMIN	FIXED	FIXED
051	Servicing Revenue Vehicles. Cleaning and refueling vehicles and associated supervision	DIRECT OP	VAR/ FIXED[c]	VAR
061	Inspection & Maintenance of Revenue Vehicles. Scheduled maintenance, unscheduled repairs, including parts	DIRECT OP	VAR/ FIXED[c]	VAR
062	Accident Repairs of Revenue Vehicles. Labor and parts for accidents, insurance costs	MAINT	FIXED	VAR/[a] FIXED
071	Vandalism Repairs of Revenue Vehicles. Labor and parts for these repairs	MAINT	FIXED	VAR
081	Servicing & Fuel for Service Vehicles. Same as 051 but for service vehicles	MAINT	FIXED	VAR

TABLE B-1 (continued)

091	Inspection & Maintenance of Service Vehicles. Same as 061 but for service vehicles	MAINT	FIXED	VAR
101	Maintenance of Vehicle Movement Control Systems. Maintenance of radios, other electronic equipment	MAINT	FIXED	VAR
111	Maintenance of Fare Collection & Counting Equipment. Labor and parts	MAINT	FIXED	VAR
121	Maintenance of Roadway and Track.	MAINT	FIXED	FIXED
122	Maintenance of Structures, Tunnels, Bridges and Subways.	MAINT	FIXED	FIXED
123	Maintenance of Passenger Stations. Maintenance and custodial service	MAINT	FIXED	VAR/ FIXED[c]
124	Maintenance of Station Building, Grounds and Equipment.	MAINT	FIXED	FIXED
125	Maintenance of Garage and Shop Buildings, Grounds and Equipment.	MAINT	FIXED	VAR
126	Maintenance of Communication Systems. All non-vehicle systems	MAINT	FIXED	VAR
127	Maintenance of General Administration Buildings, Grounds, & Equipment. Maintenance and custodial services for administration facilities	MAINT	FIXED	FIXED
128	Accident Repairs of Buildings, Grounds and Equipment.	MAINT	FIXED	FIXED
131	Vandalism Repairs of Building, Grounds, and Equipment.	MAINT	FIXED	FIXED
141	Operation and Maintenance of Electric Power Facilities.	N/A		
145	Preliminary Transit System Development. Both capital & service planning	ADMIN	FIXED	FIXED

TABLE B-1 (continued)

151	Ticketing and Fare Collection. Ticket printing, distribution, collection; cash collection and auditing	ADMIN	FIXED	FIXED
161	System Security. Patrol of service and stations - labor and associated equipment	OTHER	FIXED	FIXED[c]
162	Customer Services. Public information and service activities	ADMIN	FIXED	FIXED
163	Promotion. Marketing	ADMIN	FIXED	FIXED
164	Market Research.	ADMIN	FIXED	FIXED
165	Injuries and Damages. Accident investigation, claims, settlements, etc., insurance	ADMIN	FIXED	VAR/ FIXED[c]
166	Safety. Preventive activities for safety, employee safety, and safety in operations	ADMIN	FIXED	VAR
167	Personnel Administration. Recruiting, training, labor relations, grievances, etc.	ADMIN	FIXED	VAR
168	General Legal Services. All non-public liability legal services	ADMIN	FIXED	VAR
169	General Insurance. All non-public liability insurance services	ADMIN	FIXED	VAR
170	Data Processing.	ADMIN	FIXED	VAR
171	Finance and Accounting.	ADMIN	FIXED	VAR
172	Purchasing and Stores.	ADMIN	FIXED	VAR
173	General Engineering. Plant and equipment engineering	OTHER	FIXED	VAR

TABLE B-1 (continued)

174	Real Estate Management. Transit real estate and concessionaire contracts	OTHER	FIXED	VAR
175	Office and Management Services.	ADMIN	FIXED	VAR
176	General Management.	ADMIN	FIXED	FIXED
177	Planning. Long and short range transit planning	ADMIN	FIXED	FIXED
181	General Function. Everything else	OTHER	FIXED	VAR

[a] Split between object classes
[b] Split between cost model categories
[c] Alternative assumptions

maintenance labor; the lower bound assumes that 50 percent of the related labor is fixed in the short run. All direct maintenance labor is variable in the long run. Direct vehicle cost is calculated by developing a unit cost factor (cost per total vehicle mile (TVM)) from the Section 15 data.

B.2.2 Long Run Costs

The distinction between fixed and variable long-run avoidable cost is based on the following service contracting assumptions:

1. The transit agency supplies the vehicles.
2. The private operator maintains the vehicles.
3. The transit agency retains responsibility for service planning, marketing, and general administration.
4. The transit agency retains all fare revenue.

5. The transit agency retains responsibility for all fixed facilities.

6. The transit agency retains public information activities.

Costs associated with these activities are fixed in the long run; all other costs are long-run variable as also indicated in Table B-1. All long-run variable costs are assumed to be directly proportional to output as measured in vehicle hours. While this is admittedly a strong assumption, data are not available on the long-run response to major transit service reductions.

Given the number of activities the transit agency retains, it is difficult to determine whether certain costs are fixed or variable in the long run. These are functions 123 (maintenance of passenger stations), 161 (system security), and 165 (injuries and damages). Again, alternative assumptions are used (fixed vs. variable in long run) in order to bound the avoidable cost estimate. In either case, long run avoidable cost is estimated simply by summing the appropriate cost items to generate an annualized cost and multiplying by the proportional reduction in service. For example, if 10 percent of all service is contracted, long-run avoidable cost is 10 percent of the annual long-run variable cost. A flow chart of the short and long run transit cost model is presented in Figure B-4.

B.3 SUMMARY OF THE TRANSIT COST MODEL

To summarize, the estimation of transit agency avoidable cost is a two-step procedure. First, the driver cost model is used to estimate driver cost. Short-run costs are computed by using Section 15 data to calculate direct vehicle costs. Section 15 data are also used to calculate the long-run costs. Long-run cost change is estimated as a direct proportion of the service change. The purpose of the model is to estimate the short-run and

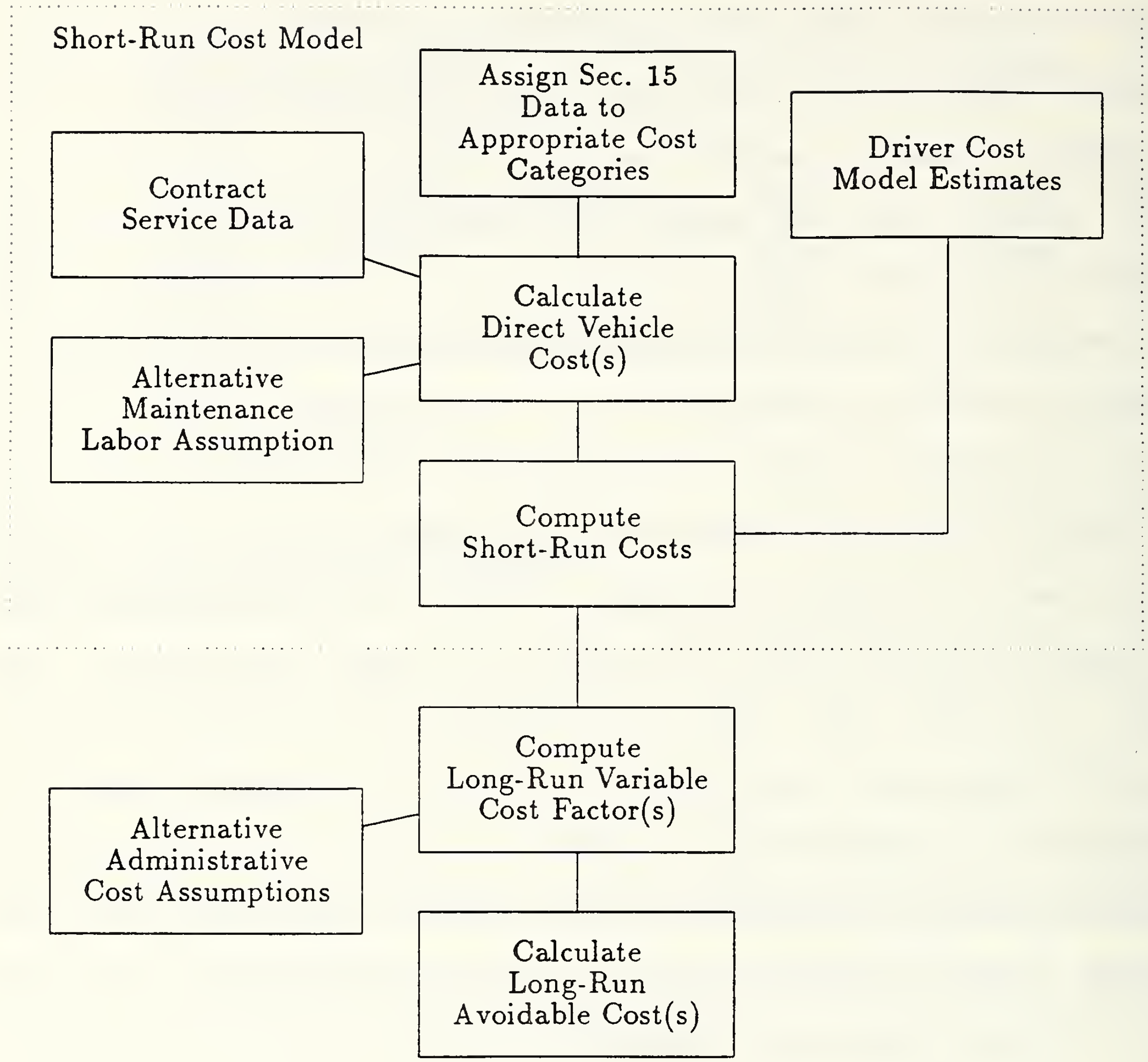

FIGURE B-4

FLOW CHART OF THE SHORT AND LONG RANGE TRANSIT COST MODEL long-run impact of service contracting, given certain assumptions. Fixed and variable long-run costs as determined by contracting service arrangements are identified and incorporated in the model. A series of alternative assumptions is used to account for cost impacts which cannot be calculated directly and for alternative transit agency actions.

The short-run and long-run cost models can now be expressed as,

$$AC_{sr} = DC + VC$$

and $$AC_{lr} = DC + VC + LRV \qquad (6)$$

where AC_{sr} = Short-run avoidable cost

DC = Driver cost (equations 4, 5)

VC = Direct cost

AC_{lr} = Long-run avoidable cost

LRV = Long-run variable cost.

Also,

$$VC = [(F + M_s)/TVM]\ TVM_{cs} \qquad (7)$$

where F = Fuel, oil, tires

M_s = Scheduled maintenance cost

TVM = Total system annual vehicle miles

TVM_{cs} = Total annual vehicle miles of contract service

and $$LRV = (A_{lr} + M_{lr} + O_{lr})\ (TVH_{cs}/TVH) \qquad (8)$$

where A_{lr} = Long-run variable administrative cost

M_{lr} = Long-run variable maintenance cost

O_{lr} = Long-run variable other cost

TVHcs = Total annual vehicle hours of contract service

TVH = Total System annual vehicle hours.

Thus, the transit avoidable cost model is comprised of equations 5 through 8. The transit avoidable cost model was developed specifically to estimate cost impacts of reducing some quantity of existing service under certain given assumptions. The model is quite flexible, however, and could easily be adjusted to reflect different assumptions.

APPENDIX C

CASE STUDIES

Cost impacts of transit service contracting were estimated in case studies of twenty-two United States transit agencies. These agencies range from very small (less than 25 vehicles) to very large (1,000 vehicles), and are representative of a wide range of operating conditions and regional differences. This appendix describes the results of the case studies. Due to the sensitive nature of this research, several transit agencies requested anonymity as a condition of participation. Transit agencies are therefore not identified by name, and the operating data presented are limited to systemwide statistics.

The case studies are presented in three groups, as in Chapter Five. The first group consists of three agencies with less than 25 vehicles, the second group consists of six agencies with 25 to 150 vehicles, and the third group consists of thirteen agencies with more than 150 vehicles. Model assumptions, service packages, and results are described for each group.

C.1 THREE SMALL TRANSIT SYSTEMS

Service contracting for small transit systems would most likely be an "all or nothing" decision. Because of the small scale of the total operation, contracting out a portion of the service would probably have an adverse impact on the efficiency of the remaining schedule. It also does not seem reasonable, from an organizational viewpoint, that a small transit agency would remain in business to operate the remaining service while taking on the additional burden of monitoring a contractor. Moreover, a 25 vehicle service should be easily manageable by private operators. It is therefore assumed that the entire system would be contracted.

C.1.1 The Contracting Scenario

Contracting the entire system is based on the following assumptions:

1. **Vehicle ownership.** The public agency retains ownership of the vehicles and leases them to the private contractor. The private contractor is responsible for all vehicle maintenance and repairs.
2. **Vehicle insurance.** The private contractor is responsible for vehicle insurance.
3. **Fare revenues.** The public agency retains all revenues from fares.
4. **Planning and marketing.** The public agency retains responsibility for planning and marketing of the transit service.
5. **Fixed facilities.** The public agency retains responsibility for maintenance of fixed facilities (e.g., bus shelters, signs).

Avoidable costs for the transit agency are estimated based on these assumptions. Because the entire system is being contracted and because of the limited data available, only one estimate of avoidable cost is made. It is also assumed that the service schedule and all service characteristics remain the same for the contracting scenario, and that service requirements are the same for the private operator as they were for the public operator. That is, vehicle, mileage, and manpower requirements are assumed to remain constant.

One highly volatile element in the estimation of private operator costs today is the issue of vehicle insurance. Dramatic increases in insurance costs for private operators have occurred. An informal telephone survey of several private operators revealed a high degree of uncertainty about possible insurance costs for new services. The values used in the cost estimation reflect a midpoint of a range of estimates, but the large variance of these estimates should be noted. It is assumed to be impossible for the private operator to obtain reduced rate insurance through the local public authority. This assumption should mean that private operator costs are not underestimated.

Private operator service cost is estimated at $1.88 per RVM, plus vehicle insurance. Contract monitoring cost is added to the private operator cost. Optimistic (low cost), pessimistic (high cost), and most probable estimates are, respectively, 5 percent, 10 percent, and 7.5 percent of the total private operator cost.

C.1.2 Description of Case Study Systems

The three case study systems are municipal systems, and are located in different geographic regions. Descriptive statistics are presented in Table C-1. Costs of Systems B and C are low, as is typical of small transit systems. System A is located in a high-cost region and has somewhat less

TABLE C-1

DESCRIPTIVE STATISTICS OF SMALL SYSTEMS

System	# Peak Vehicles	$/RVH	$/RVM	Driver Wage Rate	Peak/Base
A	12	$37.00	$2.45	$9.48	N/A
B	24	29.00	2.53	8.94	2.5
C	21	27.80	2.24	9.08 (4.25)[a]	1.5

[a] Part-time operator wage.

favorable work rules than Systems B or C. System B utilizes a large proportion of part-time drivers; System C provides a 40-hour per week guarantee for drivers and uses part-time drivers with a wage rate of $4.25/hour for the extraboard.

C.1.3 Case Study Results

Results for the total system contracting scenarios are given in Table C-2. These are long-run annual estimates, given the contract arrangements assumed. All estimates are in 1985 dollars. The private operator cost includes the contract monitoring costs. The difference between public agency cost and private operator cost is the savings (loss) due to contracting.

As expected, cost savings is related to transit system cost. System A estimated savings ranges from 5.6 to 9.9 percent--small but significant. System B estimated savings is 1.8 to 6.3 percent. Since an error of at least 5 percent would be expected in these estimates, System B savings may be considered to be insignificant. Private operator costs are estimated to be higher than public agency costs for System C. Service contracting in this case would lead to a 4.7 to 9.7 percent increase in transit costs. These results are not surprising, given the low driver cost of System C.

C.2 MEDIUM-SIZED SYSTEM RESULTS

A total of six case studies were performed for systems of 25 to 149 vehicles. Descriptive statistics are presented in Table C-3. The case study agencies are located in different geographical regions and represent a variety of operating environments. It may be noted that four of the six

TABLE C-2

TOTAL SYSTEM CONTRACTING RESULTS

	Optimistic	Pessimistic	Most Probable
System A			
Public Agency Avoidable Cost	$1,386,181	$1,386,181	$1,386,181
Private Operator Cost[a]	1,248,781	1,308,246	1,278,514
Difference	137,400	77,935	107,667
Percent of Public Agency Avoidable Cost	9.9%	5.6%	7.7%
System B			
Public Agency Avoidable Cost	$1,430,540	$1,430,540	$1,430,540
Private Operator Cost	1,340,539	1,404,374	1,372,457
Difference	90,001	26,166	58,083
Percent of Public Agency Avoidable Cost	6.3%	1.8%	4.1%
System C			
Public Agency Avoidable Cost	$1,232,767	$1,232,767	$1,232,767
Private Operator Cost	1,290,529	1,351,982	1,321,256
Difference	-57,762	-119,215	-88,489
Percent of Public Agency Avoidable Cost	-4.7%	-9.7%	-7.2%

[a] Includes contract monitoring cost.

TABLE C-3

DESCRIPTIVE STATISTICS OF MEDIUM SIZE TRANSIT AGENCIES

System	# Peak Vehicles	$/RVH	$/RVM	Peak/Base	Pay/Plat
D	31	$29.26	$2.26	1.0	1.060
E	40	49.51	3.71	1.1	1.130
F	120	39.29	2.40	1.8	1.054
G	130	43.02	3.70	1.4	1.110
H	142	42.14	2.67	2.0	1.073
I	144	45.02	3.58	1.4	1.178

agencies provide relatively little peak service, and schedule efficiency is high in most cases.

C.2.1 Service Contracting Scenarios

Service contracting scenarios were based on the assumptions described in Chapter Four. Briefly, it is assumed that for the transit agency, only direct service costs are variable in the short run. The transit agency retains responsibility for the service, and thus several elements of operating cost remain fixed in the long run.

The avoidable cost model was adapted for use with "R" level Section 15 data and for more limited service schedule data. The following simplifying assumptions were employed: 1) interlining impacts are not considered, implying that service contracting will not have any negative impact on the transit agency's remaining service schedule; 2) all maintenance cost is variable in both the short and long run; and 3) a flat 50 percent of administrative cost is fixed in the long run.

Cost parameters used in the avoidable cost estimations are given in Table C-4. Driver wage plus benefits is for full-time drivers and is calculated per regular pay hour. Part-time driver wage plus benefits is given only when the rate is significantly different from the full-time rate and when part-time runs are contained in the contract service package. Unscheduled cost is calculated per platform hour, and direct vehicle cost is based on total vehicle miles. It may be noted that unscheduled cost for System D is highly unusual; however, discussions with the transit agency failed to reveal any obvious errors in the data.

Private contractor cost estimates were also simplified. Since the contract service packages were made up primarily of all-day service, all private costs are calculated on the basis of revenue miles. Optimistic, pessimistic, and most probable private contractor costs are $2.00, $2.35, and $2.20/RVM, respectively. Contract monitoring costs are added to the private operator cost estimates. Optimistic, pessimistic, and most probable estimates are as follows:

Optimistic--5 percent of private operator cost, $50,000 minimum

Pessimistic--10 percent of private operator cost, $100,000 minimum

Most probable--7.5 percent of private operator cost, $75,000 minimum.

C.2.2 Case Study Results

Service packages corresponding to 5 percent and 20 percent of total service were selected for each transit agency. The selection was made by determining which routes had the highest ranked pay/plat ratios and selecting routes in rank order. Short-run and long run results are estimated for the

TABLE C-4

TRANSIT AGENCY COST PARAMETERS

System	Driver Wages + Benefit/Pay Hour	Part-Time Wage + Benefit/Pay Hour	Unscheduled Cost/Plat Hour	Direct Vehicle Cost/TVM
D	$10.54	N/A	$ .28	$ .88
E	14.91	N/A	1.35	.88
F	12.22	$8.53	1.99	.84
G	17.09	N/A	1.24	.85
H	15.21	N/A	1.63	.72
I	16.50	N/A	1.66	1.07

5 percent scenario; only long-run results are estimated for the 20 percent scenario. All estimates are annual costs calculated in 1985 dollars. The short run corresponds to the first year of contracting; the long run corresponds to full adjustment. Since only one estimate of transit agency avoidable cost is made for these systems, the differences in the optimistic, pessimistic, and most probable estimates are the result of alternative private operator cost assumptions. Also, the difference between short-run and long-run transit agency avoidable cost is the indirect administration cost. Results for each system are given in Tables C-5 through C-10.

Table C-5 gives results for System D. The cost estimates indicate that both short-run and long-run impacts of the 5 percent service package are negative; substantial losses would result if service were shifted to a private operator with costs based on national averages as assumed here. The 20 percent service package also indicates a significant loss for the transit

TABLE C-5

SYSTEM D RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System D	$158,490	$158,409	$158,409
Private Operator Cost	186,131	229,119	194,994
Difference	-27,722	-70,710	-36,585
Percent of Public Agency Avoidable Cost	-17.5%	-44.6%	-23%
2: 5 Percent, Long Run			
System D	$176,824	$176,824	$176,824
Private Operator Cost	186,131	229,119	194,994
Difference	-9,307	-52,295	-18,170
Percent of Public Agency Avoidable Cost	-5.3%	-29.6%	-10.3%
3: 20 Percent, Long Run			
System D	$663,499	$663,499	$663,499
Private Operator Cost	756,517	931,236	770,492
Difference	-93,018	-267,737	-106,993
Percent of Public Agency Avoidable Cost	-14%	-40%	-16%

agency. The results imply that service contracting is not a viable option for System D, unless private providers with lower than average costs could be found. These results are not surprising given the low hourly service cost and favorable work rules of System D. It should be noted that private operator costs are not adjusted to reflect local conditions more accurately, as sufficient private operator cost data were not available for doing so.

System E results are given in Table C-6. Short-run impacts of the 5 percent scenario may be positive or negative depending on the assumptions, with a most probable estimate of 5.5 percent savings. (All percentages are of the transit agency avoidable cost.) The long-run impacts of the 5 percent service package are more favorable, with a range of possible savings from 5 to almost 25 percent. Long-run impacts of the 20 percent service package are also favorable, with predicted savings of 20.3 to 35.3 percent. These are average annual estimates, assuming full adjustment to the service change. These savings are quite significant, and would amount to annual cost savings of between 3.3 and 5.7 percent of total annual operating costs.

System F results are given in Table C-7. Both short-run and long-run impacts of the 5 percent service package are predicted to be negative, even in the optimistic estimate. For the 20 percent service package, cost impacts range from 4.7 percent in the optimistic estimate to -12 percent in the pessimistic estimate. As with System D, these results indicate that service contracting would not lead to cost savings unless a very low-cost private operator could be found. These results are also not surprising given the favorable work rules, highly efficient scheduling, and low hourly costs of this transit agency.

Table C-8 gives results for System G. Positive cost savings of 19.2 to 32.8 percent in the short run and 31 to 42.6 percent in the long run are

TABLE C-6

SYSTEM E RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System E	$209,691	$209,691	$209,691
Private Operator Cost	184,664	233,230	198,130
Difference	25,027	-23,539	11,561
Percent of Public Agency Avoidable Cost	11.9%	-11.2%	5.5%
2: 5 Percent, Long Run			
System E	$245,446	$245,446	$245,446
Private Operator Cost	184,664	233,230	198,130
Difference	60,782	12,216	47,316
Percent of Public Agency Avoidable Cost	24.8%	5.0%	19.3%
3: 20 Percent, Long Run			
System E	$973,788	$973,788	$973,788
Private Operator Cost	630,385	775,973	713,424
Difference	343,403	197,815	260,364
Percent of Public Agency Avoidable Cost	35.3%	20.3%	26.7%

TABLE C-7

SYSTEM F RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System F	$ 513,802	$ 513,802	$ 513,802
Private Operator Cost	563,513	678,378	639,864
Difference	-49,711	-164,576	-126,062
Percent of Public Agency Avoidable Cost	-9.7%	-32.0%	-24.5%
2: 5 Percent, Long Run			
System F	$ 540,351	$ 540,351	$ 540,351
Private Operator Cost	563,513	678,378	639,864
Difference	-23,162	-138,027	-99,513
Percent of Public Agency Avoidable Cost	-4.3%	-25.5%	-18.4%
3: 20 Percent, Long Run			
System F	$2,375,760	$2,375,760	$2,376,760
Private Operator Cost	2,264,150	2,660,377	2,490,565
Difference	116,610	-284,617	-114,805
Percent of Public Agency Avoidable Cost	4.7%	-12%	-4.8%

TABLE C-8

SYSTEM G RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System G	$ 889,043	$ 889,043	$ 889,043
Private Operator Cost	597,290	718,066	677,019
Difference	291,753	170,977	212,024
Percent of Public Agency Avoidable Cost	32.8%	19.2%	23.8%
2: 5 Percent, Long Run			
System G	$1,040,119	$1,040,119	$1,040,119
Private Operator Cost	597,290	718,066	677,019
Difference	442,829	322,053	363,100
Percent of Public Agency Avoidable Cost	42.6%	31%	34.9%
3: 20 Percent, Long Run			
System G	$3,662,198	$3,662,198	$3,662,198
Private Operator Cost	2,297,349	2,827,951	2,527,084
Difference	1,364,849	834,247	1,135,114
Percent of Public Agency Avoidable Cost	37.3%	22.8%	31%

predicted for the 5 percent service package. Savings of a similar magnitude, 22.8 to 37.3 percent, are estimated for the 20 percent service package. System G has the highest driver cost rate within this group of systems, and work rules are not particularly favorable. These results indicate that service contracting could generate significant cost savings for System G. The 20 percent package would reduce operating costs by 4.2 to 6.8 percent.

System H results are presented in Table C-9. In the short run, negative cost savings are predicted for the 5 percent service package. Private operator cost is estimated to be from 3.9 to 25 percent higher than the System H short-run avoidable cost. In the long run, the most probable savings estimate is 3.1 percent, with a range of -2.8 to 14.6 percent. These results indicate that cost savings could only be achieved with a low-cost private operator. Long-run results for the 20 percent service package are more positive; savings of 5.5 to 23.3 percent are predicted, depending upon private operator and contract monitoring cost. These savings represent 1 to 4 percent of the annual operating cost.

System I results are given in Table C-10. System I has the second highest hourly cost and driver cost in this group, and has the highest pay/plat ratio. Both short-run and long-run results for the 5 percent service package are predicted to be positive. Short-run cost savings range from 8.3 to 24.3 percent; long-run savings range from 14.5 to almost 30 percent. Predicted savings for the 20 percent service package are even greater, from 20.2 to 35 percent. These savings would amount to annual savings of 3.4 to 5.8 percent of total operating cost.

TABLE C-9

SYSTEM H RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System H	$ 550,782	$ 550,782	$ 550,782
Private Operator Cost	572,296	688,697	649,526
Difference	-21,514	-137,915	-98,744
Percent of Public Agency Avoidable Cost	-3.9%	-25.0%	-17.9%
2: 5 Percent, Long Run			
System H	$ 670,088	$ 670,088	$ 670,088
Private Operator Cost	572,296	688,697	649,526
Difference	97,792	18,609	20,562
Percent of Public Agency Avoidable Cost	14.6%	-2.8%	3.1%
3: 20 Percent, Long Run			
System H	$2,848,572	$2,848,572	$2,848,572
Private Operator Cost	2,186,056	2,690,930	2,404,661
Difference	662,516	157,642	443,911
Percent of Public Agency Avoidable Cost	23.3%	5.5%	15.6%

TABLE C-10

SYSTEM I RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System I	$ 585,346	$ 585,346	$ 585,346
Private Operator Cost	442,802	536,542	507,082
Difference	142,544	48,804	78,264
Percent of Public Agency Avoidable Cost	24.3%	8.3%	13.4%
2: 5 Percent, Long Run			
System I	$ 627,737	$ 627,737	$ 627,737
Private Operator Cost	442,802	536,542	507,082
Difference	184,935	91,195	120,655
Percent of Public Agency Avoidable Cost	29.5%	14.5%	19.2%
3: 20 Percent, Long Run			
System I	$2,301,155	$2,301,155	$2,301,155
Private Operator Cost	1,490,448	1,834,670	1,639,493
Difference	810,707	446,485	661,662
Percent of Public Agency Avoidable Cost	35%	20.2%	28.8%

C.2.3 Summary of Results

Case studies of the six medium-sized transit agencies generated a wide range of results. Since private operator costs were constant, the variation in the results is a function of differences in the operating characteristics of the transit agencies. Systems D and F have the lowest hourly cost, driver wage, and pay/plat ratio within the group. Thus, it is not surprising that service contracting leads to the most negative impacts for these two systems. These results indicate that the avoidable service costs are not sufficient to justify contracting, if private operators bidding on the service are representative of national averages.

In contrast, Systems G and I have the highest driver wage, and the highest and third highest pay/plat ratios. Results show that these systems would realize the greatest savings from service contracting, because avoidable costs are the greatest for these systems. These systems probably represent the upper range of possible cost savings for medium-sized systems.

It may also be noted that 20 percent savings are greater in every case than 5 percent (long-term) savings. This result appears to be counter-intuitive, given that routes with the highest pay/plat ratio were chosen first. The difference, however, is due to the assumption of a minimum contract monitoring cost. The contract monitoring cost represents a larger proportion of private operator cost in the 5 percent scenario because of the smaller total cost of the service package.

C.3 LARGE SYSTEM RESULTS

Thirteen transit agencies with more than 150 vehicles were used in case studies. All but two of these agencies report Section 15 data at level A, and thus the full cost model as described in Chapter Four was used to generate estimates of service contracting impacts. For the two agencies not reporting at level A, the necessary data were obtained directly from agency records. As discussed in Chapter Four, the avoidable cost model requires schedule and runcut data as well as Section 15 data. The organization of schedule and runcut data is highly individualized, and therefore required extensive manipulation in order to be used in the computer programs written to perform the model calculations.

Descriptive statistics of the large transit systems are given in Table C-11. These systems represent a wide range of size, operating conditions, and service costs. All but two are multiple garage operations. Several of these agencies use part-time operators, but, with one exception, they are limited to a maximum of 15 percent of the number of full-time operators. These are higher cost agencies than the previous group; average cost per RVH is $55.00. The peak/base ratio and pay/plat ratio is also higher than for the medium-sized systems discussed in the previous section.

C.3.1 Service Contracting Scenarios

Service contracting scenarios were based on the assumptions described in Chapter Four. The full range of alternative assumptions were employed for both transit agency avoidable costs and private operator costs. Alternative assumptions used to generate transit agency avoidable costs are summarized in Table C-12. Treatment of interlining and part-time drivers need further comment.

Interlining is the practice of assigning driver runs to more than one route. It is widely used to improve the efficiency of driver assignments. Interlining can be restricted to individual pieces of work (e.g., a two-piece split run with each piece assigned to a different route), or can combine

TABLE C-11

DESCRIPTIVE STATISTICS OF LARGE TRANSIT SYSTEMS

System	# Veh	$/RVH	$/RVM	P/B	P/P
J	199	$40.00	$3.94	2.2	1.202
K	521	58.41	3.98	3.0	1.190
L	762	64.00	3.85	2.0	1.150
M	800	58.49	4.24	2.9	1.211
N	320	54.84	4.12	2.1	1.095
O	402	69.30	5.00	1.7	1.130
P	441	62.40	3.79	1.9	1.120
Q	231	40.48	3.05	2.3	1.160
R	844	50.69	3.76	1.9	1.130
S	659	62.72	4.50	2.3	1.150
T	1029	70.73	4.59	1.8	1.090
U	275	39.19	2.32	1.3	1.059
V	246	44.67	3.54	1.3	1.123

driver trips on two or more routes with no breaks between trips. The interlined pieces assigned to each route can be of any length, from as little as one half-hour to as much as eight hours. An analysis of interlining at four case study agencies revealed widely divergent practices. Thus interlining impacts of service contracting are highly uncertain and difficult to predict. The only accurate way to test the impact of contracting is to

TABLE C-12

ASSUMPTIONS USED TO GENERATE ALTERNATIVE TRANSIT AGENCY AVOIDABLE COST ESTIMATES

	Optimistic: High Avoidable Cost	Pessimistic: Low Avoidable Cost	Most Probable Avoidable Cost
Driver Cost (Short-Run and Long Run)			
Interlining:	Assume all leftover pieces can be reincorporated in schedule with no loss of efficiency	Assume one-third of the leftover pieces must be operated as trippers	Leftover pieces can be reincorporated in service schedule
Part Time Operators (PTOs):	Reduce only full-time operators (FTOs) through attrition; retain current number of part-time operators (PTOs)	Reduce both FTOs and PTOs through attrition in proportion to current levels of utilization	Reduce both FTOs and PTOs through attrition in proportion to use on contracted service
Direct Vehicle Operating Cost			
Short Run Only:	Maintenance labor cost reduced in same proportion as amount of contracted service	Maintenance labor cost reduced at 50 percent of proportion of amount of service which is contracted	Maintenance labor cost reduced at 75 percent of proportion of amount of service which is contracted
Long Run:	Costs are reduced in the same proportion as amount of contracted service		
Administrative Cost			
Short Run:	No reduction of administrative costs		
Long Run:	Proportional reduction in cost of selected administrative functions	No reduction in cost of selected administrative functions	Proportional reduction in cost of selected administrative functions

re-cut the remaining schedule, and experimental runcutting is not feasible for most transit agencies.

Alternative ways of treating interlining impacts were tested and discussed with schedulers at several of the large agencies. Interlining assumptions used here are the result of these discussions and some experimentation. There was consensus that if only 5 percent of the agency's service were contracted, any leftover pieces of work could easily be reincorporated into the schedule with no loss of efficiency. Thus the pessimistic assumption that one third of the leftover pieces must be operated as trippers is very conservative for the 5 percent contracting scenario. At some level of contracting, however, schedule efficiency would probably be affected. Thus, the pessimistic assumption appears to be a valid possibility for the 20 percent contracting scenario.

Although the vast majority of transit agencies have won the right to use part-time drivers, few agencies use them in significant numbers. The case studies revealed that although 10 to 15 percent of the drivers can be part time at most agencies, actual numbers employed are often 5 percent or less. When only a few part-time drivers are involved, alternative assumptions regarding part-time versus full-time driver attrition policy are insignificant. Thus part-time drivers are treated separately only when they are assigned in significant numbers on the service to be contracted and when their wage (plus benefits) rate is significantly different from the full-time rate.

Private operator cost estimates are also based on the full set of models and assumptions described in Chapter Four. These are summarized in Table C-13. All peak-only and predominantly peak (e.g., with peak/base greater than

TABLE C-13

PRIVATE CONTRACTOR COST ASSUMPTIONS

	Optimistic (Low Cost)	Pessimistic (High Cost)	Most Probable
1: Peak Service			
Driver Cost	Paid for platform hours only	4 hour guarantee per piece	2 hour guarantee per piece
Mileage Related Cost	$.72/TVM	$.87/TVM	$.82/TVM
Administration/ Overhead	$10,000/bus/year	$10,000/bus/year	$10,000/bus/year
Profit	10%	10%	10%
2: All-Day Service			
Total Cost	$2.00/RVM	$2.75/RVM	$2.35/RVM
3: Contract Monitoring Cost			
	5% of contract cost, minimum of $75,000, maximum of $300,000	10% of contract cost, minimum of $100,000, maximum of $1,000,000	5% of contract cost, minimum of $100,000, maximum of $500,000

2) service cost is estimated with the three-variable cost allocation model; all-day service is based on flat mileage rates.

C.3.2 Case Study Results

Service packages of 5 and 20 percent of total service were selected for each transit agency. As before, the selection was made by determining which routes had the highest ranked pay/plat ratios and selecting routes in rank order. Additional service packages were selected for three agencies in order to determine whether the type of service selected affects predicted cost savings. Short-run and long-run results are estimated for the 5 percent scenarios; only long-run results are estimated for the 20 percent scenario. All estimates are annual costs calculated in 1985 dollars.

Cost parameters used in the calculation of transit avoidable costs are shown in Table C-14. The full-time driver wage plus benefit rate ranges from $11.27 (System U) to $19.70 (System O). Part-time drivers are employed in significant numbers at seven agencies. Unscheduled cost is quite consistent, with the exception of System V. The range of direct vehicle costs corresponds to the pessimistic and optimistic assumptions regarding maintenance labor attrition. System U also has the lowest direct vehicle costs; System S has the highest. Case study results are presented in Tables C-15 through C-27.

Case study results for System J are presented in Table C-15. System J is somewhat unusual. It is a one-garage operation, and driver scheduling is done by hand. Despite a rather peaked service schedule, work rules are quite restrictive. Driver assignments are heavily interlined. Four different service packages were identified: 1) 5 percent of total service based on TVM, 2) 5 percent of the total service based on TVH, 3) 20 percent of the total service (based on TVH, consisting of express and local service), and 4) 20

TABLE C-14

TRANSIT AGENCY COST PARAMETERS

System	Driver Wage + Benefit/Hr	PT Wage/Hr	Unscheduled Cost/VH	Direct Vehicle Cost/VM
J	$15.78	N/A	$1.55	$ .85 - .95
K	15.00	N/A	1.50	.77 - .97
L	16.30	$ 9.27	1.52	.67 - .87
M	19.31	11.96	1.45	.69 - .95
N	16.19	N/A	1.34	.59 - .87
O	19.70	N/A	1.74	.80 - 1.17
P	18.96	12.02	1.57	.55 - .81
Q	15.34	12.06	1.38	.88 - .97
R	18.26	N/A	1.74	.61 - .91
S	14.63	N/A	1.43	1.04 - 1.34
T	18.86	13.42	1.40	.52 - .78
U	11.27	9.67	1.50	.48 - .62
V	18.15	12.09	2.40	.62 - .81

percent of the total service (based on TVH and consisting of all local, all-day service).

Both 5 percent service packages consist of express-only routes selected on the basis of pay/plat ratio. For both short run and long run, the pessimistic assumptions lead to negative results: private operator cost is higher than transit avoidable cost. Optimistic assumptions indicate positive cost savings, 9 and 12.2 percent for the short run and 23.2 and 22.2 percent

TABLE C-15

SYSTEM J RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent of TVM, Short Run			
System J	$ 724,308	$ 556,467	$ 703,990
Private Operator Cost	658,519	880,022	723,230
Difference	65,789	-323,565	-19,240
Percent of Public Agency Avoidable Cost	9%	-58%	-2.7%
2: 5 Percent of TVM, Long Run			
System J	$ 857,627	$ 713,457	$ 840,662
Private Operator Cost	658,519	880,022	723,230
Difference	199,108	-163,565	117,432
Percent of Public Agency Avoidable Cost	23.2%	-22.9%	14%
3: 5 Percent of TVH, Short Run			
System J	$1,041,331	$ 792,865	$1,008,497
Private Operator Cost	914,047	1,221,291	996,295
Difference	127,284	-428,426	12,202
Percent of Public Agency Avoidable Cost	12.2%	-54%	1.2%
4: 5 Percent of TVH, Long Run			
System J	$1,174,650	$ 974,887	$1,157,685
Private Operator Cost	914,047	1,221,291	996,295
Difference	260,603	-246,404	161,390
Percent of Public Agency Avoidable Cost	22.2%	-25.3%	13.9%
5: 20 Percent of TVH, Express + Local, Long Run			
System J	$4,316,829	$3,727,055	$4,248,968
Private Operator Cost	3,137,575	4,392,681	3,549,937
Difference	1,179,254	-665,626	699,031
Percent of Public Agency Avoidable Cost	27.3%	-17.8%	16.5%
6: 20 Percent of TVH, Local, Long Run			
System J	$3,539,434	$3,153,243	$3,471,573
Private Operator Cost	2,387,141	3,438,620	2,704,891
Difference	1,152,293	-285,377	666,682
Percent of Public Agency Avoidable Cost	32.5%	-9%	19.2%

for the long run. Results are similar for the express + local 20 percent package, ranging from -17.8 to 27.3 percent.

These results are due to the characteristics of the express service and their impact on the private driver assumptions. The express service consists of very short, difficult to combine pieces of work. Thus, vehicle requirements are high, and since private operator indirect costs are based on vehicle requirements, private overhead costs are high. In addition, about half of all vehicle miles are deadhead miles. Finally, the private driver pay guarantees assumed are very costly because of the short pieces of work involved. Since the model assumes that the private operator cannot interline, a great deal of guarantee time is paid in the pessimistic and most probable private cost estimates. These service characteristics lead to very high private operator cost estimates. For example, the most probable private cost estimate for the 5 percent (TVH) package is $4.44/RVM.

The fourth service package was developed to determine whether local service could be more effectively contracted for this transit agency. Table C-15 shows that results are somewhat more positive, but the pessimistic assumptions still predict negative cost savings.

Additional service packages were also evaluated for systems L and M. Table C-16 gives results for System L. Two different 5 percent packages were identified, one of express-only routes and one of regional routes. Express routes provide commuter service from residential areas to downtown; regional routes are long distance, mainly peak-only routes which link neighboring communities within the metropolitan area. Like System J, the express-only package leads to very negative short-run cost impacts under the pessimistic assumptions. Again, this seems to be the result of the restrictive private driver pay guarantees assumed and the nature of the express service. Long-run

TABLE C-16

SYSTEM L RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Express + Regional, Short Run			
System L	$2,725,404	$1,996,498	$2,398,535
Private Operator Cost	2,214,810	2,965,730	2,409,517
Difference	510,594	-969,232	-10,972
Percent of Public Agency Avoidable Cost	18.7%	-48.5%	< 1%
2: 5 Percent, Express + Regional, Long Run			
System L	$3,488,415	$2,996,938	$3,249,417
Private Operator Cost	2,214,810	2,965,730	2,409,517
Difference	1,273,605	31,208	839,900
Percent of Public Agency Avoidable Cost	36.5%	1.0%	25.8%
3: 5 Percent, Express, Short Run			
System L	$2,841,104	$1,979,895	$2,461,992
Private Operator Cost	2,395,214	3,471,790	2,601,847
Difference	445,893	-1,491,895	-139,855
Percent of Public Agency Avoidable Cost	15.7%	-75.4%	-5.7%
4: 5 Percent, Express, Long Run			
System L	$3,562,874	$2,960,377	$3,283,940
Private Operator Cost	2,395,214	3,471,790	2,601,847
Difference	1,167,660	511,413	682,093
Percent of Public Agency Avoidable Cost	32.8%	-17.3%	20.8%
5: 20 Percent; Express, Regional, and Local; Long Run			
System L	$21,232,450	$18,915,709	$19,574,538
Private Operator Cost	13,129,228	15,423,822	14,307,562
Difference	8,103,222	3,491,887	5,266,976
Percent of Public Agency Avoidable Cost	37.7%	18.5%	26.9%

results are more favorable, as the relatively high private service costs are offset by decreases in transit agency indirect costs. The 20 percent service package results are positive and quite significant, from 18.5 to 37.7 percent. These savings are equivalent to from 4 to almost 10 percent of total annual operating cost, far beyond the magnitude of more traditional cost saving strategies. (Note that part-time drivers are accounted for in these estimates.) The System L case study results indicate that large savings can be realized from service contracting, but initial implementation would possibly result in large short-term losses.

Case study results for System M are given in Table C-17. The 5 percent service package was selected on the basis of pay/plat ratio, and is made up of peak-only routes operated entirely with tripper runs. These trippers are run either off the extraboard or as overtime work by regular drivers. The model driver assignment assumptions were adjusted to reflect these conditions. Short-run estimates exhibit a wide range, from -43 to 40 percent, with a most probable estimate of 15 percent. All long-run estimates for the 5 percent scenario are positive and again have a wide range. The long run most probable percentage estimate is more than double the short-run estimate, reflecting the large contribution of indirect costs to potential cost savings.

Two different 20 percent packages were estimated for System M: one predominantly express service and one all-day service. The local service package was used to determine whether contracting all-day service could result in similar cost savings. Model results show that cost savings for the all-day service package (29 percent to 51 percent) are greater than for the express service package (16 to 46 percent). However, the most probable estimates are quite similar. The analysis of these additional service packages leads to some interesting possible interpretations. If the private cost estimation

TABLE C-17

SYSTEM M RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Peak Only, Short Run			
System M	$4,193,255	$2,433,975	$3,313,074
Private Operator Cost	2,531,031	3,482,430	2,821,213
Difference	1,662,224	1,048,455	491,861
Percent of Public Agency Avoidable Cost	40%	-43%	15%
2: 5 Percent, Peak Only, Long Run			
System M	$4,944,373	$3,541,123	$4,242,207
Private Operator Cost	2,531,030	3,482,430	2,821,213
Difference	2,413,343	58,693	1,420,994
Percent of Public Agency Avoidable Cost	49%	2%	33%
3: 20 Percent, Express, Long Run			
System M	$18,473,113	$15,697,415	$17,619,717
Private Operator Cost	9,920,749	13,107,605	11,040,191
Difference	8,552,364	2,589,810	6,579,526
Percent of Public Agency Avoidable Cost	46%	16%	37%
4: 20 Percent, All Day, Long Run			
System M	$18,146,254	$17,930,333	$18,038,294
Private Operator Cost	8,871,570	12,785,908	10,500,173
Difference	9,274,684	5,144,425	7,538,121
Percent of Public Agency Avoidable Cost	51%	29%	42%

methods are reasonable, then cost savings is apparently not closely tied to the type of service selected for contracting. This result is not surprising, since in effect the estimation methods assume similar cost structures for both public and private operators. That is, the relative cost of peak service compared to all-day service is similar for both the private and public operator. The alternate interpretation is that the peak service private operator cost model tends to overestimate likely private operator costs. This interpretation is also reasonable, simply because a private operator with a four-hour minimum guarantee would not be able to successfully bid on a peak-only service package.

The remaining ten case studies include only two service packages, one for 5 percent and one for 20 percent of the total service, based on total platform hours. In all cases, routes are chosen on the basis of the pay/plat ratio. No attempt is made to choose more realistic service packages (e.g., from the same garage or the same geographic area).

Results for System K are presented in Table C-18. Short-run impacts for the 5 percent scenario range from -25 to 20.1 percent. (A most probable short-run estimate was not computed for any of the remaining systems.) Long-run impacts are positive, with a most probable estimate of almost 30 percent. Results for the 20 percent service package are similar in magnitude. These results are more consistent with previous public/private cost comparisons. It may be noted that this agency has rather favorable driver work rules and a lower than average wage rate. However, these advantages are offset by its high peak/base ratio.

Again, the range of estimates is due primarily to the difference in private operator cost estimates resulting from driver pay guarantee assumptions. For example, in the 20 percent package, the additional driver pay due to the four-hour pay guarantee in the pessimistic estimate, is $710,000, or about 9 percent of the total contract cost. In addition, the pessimistic estimate includes the transit cost interlining penalty as well.

TABLE C-18

SYSTEM K RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System K	$2,065,767	$1,634,950	N/A
Private Operator Cost	1,649,741	2,046,574	N/A
Difference	416,026	-411,624	N/A
Percent of Public Agency Avoidable Cost	20.1%	-25%	N/A
2: 5 Percent, Long Run			
System K	$2,523,729	$2,077,167	$2,507,984
Private Operator Cost	1,649,741	2,046,574	1,768,228
Difference	873,988	30,593	739,756
Percent of Public Agency Avoidable Cost	34.6%	1.5%	29.5%
3: 20 Percent, Long Run			
System K	$9,183,929	$8,620,894	$9,125,871
Private Operator Cost	6,109,399	7,781,093	6,581,881
Difference	3,074,530	839,801	2,543,990
Percent of Public Agency Avoidable Cost	35.5%	9.7%	27.9%

The 20 percent most probable service contracting savings are equivalent to 4 percent of the total annual operating cost.

Results for System N are given in Table C-19. Short-run results for the 5 percent service package range from no savings to an increase in service cost of 80 percent. However, long-run results indicate transit agency cost savings of 2.3 to 32.7 percent. The large difference between short-run and long-run results indicates that indirect costs make up a large proportion of total costs. This is particularly true in the pessimistic estimate, as it may be

TABLE C-19

SYSTEM N RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System N	$1,314,333	$ 992,464	N/A
Private Operator Cost	1,318,246	1,788,707	N/A
Difference	-3,913	-796,243	N/A
Percent of Public Agency Avoidable Cost	< 1%	-80.2%	N/A
2: 5 Percent, Long Run			
System N	$1,959,734	$1,831,086	$1,940,415
Private Operator Cost	1,318,246	1,788,707	1,456,057
Difference	641,488	42,379	484,358
Percent of Public Agency Avoidable Cost	32.7%	2.3%	25%
3: 20 Percent, Long Run			
System N	$7,791,335	$7,123,739	$7,715,277
Private Operator Cost	4,631,818	5,966,380	5,044,415
Difference	3,159,517	1,157,358	2,670,863
Percent of Public Agency Avoidable Cost	40.6%	16.2%	34.6%

recalled that only half of the direct maintenance labor cost is assumed variable in the short run (Table C-12). The 20 percent service package estimates cost savings of 16.2 to 40.6 percent, with a most probable estimate of 34.6 percent. These results indicate savings of 3 to 8 percent of the total annual operating costs. System N costs and operating characteristics are quite representative of the large system group. Wage rates, work rules, and other factors are quite typical. As will become apparent, the long-run results for System N are also quite typical.

In contrast to System N, System O is one of the highest cost transit agencies in the group. Average hourly cost is second highest within this group and the driver wage plus benefit rate is the highest. Part-time drivers make up 7 percent of the workforce, but wages and benefits are similar to those of full-time drivers. Despite a moderate peak/base ratio, schedule efficiency is modest, reflecting the restrictive work rules existing at this agency (e.g., a ten-hour spread threshold, and a three-hour guarantee for all extra work).

Results for System O are given in Table C-20. Surprisingly, short-run results for the 5 percent service package range from -59.9 to 27.8 percent, and long-run results range from 26 percent to 50.6 percent. The implication here is that service contracting will result in substantial cost savings in the long run, but may also generate significant short-run losses. The extent of possible losses depends on the rate at which direct maintenance and indirect costs can be reduced, and the extent to which interlining affects schedule efficiency. The 20 percent service package predicts slightly greater cost savings, from 35.2 to 54 percent, with a most probable estimate of nearly 50 percent. Savings of this magnitude are quite significant, representing 6 to 10 percent of the total annual operating cost.

System P results are given in Table C-21. Like System O, System P is a relatively high-cost agency. However, work rules are less restrictive, part-time drivers are more effectively utilized, and other direct cost elements are lower. Short-run results indicate a range of 11.6 to -55.6 percent. Interlining impacts are less extreme for System P because a relatively smaller proportion (less than 40 percent) of the runs of the selected routes are interlined. Long-run results for the 5 percent package range from 3.7 to 31 percent, substantially lower than for System O, as would

TABLE C-20

SYSTEM O RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System O	$2,839,730	$1,782,366	N/A
Private Operator Cost	2,049,053	2,850,024	N/A
Difference	790,677	-1,067,658	N/A
Percent of Public Agency Avoidable Cost	27.8%	-59.9%	N/A
2: 5 Percent, Long Run			
System O	$4,152,094	$3,850,637	$4,037,465
Private Operator Cost	2,049,053	2,850,024	2,225,587
Difference	2,103,041	1,000,613	1,811,878
Percent of Public Agency Avoidable Cost	50.6%	26%	44.9%
3: 20 Percent, Long Run			
System O	$16,823,833	$15,753,351	$16,373,401
Private Operator Cost	7,729,863	10,203,670	8,366,848
Difference	9,093,970	5,549,681	8,006,553
Percent of Public Agency Avoidable Cost	54%	35.2%	48.9%

be expected. Long-run results for the 20 percent package are from 15.6 to 36 percent, with a most probable estimate of 28.5 percent. These savings estimates amount to from 2.6 to 6.5 percent of the total annual operating costs.

System Q is one of the smaller transit agencies in this group. Average hourly costs are modest. Driver wages and benefits are also modest, and part-time drivers are used effectively. Work rules are fairly typical of other transit agencies of similar size. Results for System Q are given in

TABLE C-21

SYSTEM P RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System P	$2,680,309	$1,939,105	N/A
Private Operator Cost	2,369,563	3,022,326	N/A
Difference	310,746	-1,083,221	N/A
Percent of Public Agency Avoidable Cost	11.6%	-55.9%	N/A
2: 5 Percent, Long Run			
System P	$3,448,805	$3,137,938	$3,243,385
Private Operator Cost	2,369,563	3,022,326	2,549,189
Difference	1,079,242	115,612	696,196
Percent of Public Agency Avoidable Cost	31%	3.7%	21.4%
3: 20 Percent, Long Run			
System P	$12,528,198	$11,850,666	$12,111,299
Private Operator Cost	7,921,103	9,999,699	8,653,671
Difference	4,607,095	1,850,967	3,457,628
Percent of Public Agency Avoidable Cost	36%	15.6%	28.5%

Table C-22. For the 5 percent service package, the most notable result is the relatively small difference between short-run and long-run transit agency avoidable cost, indicating that indirect costs make up an unusually small proportion of avoidable costs. Consequently, short-run and long-run results do not differ as much as in the previous case studies. Short-run results range from -56.0 to 5.1 percent; long-run results range from -28.8 to 11 percent, with a most probable estimate of no change in cost due to service contracting. The 20 percent service package estimates cost savings of 4.9 to

TABLE C-22

SYSTEM Q RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System Q	$1,054,643	$ 870,454	N/A
Private Operator Cost	1,001,950	1,357,978	N/A
Difference	53,693	-487,524	N/A
Percent of Public Agency Avoidable Cost	5.1%	-56.0%	N/A
2: 5 Percent, Long Run			
System Q	$1,130,522	$1,054,076	$1,125,548
Private Operator Cost	1,001,950	1,357,978	1,124,762
Difference	128,572	-303,902	822
Percent of Public Agency Avoidable Cost	11%	-28.8%	<1%
3: 20 Percent, Long Run			
System Q	$4,401,488	$4,735,593	$4,387,323
Private Operator Cost	3,446,117	4,502,897	3,710,337
Difference	955,371	232,696	676,986
Percent of Public Agency Avoidable Cost	21.7%	4.9%	15.4%

21.7 percent, or 1 to 4 percent of the total annual operating cost. For this transit agency, interlining is a significant factor, as over 80 percent of all runs in both service packages are interlined. Thus potential contracting cost savings would be highly dependent on the extent to which adverse effects on the remaining schedule could be avoided.

System R is one of the largest case study agencies. Hourly costs are slightly below average for a large transit agency. Driver costs are among the highest in the sample, and there are no part-time drivers. Work rules are not unusually restrictive. System R results are presented in Table C-23. Owing to the way routes are organized, a significant portion of both service packages is made up of all-day service. Short-run estimates are from -10.1 to 29.5 percent, and long-run estimates are from 11.9 to 40.8 percent for the 5 percent service package. The most probable estimate is 34.2 percent. These results indicate that short-term losses due to contracting are not very likely, and long-term impacts are likely to be quite favorable. Estimated cost savings for the 20 percent service package are similar: from 16.8 to 43.4 percent. Potential savings due to service contracting are quite significant for System R; total annual operating costs could be reduced by 2.7 to 7.6 percent, and would most probably be reduced by about 6 percent.

System S is another high-cost agency. In this case, high average hourly costs are attributable to unusually high direct vehicle costs (Table C-14)--significantly higher than any other case study agency. Outlying values are, of course, suspect; however, further investigation of the data did not reveal any obvious inconsistencies. Driver costs are quite low, and all other operating characteristics are typical of the large system group. Table C-24 gives results for System S. The 5 percent service package consists entirely of peak-only or highly peaked routes; the 20 percent service package also is highly peaked. Because of data limitations, administrative costs are not subject to the alternative assumptions. Thus, there is one less source of variation in these estimates. The 5 percent service package short-run estimates are -21.1 percent and 25.3 percent, indicating that short-run losses are quite possible. The most probable long-run result is 26.1 percent with a range of 7.4 to 31.4 percent. The 20 percent service package cost savings estimates have a much smaller range, from 20.3 to 36.4 percent. In terms of total annual operating costs, cost savings amount to between 3 and 6 percent.

TABLE C-23

SYSTEM R RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System R	$3,982,601	$3,507,027	N/A
Private Operator Cost	2,835,024	3,859,746	N/A
Difference	1,147,577	-352,719	N/A
Percent of Public Agency Avoidable Cost	29.5%	-10.1%	N/A
2: 5 Percent, Long Run			
System R	$4,791,044	$4,380,370	$4,702,329
Private Operator Cost	2,835,024	3,859,746	3,091,814
Difference	1,956,020	520,624	1,610,515
Percent of Public Agency Avoidable Cost	40.8%	11.9%	34.2%
3: 20 Percent, Long Run			
System R	$19,558,652	$17,749,937	$19,191,940
Private Operator Cost	11,067,745	14,769,427	12,346,337
Difference	8,490,907	2,980,510	6,845,603
Percent of Public Agency Avoidable Cost	43.4%	16.8%	35.7%

System T is the largest agency in the sample. It also has the highest average hourly cost. Full-time driver costs are among the highest in this group, but lower cost part-time drivers are used extensively. Use of part-time drivers, together with a moderate peak/base ratio, probably accounts for the relatively efficient pay/plat ratio. Results for System T are presented in Table C-25. The 5 percent service package contains peak-only and heavily peak-oriented routes. The 20 percent service package is also heavily peaked, but some all-day service was also included. Short-run results for the

TABLE C-24

SYSTEM S RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System S	$6,000,471	$4,754,207	N/A
Private Operator Cost	4,484,556	5,757,587	N/A
Difference	1,515,914	-1,003,380	N/A
Percent of Public Agency Avoidable Cost	25.3%	-21.1%	N/A
2: 5 Percent, Long Run			
System S	$6,537,212	$6,217,639	$6,537,212
Private Operator Cost	4,484,557	5,757,587	4,833,644
Difference	2,052,655	460,052	1,703,568
Percent of Public Agency Avoidable Cost	31.4%	7.4%	26.1%
3: 20 Percent, Long Run			
System S	$21,884,560	$19,447,900	$21,884,560
Private Operator Cost	13,927,777	15,491,112	14,731,723
Difference	7,956,783	3,956,788	7,152,837
Percent of Public Agency Avoidable Cost	36.4%	20.3%	32.7%

5 percent package are 10.1 percent and -46 percent. Long-run results are 35.8 and 13 percent, with a most probable estimate of 23.7 percent. Given the relatively modest direct cost parameters of System T, the large difference between short-run and long-run results is reasonable. It implies that indirect costs are a critical factor in potential cost savings, and long-run net impacts would depend on the rate at which indirect costs would be reduced. The 20 percent estimates predict larger savings, ranging from 23.7 to 43.3 percent, with a most probable estimate of almost 35 percent. These

TABLE C-25

SYSTEM T RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System T	$4,657,334	$3,496,763	N/A
Private Operator Cost	4,185,564	5,107,175	N/A
Difference	471,770	-1,610,412	N/A
Percent of Public Agency Avoidable Cost	10.1%	-46.0%	N/A
2: 5 Percent, Long Run			
System T	$6,518,365	$5,869,857	$5,920,045
Private Operator Cost	4,185,564	5,107,175	4,516,821
Difference	2,332,801	762,682	1,403,224
Percent of Public Agency Avoidable Cost	35.8%	13%	23.7%
3: 20 Percent, Long Run			
System T	$23,895,112	$22,629,188	$22,739,642
Private Operator Cost	13,556,453	17,254,432	14,850,927
Difference	10,338,659	5,374,756	7,888,715
Percent of Public Agency Avoidable Cost	43.3%	23.7%	34.7%

savings would have a significant impact on system operating costs. The most probable estimate would result in a 6.6 percent annual operating cost savings.

System U is the lowest cost transit agency in this group. Costs and operating characteristics are quite unusual for larger systems and more typical of the medium-sized systems discussed in Section C.2 above. System U provides very little peak service. Driver work rules and wages are exceptionally favorable. The spread threshold is 13.5 hours, and extraboard drivers have a lower wage rate (starting at $6.00 per hour) and a biweekly pay guarantee. Consequently, very little overtime or guarantee time is paid, as reflected in System U's very low pay/plat ratio.

The cost estimation procedure was modified in several ways for System U. It was not possible to estimate short-run avoidable costs because of limited data availability. The lower extraboard driver costs had to be incorporated into the model. Private operator cost estimation also required modification, as vehicle requirements for the service package could not be identified. Thus, overhead costs are calculated as a factor of driver-related and mileage costs. Driver and mileage rates were also reduced to better reflect the low prevailing wage rates in this area. (However, the assumed private driver cost rate is still higher than the transit agency starting driver rate.)

Case study results for System U are given in Table C-26. As expected, the predicted results of service contracting are not favorable. Pessimistic estimates for both service packages are negative, and optimistic estimates are quite modest. The most probable estimates are insignificant. Given the error of these estimates, the results indicate that System U would not realize any long-term savings from service contracting. These results are quite reasonable, given that wages and work rules at System U are comparable to those assumed for the private operator.

System V is also one of the smaller agencies in this group, and is a one-garage operation. Hourly costs are below average. Relatively little peak-only service is operated by System V. Work rules are not unfavorable, with the possible exception of a limitation on interlined runs. The full-time driver wage is high, but lower cost part-time drivers are being used to the maximum extent allowed. The unscheduled cost calculated for System V is

TABLE C-26

SYSTEM U RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run	N/A	N/A	N/A
2: 5 Percent, Long Run			
System U	$1,267,056	$1,157,801	$1,241,948
Private Operator Cost	1,083,821	1,377,218	1,251,096
Difference	183,235	-219,419	9,148
Percent of Public Agency Avoidable Cost	14.5%	-19%	< 1%
3: 20 Percent, Long Run			
System U	$4,926,914	$4,622,184	$4,877,700
Private Operator Cost	4,176,561	5,336,599	4,765,584
Difference	750,353	-717,415	112,116
Percent of Public Agency Avoidable Cost	15.2%	-15.4%	2.3%

unusually high (Table C-14), but because of data limitations could not be more thoroughly investigated.

Table C-27 gives results for System V. The 5 percent service package contains highly peaked service. Because so little extra peak service is provided, the 20 percent package is primarily all-day service. In both cases, interlining is not a factor, as only 12 percent of all the selected runs were interlined. Short-run results are -16.2 and 17.9 percent, and long-term results are 11.6 to 29.5 percent for the 5 percent package. The most probable estimate is 20 percent. Twenty percent savings are similar with a range of 5.5 to 33.1 percent and a most probable estimate of 21.6 percent. In terms of annual operating cost, these savings range from 1 to 6 percent. These results

TABLE C-27

SYSTEM V RESULTS

Scenario	Optimistic	Pessimistic	Most Probable
1: 5 Percent, Short Run			
System V	$1,553,264	$1,330,542	N/A
Private Operator Cost	1,274,482	1,545,804	N/A
Difference	278,782	-215,262	N/A
Percent of Public Agency Avoidable Cost	17.9%	-16.2%	N/A
2: 5 Percent, Long Run			
System V	$1,807,980	$1,748,966	$1,753,800
Private Operator Cost	1,274,482	1,545,804	1,403,046
Difference	533,490	203,162	350,754
Percent of Public Agency Avoidable Cost	29.5%	11.6%	20%
3: 20 Percent, Long Run			
System V	$6,405,804	$6,250,421	$6,278,758
Private Operator Cost	4,286,398	5,906,042	4,924,856
Difference	2,119,406	344,379	1,353,902
Percent of Public Agency Avoidable Cost	33.1%	5.5%	21.6%

indicate that service contracting can generate significant long-term savings for System V, but short-term losses are possible. Thus the net effect of contracting would depend on rate of adjustment of indirect costs.

C.3.3 Summary of Large System Case Study Results

Several conclusions can be drawn from the case study results. First, estimated potential cost savings have a wide range, and seem to depend on a variety of factors. The results here display a rough correspondence between transit agency operating costs or driver costs and the predicted savings, but the relationship is certainly not sufficient to be able to accurately predict potential savings based on these characteristics. Important factors affecting cost savings appear to be service characteristics, interlining, and the relative proportions of fixed and avoidable costs, in addition to transit agency overall costs.

Service characteristics, or the actual configuration of runs and trips making up the schedule, affect the private operator cost. Service which requires unproductive use of either vehicles or drivers adds to private operator costs, given the way in which we estimated private costs. It was assumed that all of the contract service is a "stand alone" operation, with no opportunities for interlining or integration with other services. Under these circumstances, private operator costs become less competitive. In effect, the economies realized by the transit agency from integrating these services are lost, and the difference between avoidable cost and private cost declines.

Interlining affects the direct avoidable costs of the transit agency. As discussed earlier, interlining impacts are highly variable and difficult to predict. The interlining assumptions used in the case studies are probably the weakest element in the methodology. The only way to accurately determine interlining impacts is through schedule and runcutting, a computationally complex and time consuming task. However, as more efficient scheduling programs are developed, they will become more feasible planning tools. The case study results indicate that a heavily interlined schedule can significantly reduce the potential cost savings of service contracting.

The case studies also showed that the relative proportions of transit agency fixed and avoidable costs are important. A high-cost agency may realize only modest cost savings if a large share of operating costs are fixed, as in the case of System L. That is, the service planning and management functions which are retained by the transit agencies account for a large proportion of total costs at System L. The opposite is true for System R, which showed one of the largest cost savings, despite modest average hourly costs.

The second conclusion to be drawn from these case studies is that differences between short-run and long-run impacts are important. Because all indirect costs were assumed fixed in the short run, savings in the short run are, of course, less than long-run savings. However, because of the alternative assumptions used regarding maintenance labor attrition, short-run savings were extremely variable. Combining the conservative attrition assumption and the interlining penalty in the pessimistic avoidable cost estimate led to consistently negative results. If these assumptions are valid, the likelihood of short-run losses (e.g., an increase in operating cost) is strong, all other things being equal. Thus, a key factor in service contracting is how quickly the transit agency could reduce maintenance labor and indirect costs in proportion to a reduction in service. Any consideration of service contracting would thus require an estimate of the rate of long-run adjustment, and the consequent net financial impact over the five-year planning period.

The third conclusion from these case studies is that the cost of the transit agency service may not be the best selection criterion for service to be contracted. The case studies in which alternative service packages were used showed little difference in expected savings between service packages. As discussed previously, this is explained at least in part by the methods used to generate private operator costs. If transit agency service cost is less important, then other factors--such as interlining, geographic location, and focusing on one garage--may be more appropriate considerations. Indeed, the most frequent criticism of this methodology on the part of the case study agencies was that the method of service selection was unrealistic and impractical.

Finally, the thirteen case studies showed that the cost models developed in this research are a useful means for assessing possible service contracting impacts. There is no way to evaluate the accuracy of these models, in the absence of actual test projects. However, every effort was made to develop reliable estimation methods. It should be noted that the transit avoidable cost model has been the focus of this research effort. Private operator costs were estimated for illustrative purposes only. In actual applications, private costs would be determined in the bidding process. The avoidable cost model provides transit agencies with a realistic means for determining the magnitude of potential cost savings, both short run and long run, for a given private bid cost.

APPENDIX D
GLOSSARY[1]

BLOCK - The sequence of all trips, including deadheading, made by a bus between the time it leaves the garage and the time it returns. The corresponding concept for drivers is the run. A block may consist of many driver runs.

DEADHEADING - The portion of a route where a bus is moving, but out of service. For example, the trip from the garage to the starting point of a run.

EXTRABOARD - The group of operators responsible for covering runs left open by sick or absent regular drivers. In addition, the extraboard covers runs left open by vacationing drivers at most districts; it also often covers scheduled trippers and charter runs.

GUARANTEE TIME - The bonus paid to meet a driver's daily (or weekly) guaranteed minimum pay hours.

HEADWAY - The time between successive buses along a route.

INTERLINING - The practice of assigning driver runs and bus blocks to more than one route.

PART-TIME RUN - The combination of regularly scheduled trips making up a part-time driver's daily assignment. Part-time runs are usually one-piece runs of less than six hours. The specific characteristics of part-time runs are determined by the labor contract.

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[1] Adapted from the glossary in Chomitz and Lave, 1981.

PAY HOUR - A unit of money equivalent to one hour of straight-time wages.

PAY/PLAT RATIO - The total scheduled pay hours divided by the total scheduled platform hours.

PEAK/BASE RATIO - Total buses in service during the peak commuting period divided by the number of buses in service during the midday period.

PIECE - An unbroken driver assignment of trips.

PLATFORM HOURS - The actual time in a day's assignment during which an operator is in charge of the vehicle, whether it is in motion or not.

REGULAR OPERATORS - The operators assigned to regular runs, as opposed to extraboard operators.

REGULAR RUN - The combination of regularly scheduled trips making up an operator's daily assignment. If the combined platform times exceed a certain amount, say six hours, it is a full-time run. Unless otherwise specified, the term refers to a full-time operator's run.

REPORT (TIME) - The driver-paid time for vehicle preparation prior to the time at which the bus leaves the garage, usually five or ten minutes.

RUN - see REGULAR RUN.

SCHEDULING - The process of assigning buses and drivers to the service schedule.

SPLIT RUN - A regular run split into two or more pieces and containing an unpaid break.

SPREAD MAXIMUM - The longest permissible spread time for an operator.

SPREAD PENALTY - The penalty pay to drivers for work performed in excess of a specified spread threshold. For example, if the spread threshold is ten hours, a driver would receive extra pay for all work with spread time of more than ten hours.

SPREAD THRESHOLD - The total maximum allowed spread time for which all work up to eight hours will be paid at the regular rate.

SPREAD TIME - The total elapsed time from the beginning to the end of a day's assignment, including all breaks.

STRAIGHT RUN - A run without an unpaid break.

TRIPPER - A short operator assignment. Typically, a tripper begins and ends in the garage.

TWO-PIECE RUN - A run containing a break; if the break is unpaid, the run is a split run.

APPENDIX E

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