Transit Service Contracting and Cost Efficiency

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Transit Service Contracting and Cost Efficiency

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by

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ABSTRACT OF THE THESIS

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The federal government, along with many states, has adopted policies favoring the provision of public transit by the private sector. During the 1980s, this turn to contracting to halt rising operating deficits prompted several studies into the impacts of contracting on operating efficiencies.

Most research found that service contracting saves 10 to 60 percent over publicly operated services However, no research has yet examined the long-term cost trends of private contracting vis-à-vis public operations The evaluations done to date often make inappropriate comparisons between small single mode private carriers and large multi-service transit authorities with greater political and social obligations As a result the findings from these studies are certain to show dramatic savings, yet do not address the underlying dynamics driving transit costs such as political pressures to provide service.

This study examined cost efficiency trends for 142 transit operators providing fixed-route bus transit between 1989 and 1993 This analysis

produced no evidence that fully contracted operations cost less per revenue hour than publicly operated services doing no contracting Vehicle and driver scheduling inefficiencies were found to contribute the most to unit costs Estimated elasticities indicate that a 10 percent reduction in vehicle scheduling inefficiency may produce a 19 percent improvement in cost efficiency A 10 percent improvement in operator scheduling efficiency shows a 6 percent reduction in operating costs per revenue hour These findings indicate that transit service contracting may not produce cost savings over the long-term and that strategies of decentralization and changes in the craft structure for labor may be more appropriate ways for relieving the fiscal crisis of public transit.

Chapter 1

INTRODUCTION

Rising operating costs and declining service effectiveness have prompted the federal government and many state and local governments to reexamine service provision to stem the tide of rising deficits (Gómez-Ibáñez, 1996, Lave, 1994, Pickrell, 1986) One of the most common solutions proposed has been to contract for public transit services Previous research suggests that cost savings due to contracting can exceed ten percent, but little research has monitored the impacts of contracting over the long-term

This thesis examined cost efficiency trends for 142 transit operators providing fixed-route bus services between 1989 and 1993 These operators were divided into three groups. Those that contracted all of their routes over the entire five year period, those contracting a portion of their routes, and those doing no contracting over the study period

The analysis found that operators contracting all fixed-route services over the five-years are no more cost efficient in the aggregate than operators doing no contracting The analysis also revealed that the group of operators contracting some services have been able to reduce unit costs between 1989 and 1991, which may be due to service contracting, but since 1991 these costs have risen faster than costs for the other two groups of operators

Sixty-one operators were used in a regression model to determine which factors contribute the most to operating costs per revenue hour of service Vehicle scheduling as measured by *deadheading* and labor utiliza ion measured by the ratio of pay hours to total vehicle hours were found to contribute the most to cost inefficiencies.[1] Ironically, the percent of fixed-route services under contract was not a statistically reliable determinant of cost efficiency High levels of *deadheading* are principally caused by providing service over a dispersed area, poor scheduling, or driver work rules. Work rules may prohibit the interlining of routes or limit the use of part-time employees to provide peak period services thus greatly impacting a scheduler's ability to develop cost efficient runs

Driver work rules also influence the number of paid driver hours to total vehicle hours For example, some labor agreements still require a "cash-out" period for drivers even though drivers no longer carry fareboxes or have access to fare revenues as they did around the turn of the century. Labor agreements may also require a minimum of *extraboard* or stand-by drivers to cover in case of emergency or for drivers who fail to show up for work Sometimes this minimum extraboard can be well in excess of the number of stand-bys needed to fill in for absent employees or in emergencies

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[1] *Deadheading* is the ratio of total vehicle hours to vehicle revenue hours An operator with a high level of deadheading incurs additional labor, fuel and maintenance costs that do not result in ridership

Estimated elasticities provide some insight as to the effect of changes in these two variables Reducing deadheading by 10 percent may improve cost efficiencies by up to 19 percent while improving driver scheduling may also produce smaller, yet still significant improvements These results imply that two strategies may be more appropriate than contracting to relieve the fiscal crisis in public transit A strategy of decentralization can improve both vehicle scheduling and the general management of transit operations. Smaller operational units can also serve as a point of departure for improved management-employee relations and for giving employees a greater stake in the performance of the operation Following from the decentralization strategy, a second strategy for improving operating efficiencies would be to overhaul the current craft structure of the transit industry to allow for greater upward mobility and pay by moving workers along a career path of increasing skills leading to positions of greater responsibility.

Background

Since 1980 federal transit policies have explicitly favored private sector involvement in the provision of public transit These policies attempted to reverse a four decade trend toward public ownership and operation of transit properties as increasing auto ownership coupled with declining private investments in transit forced many companies into bankruptcy

Efforts at urban renewal during the 1960s funded the acquisition of many failing transit providers by the public sector However, transit operating and maintenance costs unexpectedly spiraled upward while ridership continued to decline precipitously Between 1950 and 1980 the inflation adjusted cost per mile of transit service rose 125 percent During this period transit went from a profit making operation to one in which fare revenues covered less than 40 percent of operating costs (although most systems had been in a state of long-term disinvestment since the early part of this century) In contrast, efficiency measured in terms of operating cost per revenue hour in privately owned bus companies increased more than 8 percent over the same period (Lave, 1994) Most of these cost increases were related to increased public subsidies that were absorbed by transit employees through increased wages while service quality declined (Pucher, Markstedt, *et. al.*, 1983).

Federal encouragement of private enterprise in the public sector grew during the Carter administration in the 1970s It was not until the 1980s, however, that the federal government began to look closely at privatization as a means to reduce transit subsidies The 1964 Urban Mass Transportation Act allowed public agencies to contract for transit services, but not until 1983 did the Surface Transportation Act require federal transit grant recipients to develop programs in consultation with private providers In 1985 the Urban Mass Transportation Administration, now the Federal Transit Administration, affirmed its commitment to privatization by basing discretionary grant awards on an applicant's commitment to contracting. In the following year it issued implementation guidelines requiring documentation of private sector participation in service planning and provision

Transit contracting in the U S has grown since the 1980s, although the total extent of this growth is not well known Teal (1988a) estimated that only around 5 percent of all transit operating expenses in 1985 and fewer than 9 percent of revenue miles were provided under contracting arrangements. Furthermore, almost 60 percent of these miles were in demand responsive services, leaving only 2 percent of all fixed-route revenue miles provided under contract Public agencies in many areas of the country have contracted for transit service since the 1970s By the late 1980s many more agencies had begun to contract some or all of their routes. The number of agencies that reported to the Federal Transit Administration that they contract for fixed-route motorbus services increased from 93 to 118 between 1989 and 1993, an increase of 27 percent (U S. Department of Transportation, 1994b) The number of revenue hours of motorbus services under contract grew by 133 percent over the five year period and now makes up 5 8 percent of all fixed-route revenue hours (U.S. Department of Transportation, 1994b, 1990)

This growth has given birth to a number of studies into the effects of privatization and contracting on transit efficiency.[2] Most of these studies looked

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[2] *Privatization* generally refers to the total deregulation of the transit industry where market forces drive service provision except in cases where social demands require government intervention

at realized or potential cost savings and the vast majority reported substantial savings over publicly operated routes. On the other hand, some research showed virtually no cost savings and one report documented increased costs due to contracting Unfortunately, the issue of privatization is highly charged and many, though not all, of these studies attempt to present privatization in the best or worst possible light Proponents of contracting often claim it to be the savior of public transit, while its opponents argue that it is simply a union busting tactic designed to break the social contract with labor

Labor relations have been tenuous throughout the history of public transit in the United States dating back to the last century. The low skills needed for some transit jobs coupled with generally low profit margins and high demands for service created a situation in which the most vulnerable workers, typically immigrants, were exploited by private transit operators (Jones, 1985) As employees became empowered through unionization, working conditions and wages gradually improved At the same time, however, the regulation of fares and further declines in profitability led to a state of disinvestment in transit Transit unions became powerful forces particularly in large urban areas where a transit strike could paralyze a city causing economic harm During the 1960s, transit unions were influential in directing federal policies to buy out failing

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Contracting is the selective provision of routes or services by privately owned companies or other public operators working under contract to the public agency Generally, under contracting the routes and services may be determined by the public agency and the private carrier operates the services Many public agencies own the vehicles, but lease them to the private operator which supplies the drivers and maintenance of the vehicles private operators and were successful in getting worker protection clauses written into the Urban Mass Transportation Act of 1964 (Black, 1995) During the 1970s and 1980s when transit subsidies skyrocketed and productivity fell many blamed unions for absorbing subsidies in wages and benefits rather than expanding a much needed public service (Lave, 1994, Pucher, Markstedt, *et. al*, 1983). Proponents of contracting claim that public transit agencies are monopolies strongly influenced by labor unions and that they have no incentive to be efficient. They argue that introducing competition in public transit will allow market forces to determine appropriate wages for employees while providing more efficient service. Contracting's opponents, generally labor supporters, assert that contracting is an attempt to "turn back the clock" on labor's gains to an era where employees worked long hours for little pay and few benefits

The results presented in this study show that contracted operations are not inherently more cost efficient On the other hand, the evidence suggests that labor inefficiencies continue to plague the transit industry and that large transit providers may simply be too big to manage operations efficiently The study concludes by advising that large transit agencies be decentralized into smaller units or transit zones These units may be publicly or privately operated according to local preferences Decentralizing operations can improve scheduling efficiencies and provide more manageable work units Workers can gain by an overhaul of the craft structure of transit to allow for a career path of increasing skills and responsibilities.

Chapter 2

RECENT RESEARCH ON TRANSIT SERVICE CONTRACTING

The Federal Transit Administration estimates that service contracting can produce cost savings between 25 and 30 percent per unit of service provided (Bladikas *et al.*, 1992) Some studies show much higher cost savings in the range of 30-60 percent (Morlok and Viton, 1985; Ernst & Young 1991, 1992a, 1992b, Richmond, 1992 Reason Foundation, 1991) A few others, in contrast, have presented the results of contracting as less than ideal.

A controversial study was commissioned by the Los Angeles County Transportation Commission (LACTC) to analyze the impacts of Southern California's experiment in privately operated "transportation zones" (Ernst & Young, 1991, 1992a, 1992b) [3] The Foothill Transit Zone was formed in 1988 by several San Gabriel Valley cities along with Los Angeles County and the LACTC to take over several routes scheduled for service cuts by the Southern California Rapid Transit District (SCRTD)

The study documented substantial subsidy reductions and patronage improvements, but was criticized by SCRTD as being unfair in its assessment of inefficiencies on the part of the public operator SCRTD argued that the cost allocation guidelines established by the Commission did not adequately address the full range of costs borne by SCRTD such as route planning and marketing associated with providing public transit They subsequently hired Coopers & Lybrand to produce an equally controversial report finding virtually no cost savings by contracting out Foothill Transit's routes.

Richmond (1992) was retained by Los Angeles County Supervisor Michael Antonovich to critique both studies and concluded that the Ernst & Young analysis showing cost savings of around 48 percent overstated the long-term impacts Richmond's own assessment is that Foothill Transit's savings range between 24 and 34 percent depending on whether one includes buses that remained idle during a legal battle over route duplication between SCRTD and Foothill Transit (Los Angeles Times, 1992). Richmond estimates that savings could be as high as 38 percent once Foothill Transit purchases its own vehicles, removing interest payments on leases included in the Ernst & Young analysis.

As for the Coopers & Lybrand report showing minimal savings -- on the order of less than one percent -- Richmond concluded that that the marginal costing method used by the SCRTD was reasonable for the short-term, but that such an approach is not a good predictor of future performance SCRTD argued, for example, that it was unable to remove costs associated with fixed-assets such as maintenance facilities and had to incur costs to shift personal to

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[3] In 1993 the Los Angeles County Transportation Commission (LACTC) and the Southern California Rapid Transit District (SCRTD) merged to form the Los Angeles County Metropolitan

other tasks (Richmond, 1992) Operating decisions, he concludes, should be based on long-term effects, and over the long-term fixed-assets will be likely be sold or removed and staffing levels will be adjusted appropriately.

In Denver, Peskin, Mundle *et. al* (1991) conducted a similar two-year analysis using both marginal and fully-allocated cost approaches.[4] In 1988 the State of Colorado mandated that the Denver Regional Transportation District contract at least 20 percent of its service to private operators In the second year of this experiment, the marginal cost analysis revealed savings of 13 percent and the fully-allocated analysis revealed 26 percent savings without capital costs included and 31 percent including capital costs Interestingly, the review revealed that the contractors only made a profit of 0 3 percent after two years of operation

In general, there are few reports disputing the claims of significant savings by contracting proponents. Using an unidentified costing method, Sclar (1994) claims that Denver's contracting costs per revenue hour actually exceed the costs of the publicly operated routes. Sclar *et al* (1989) also published the

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Transportation Authority (LACMTA)

[4] *Fully-allocated* cost models attempt to assign the total long-term cost of providing transit services to particular modes and routes These models can use one or more variables such as hours, miles, or the number of vehicles to allocate costs For example, driver wages may be assigned according to the percent of revenue hours of given route while mechanics' wages may be assigned according to vehicle miles *Marginal* or *Incremental* costing methodologies attempt to derive the short-term cost of providing one additional or one less unit of service When services are contracted out, an agency cannot immediately layoff or reassign workers or sell facilities In the short-term, a fully-allocated costing methodology would assign these costs to the remaining routes in the system, making operating costs appear higher than they really are The *marginal* cost of contracting would be the cost of those employees not yet reassigned less the contracting costs In the long-term, the marginal and fully-allocated cost approaches converge

only comparative report that has disputed the savings credited to contracted services in the United States This report argues that privatization savings are grossly overstated and that contracting has produced losses in many cases With New Orleans, New Jersey Transit, and Westchester County, New York as examples. Sclar shows that private operator costs could exceed public provider costs The report notes. however, that the operations examined were not competitively bid Many researchers believe that in the cases where private costs exceed public costs these exceptions can be explained by the existence of a private monopoly where there is a guaranteed subsidy to cover deficits (Morlok and Viton, 1985) Private monopolies, or franchise operations, have the same disincentives as public operators to be efficient while a competitive environment, regardless of whether the private sector provides the competition, provides incentives to keep costs down

Sclar (1994) counters such claims by arguing that unless large numbers of bidders are present in a given market there exists the danger that collusion and political influence will have an impact on the contracting decision In Northern California, he reports, Sonoma County denied a competitively bid contract to the Golden Gate Bridge and Transit District even though it presented the lowest bid Sclar claims that lobbying efforts by the California Bus Association led the Urban Mass Transportation Administration to require that the contract be awarded to a higher priced private operator Similarly, Dobek (1993) argued that national transit privatization efforts in England were ideologically driven, yet sold on economic terms with little regard for the true economic consequences

In writing about the mid-term impacts of the transit privatization wave in Great Britain since 1986. Gómez-Ibáñez and Meyer (1993) concur with Sclar that cases exist where private carriers prevented open entry into markets They show that the deregulation was structured such that entrants into a given market had to give 40 days notice of their intentions to provide transit service which allowed established carriers to impose predatory pricing to eliminate competition. Pucher and Lefèvre (1996) report that profits for private operators can be less than 2 percent per year and that there may be little investment in capital equipment

Gómez-Ibáñez and Meyer (1993) caution, however, that Britain's large scale privatization effort produced complicated results, providing too rich a portfolio of lessons to draw binding conclusions about the impacts of privatization They conclude that British privatization has proven largely successful in a number of areas Public subsidies in Great Britain were reduced by nearly 25 percent in just two years, and by 1992 total subsidies for public bus operations outside of London decreased by 56 percent mostly due to fare increases, declines in the cost of fuel, and a drop of more than 30 percent in unit operating costs (Pucher and Lefèvre, 1996)

Long-time transit workers also lost less than expected by allowing work rule changes in exchange for maintaining wage rates and substantial early retirement or "buy-out" programs Because there have been service expansions, total transit employment has shown no net losses, but new employees face lower wage rates than their experienced co-workers. Debates over the extent and quality of service improvements due to privatization can be heated, but some customer oriented innovations have come from Britain's privatization Examples include using smaller vehicles for more frequent and faster service and suburb-to-suburb express services (Gómez-Ibáñez and Meyer, 1993).

Other research confirms savings due to contracting Morlok and Viton (1985) cite cost savings from a number of international studies conducted in the late 1970s and early 1980s demonstrating that American, Australian, and English private carriers cost between one-half and two-thirds of public carriers. They discuss three anecdotal cases in the U S where private carriers took over services previously run by public agencies and reduced costs between 50 and 60 percent Teal (1988b) details a case in Yolo County, California where a private company took over service provided by Sacramento Rapid Transit, a public operator Cost savings - no elaborate costing methods were necessary - exceeded 35 percent The private operation was simply less expensive than the same service provided by the public operator

There is no doubt where most of the savings occur as virtually every study shows that most savings come in reduced labor expenses. Richmond (1992) writes that contractor proposals for Foothill Transit showed wage rates "well under $10" compared to $14 69 for SCRTD drivers After four years of employment, even the highest paid contract drivers in Denver earned roughly 77 percent of the Denver Regional Transportation District's drivers (Peskin, Mundle, *et. al*, 1991). When the Bay Area Rapid Transit District awarded a contract for express bus services in 1989, the only public agency to submit a bid, the Alameda-Contra Costa Transit District, proposed an hourly driver's rate of $11 01. In contrast, the highest private bidder proposed a wage rate of $9.10 per hour while the lowest private bidder submitted a rate of $7.37 (Auditor General of California, 1989) Similar results hold for drivers in San Diego County where, in 1994, a full-time public agency driver earned $15 69 on average compared to $8 96 for the highest paid contract driver (Metropolitan Transportation Development Board, 1996) Finally, a study of wage differentials between public and private transit personnel in Houston found that operators and mechanics received much lower wages in the private sector than from the region's public operator (Moore and Newman, 1991). Metro's bus drivers earned 83 percent higher wages on average than their private sector peers while the public mechanics received over 31 percent more in wages than equivalent private sector workers.

There is evidence that even the threat of privatization can induce labor to give concessions in exchange for job security. Talley (1991) studied the effects of contracted paratransit services in reducing motor bus operating costs in the Tidewater Transportation District Commission in Virginia He found that once the agency initiated paratransit service, the Amalgamated Transit Union was willing to relax work rules to preserve job security The Institute of Transportation Engineers presented a dozen case histories showing dramatic cost savings and "positive ripple effects" due to service contracting such as lower unit costs and improved service (Bladikas *et al*, 1992). All of the cases presented by the Institute cited the improved position of management in labor negotiations, which resulted in lower costs to the public agency

Finally, there is evidence that public operators become more competitive themselves once contracting is initiated The Los Angeles Department of Transportation contracts for all of its service and has been able to reduce operating costs on routes formerly run by the Metropolitan Transportation Authority However, the Authority recently won a competitive bid to provide service on one of the city's routes (McCullough, 1996a) Hurwitz (1995) and Bladikas (1992) also report that formerly cost inefficient public agencies have been able to compete successfully on some contracted routes

The evidence to date strongly suggests that contracting produces immediate cost savings in the provision of transit services However, the current body of research has two principal weaknesses First, these studies typically only look at costs during brief periods of time following the initiation of contracting Most of this research was conducted one to two years after contracting was initiated with no follow-up investigations. And one might expect, for example, that increasing demand for private carriers might cause costs to rise for these operations

The second weakness is that this research does not necessarily make the most appropriate comparisons between operators. Most of the comparative research p ts smaller single service private companies against large multi-service transit authorities meeting a variety of regulatory, social, and political demands. An appropriate analysis would compare similarly sized agencies and, ideally, agencies with similar modal and service area compositions

This research adds to the literature on contracting by addressing these two weaknesses This was done empirically by comparing cost efficiency trends among the three groups of operators described in the *Introduction* over a five year period. In addition, a linear multiple regression model was developed to determine the factors that most contribute to operating efficiency By comparing costs among agencies nationwide that contract and those that do no contracting one may draw conclusions about the long-term impacts of contracting.

Chapter 3

RESEARCH DESIGN/METHODOLOGY

The analysis was conducted in two phases The first phase looks at operating cost efficiency trends, measured in terms of operating expense per revenue hour, over a five year period to test whether contracted transit services are inherently more efficient than non-contracted services The second phase uses a linear multiple regression model to isolate those factors thought to best explain contracting's efficiencies.

Data for the study were principally drawn from the Federal Transit Administration's National Transit Database Cost-of-living data were provided by the American Chamber of Commerce Research Associates, and climate information was taken from the Climate Diagnostic Center of the National Oceanic and Atmospheric Administration Finally, general metropolitan area union membership rates, obtained from Hirsch and Macpherson (1993), were used to establish a relationship between the *union-friendliness* of a region and unit operating costs. After reviewing these sources in some detail, the chapter closes with a discussion of the limitations of the data and a general description of the final dataset used for this study.

Research Approach

The study was conducted in two phases The first phase analyzes cost efficiency trends for three groups of transit operators

- public agencies or state departments of transportation contracting 100 percent of their fixed-route general public motorbus transit service over the entire five year study period as measured by the ratio of revenue hours provided by *purchased transportation* to the total revenue hours provided by the agency

- public agencies or state departments of transportation doing no contracting over the entire five year period, and

- public agencies or state departments of transportation contracting some portion of their total transit revenue hours

These three classifications were chosen to test the hypothesis that contracting is inherently more cost efficient than not contracting If contracting is more cost efficient, then operators contracting all of their services will tend to be more efficient than those doing no contracting Testing this hypothesis over a five year period normalized cost anomalies which occur when an operator initiates contracting by allowing costs to level out over time The third classification of operators contracting a portion of their services allows one to determine whether or not contracting has a positive influence on system efficiencies In general, the three groups were hypothesized to exhibit the following trends:

- agencies contracting all transit services over the five year period should maintain relatively stable unit cost increases during the study years One might also expect costs to decrease for these operators as more competitors enter the market given federal and state incentives or mandates.

- agencies doing no contracting were hypothesized to show cost increases at or near the rate of inflation This is expected because annual expenditures are assumed to be constrained by operating budgets indexed to inflation.
- agencies contracting some services should show declining unit costs due to lower costs for contracted operations

The group contracting some transit services was further divided into two sub-groups The first sub-group represented operations performed in-house (i e., directly operated services) while the second sub-group included the "purchased" or contracted operations These two sub-groups were analyzed over a three-year period between 1991 and 1993 Before 1991 agencies reporting to the Federal Transit Administration did not have to fully allocate expenses associated with contract operations such as contract monitoring and administration Before that year only actual contract amounts were reported for purchased transportation

Operating cost efficiency is the measure by which the three groups were compared Some argue that a cost efficiency approach is too simplistic and does not adequately address the full range of demands placed on transit providers (Berechman, 1993) Although there are different metrics by which transit service can be evaluated such as service effectiveness (e.g , boardings per hour) and cost effectiveness (e.g , subsidy per passenger), using cost efficiency as the decision model for public transit agencies can be justified on two grounds

First, there is no evidence that transit managers allocate their resources any differently than other economic entities, public or private (Berechman, 1993). The decision to contract is above all a cost efficiency decision This view is supported by a survey of transit operators in which 16 of 35 transit managers surveyed cited the cost saving potential of contracting as the number one reason for initiating contracting (Goldstein and Luger, 1990)

Second, service effectiveness depends on a demand for service that lies largely beyond the control of the agency Even though actions of the agency may have an impact on effectiveness (e.g , restructuring routes or altering service frequencies), policies made by elected or appointed boards can hinder effective service provision

A case in point is Portland's Tri-Met. In 1969 Tri-Met was formed to take over the failing Rose City Transit operation To finance operations the agency turned to a local payroll tax which immediately spawned geographically based constituencies demanding service in their areas, many of these being dispersed cities with little propensity to use transit. Meeting these demands has resulted in fare and service policies that are both inefficient and inequitable (Adler and Edner, 1990).

To counter claims that its rail expansion policies favored downtown Portland and the few communities receiving stations at the expense of the region as a whole, Tri-Met covered the region with bus services that proved to be not very service effective To maintain ridership levels and to stave off criticisms of its downtown "fare free" zone, Tri-Met reduced suburban bus fares even though these dispersed services are the most expensive to provide. In effect, Tri-Met's efforts to meet the demands of diverse constituencies have created a situation where both service effectiveness and cost efficiency have been compromised Ironically, Tri-Met turned to contracting to relieve financial burdens created by these policies

Annual operating costs per revenue hour of service produced was used as the efficiency measure Revenue hours in the denominator effectively normalizes service characteristics and operating conditions Buses traveling along congested urban streets at slower speeds take longer to cover the same distance as express commuter services operating on freeways (Fielding, 1987) Thus, revenue hours removes regional and modal biases in producing transit service Operating expenses in the numerator were calculated after omitting reconciling items such as depreciation and amortization There is a wide variation in accounting methods between agencies for dealing with these items. Although removing these expenses understates the true costs of service provision, it keeps comparisons between operators consistent

After tracking the cost efficiency trends for the three groups, a linear multiple regression model was used to determine factors that most influence costs for the operators in the sample If contracting contributes to cost efficiency, it should show up in the model as having a downward influence on operating costs per unit of service provided.

Data Sources

Three principal data sources were used for this research The primary source was the Federal Transit Administration's National Transit Database for the years 1989-1993 (United States Department of Transportation, 1990, 1991, 1992, 1993a, 1994a) Other sources included the American Chamber of Commerce Research Associates composite Cost-of-living Index, the National Oceanic and Atmospheric Administration Climate Diagnostic Center, and the union membership and coverage files from Florida State University (ACCRA, 1994, NOAA, 1996; Hirsch and Macpherson, no date)

The National Transit Database (NTD) was formerly known as the "Section 15" database This source contains a wide range of data covering almost every aspect of public transit including revenues, operating and capital expenses, non-financial operating statistics, and capital inventory information. The Federal Transit Administration receives these data annually from operators receiving Section 9 operating grants in accordance with Section 15 of the Urban Mass Transportation Act of 1964 The Section 15 reporting system is an attempt to standardize operating and financial statistics among operators by creating a uniform system of accounts

The American Chamber of Commerce Research Associates' (ACCRA) composite Cost-of-living Index (COLI) measures differences in the costs of consumer goods and services between urban areas. This index is more appropriate for comparing price differences between regions than the consumer price index published by the U S Department of Commerce. The consumer price index captures dif erences in the cost-of-living for a given location over time whereas the COLI compares differences spatially for a given point in time

To establish the COLI, quarterly price data are collected in different cities for 59 items in six general areas. grocery items, housing, utilities, transportation, health care, and miscellaneous goods and services. This information is weighted and averaged and a composite index figure is derived with *100* representing the national average If a city has an index value of *115* this means that it is 15 percent more expensive to live in that city than in the average U S city Since the number of consumption items included in the index is limited, small differences in the COLI are not meaningful

Third quarter 1993 data were used in the analysis to determine regional cost-of-living impacts on transit costs The COLI is based on voluntary self-reporting from chambers of commerce and many of the operators in this dataset did not operate in areas reporting data to ACCRA To increase the sample size two assumptions were made about relative living costs. The first assumption, suggested by a representative of ACCRA (McCullough, 1996b), was that cities in the same metropolitan area share the same COLI because variations of a few points in the index would not be statistically significant Thus, Santa Monica, California was assumed to experience the same cost-of-living as Los Angeles The second assumption was that within a given region, the COLI would not vary much between metropolitan areas In other words, if several proximate metropolitan areas did not vary by more than a few points in the COLI. then any other city not reporting data in the same region was assumed to have a COLI based on the COLI's of the nearby cities weighted by distance This approach was used to obtain the index value for medium to small-sized cities in Texas, Georgia, Louisiana, California, and Indiana, among other states. Based on these assumptions, 98 of the 142 operators in the original dataset were assigned an index value

We also hypothesized that regions experiencing higher than normal levels of snow and rain may incur maintenance costs or accident levels not experienced by other operators To ascertain the effects of weather on transit costs, the Environmental Research Laboratories' Climate Diagnostic Center databases were used (NOAA, 1996) Thirty-year average annual precipitation and snowfall data from the Climate Diagnostics Center World Wide Web site were collected for every city represented in the dataset. These data were used as independent variables in the linear regression model to measure weather impacts on costs per revenue hour of service

Finally, to test the influence of *union-friendly* urban areas on cost efficiency, general population unionization rates for 1990 were examined for metropolitan areas with operators from this sample These 1990 rates were obtained from the *Union Membership and Coverage Files* developed by Hirsch and Macpherson (1993) at Florida State University These data are based on monthly Current Population Surveys conducted by the U.S Census Bureau Hirsch and Macpherson have produced union density files disaggregated by state, metropolitan area, occupation, and industry The data used here included only generalized metropolitan area unionization rates since the data files do not include the occupational breakdown for the public transit industry by metropolitan area It is important to emphasize that these data do not reflect the impact of unionization on transit performance, but serve as an indicator of the impact of an urban area's *union friendliness*. If the citizens of a metropolitan area value the benefits that unions bring to workers, then high operating costs per unit of transit service may reflect that preference The latest data available for this study were for the year 1990. An assumption of constant unionization rates over the five year study period was necessary.

Limitations of the National Transit Database

It is important to clarify issues surrounding the NTD First, only operators receiving federal monies for transit are required to file a report Although operators may voluntarily submit reports, transit agencies subsidized exclusively with state and local grants may be excluded from the database Since funding structures may play a role in the decision to contract, these missing operators would surely provide some insight into the contracting question. Such operators may simply be very small and can rely solely on alternative financing mechanisms or they may be privately owned subscription or charter services which depend on contracts from universities or other entities.

Another issue surrounding the NTD concerns cost allocation by transit mode There are many reasonable ways to allocate system costs to service outputs For example, to allocate labor costs an agency may use vehicle hours for drivers, vehicle miles for maintenance personnel or the number of peak vehicles for other staff members Other expense categories such as advertising may depend on other criteria to allocate costs (U.S. Department of Transportation, 1993b)

Cost allocation is typically done using *cost allocation models* which are not standardized across operators Each agency has discretion as to which model will be used. Large agencies tend to utilize very complex models while smaller, less sophisticated agencies may use simpler methods The accuracy of the NTD cost data, although audited, may vary depending on the sophistication and type of the model used. Agencies providing multiple transit services (e g , rail, motorbus, demand response) may also have significant joint expenses which are not easily allocated between modes For example, costs attributed to the mechanic who repairs both 45 foot transit buses and vans used for paratransit service can be allocated according to vehicle miles, but perhaps one vehicle type requires more extensive maintenance per mile or perhaps one mode utilizes older, less reliable vehicles. The allocation model may not capture these nuances and, therefore, may inaccurately allocate costs between modes

Another issue surrounds the capitalization of operating expenses Agencies may allocate certain items to the capital side of the ledger while other agencies include these items as operating expenses For example, certain spare parts that are used frequently may be considered a fixed asset while other agencies may consider them to be operating expenses Agencies contracting for services may lease vehicles to the contractor in which case the capital costs would appear on the capital side of the ledger Agencies requiring contractors to purchase the vehicles will have the amortized cost for the vehicles passed on to the agency as an operating expense

The evolution of the NTD reporting system influences the data as well Over time reporting requirements have been added, deleted, or modified Prior to 1992 agencies were not required to report the nature of the contractual relationships between the contracting agency and the contractor Therefore, there is no way to ascertain from the data whether or not an agency contracts with a private operator or another public agency. The Los Angeles City Department of Transportation, for example, contracts one route to the local Metropolitan Transportation Authority In San Diego a similar situation occurs where the public operator, San Diego Transit Corporation, has competitively won routes run by private companies Other agencies around the nation also contract with public entities to provide transit service Therefore, the dataset includes public as well as private contractors

Finally, this reporting nuance also does not allow the researcher to distinguish between operations that are competitively bid from those that are operated under franchise agreements A franchise agreement is one in which the private carrier is given exclusive rights to provide service along a given route In contrast, a competitively awarded route is re-bid every few years Some researchers argue that without any competition, franchise operators have no incentive to provide cost efficient service (Morlok and Viton, 1985)

In developing the final dataset, some restrictions were necessarily imposed. To be included in the dataset an operator must not have moved from one of the three classifications presented above to another over the entire period between 1989-1993 In other words, if an operator was classified as not having contracted any services in 1989, that operator had to maintain that status through 1993 This insured that the dataset contained consistent longitudinal information for each operator. Cost savings due to contracting may be short-lived In other words, cost savings are gained in the first couple of years of contracting, but that these savings diminish over time Structuring the dataset in this manner allows this hypothesis to be tested

Another restriction was that each operator had to report all data for each year during the study period This restriction was imposed to facilitate data analysis. When dealing with very large datasets one wants to maintain flexibility Having a clean dataset facilitates the manipulation of data via sorting and creating new fields requiring mathematical formulas Such rigidity reduces the sample size and, to some degree, reduces the story that each operator brings to the analysis However, only two or three operators were eliminated due to missing data

The most difficult limitation to impose was one dealing with a reporting requirement of Section 15 The requirement dictates that contract operators running more than a threshold number of peak vehicles must file a separate Section 15 report with the Federal Transit Administration In 1989 this threshold was 50 vehicles and since 1990 it has been 100 vehicles. Individual transit properties running a number of peak vehicles below this threshold are included with the contracting agency's own Section 15 report, while those exceeding the threshold number file a separate report. Thus, if an agency contracts out to four operators each running under 100 peak vehicles in 1993, data for the four would be reported together in the contracting agency's Section 15 report If, for example, this agency were to contract with an additional operator running more than the 1993 threshold of 100 peak vehicles, the contracting agency would still file one aggregate report for the four small operators, but would indicate in its report that a separate report would be filed by the one large contractor

Prior to 1992 the nature of the contractual relationships between contracting agencies and their contract operators was not explicitly reported, making it difficult to identify which contractors worked for a particular agency As a result the dataset does not include any agencies that contracted with operators whose size exceeded the Federal Transit Administration threshold. This resulted in seven agencies being eliminated from the dataset, four of which represent or operate in major metropolitan areas (New York City Department of Transportation, New Jersey Transit Corporation, Dallas Area Rapid Transit, Westchester County Department of Public Works, and the City of Los Angeles Department of Transportation)

Excluding these large agencies implies that the study may not fully represent the range of contracting experiences in the U S On the other hand, the three New York and New Jersey operators also represent a unique transit environment in many respects For example, many of the contractors to the New York City Department of Transportation are heavily regulated franchises in many ways not too different from public operators Franchise operations as in Westchester County, New York, are likely to be more expensive as less expensive than public operations (Sclar *et al*, 1989, Morlok and Viton, 1985)

The case of New Jersey Transit (NJT) is also unique Although NJT does do "traditional" competitive contracting, the majority of its contract services are provided by franchise and charter companies. NJT gives buses to these operators in lieu of providing operating support Other than administrative costs, expenses accrued to NJT show up as capital expenditures which are not being considered by this study Given the large tourist industry in New Jersey, many of these franchise operations also run charter service to Atlantic City which is not a common characteristic of most transit operators in the U.S. The City of Los Angeles' one large contractor is the Metropolitan Transportation Authority, itself a large public operator that does not report its contracted services separately from its directly operated services

Description of the Final Dataset

Recognizing these limitations, the final dataset contained 142 operators providing general fixed-route motorbus transit services (Appendix A). This sample represents 29 percent of all agencies reporting to the Federal Transit Administration in 1993 and 35 percent of those reporting in 1989 Within the sample there are 55 operators contracting either some portion or all of their services comprising 47 percent of all operators reporting purchased transportation in 1993 and 55 percent reporting in 1989.

Over half of the operators for the study were very small with fewer than 25 peak vehicles (Appendix B). Slightly under 25 percent operated between 25 and 100 vehicles, and twenty percent ran over 100 peak vehicles. Only two operators, the Los Angeles County Metropolitan Transportation Authority and the Washington Metropolitan Area Transportation Authority, operated over 1,000 vehicles Neither of these two operators contracts out any transit services, although the Los Angeles MTA provides contract services to the City of Los Angeles Department of Transportation.

Two other interesting observations can be made about this dataset. First, most agencies that contract some of their services are generally mid- to large-sized, operating between 100 and 1,000 vehicles For small operators doing no contracting, the marginal cost of adding drivers and equipment is generally much lower than the overhead costs to procure and monitor contracts In some instances the costs incurred by the small agencies to contract may exceed in-house costs (Giuliano and Teal, 1988) In addition, these operations may be located in smaller communities with no competitive market for transit contracting

The second observation involves the regional distribution of contracted services These operations tend to be concentrated in the Northeast or the Southwest while most operators doing no contracting are located in the Southeast In part this reflects the smaller sized urban areas in the Southeast, but is also due to pro-contracting policies in states such as California, New York, Texas, Massachusetts, and Connecticut

Massachusetts' General Law 161b mandates that all transit service outside the Boston area be competitively bid. For the Metropolitan Boston Transportation Authority, the Massachusetts' Management Rights Act of 1980 allows the Authority to contract and prohibits the issue of contracting from being discussed in contract negotiations between management and labor (Black, 1995, Goldstein and Luger, 1990). California transit financing mechanisms also give priority to agencies that contract. In 1979 that state's Transportation Development Act (TDA) was amended so that no agency could receive TDA funds if prevented by a union agreement from using part-time drivers or contracting for transit services (Walther, 1993).

In other states, particularly in the Southeast, organized labor is relatively weak and in Texas public employees are bound by arbitration rulings while contracting decisions are the sole domain of management Right-to-work laws in other states which prevent union-only workplaces combined with generally low wage rates make contracting a less desirable option than in other regions of the country (Freeman and Medoff, 1984) Despite the small proportion of Southeastern operators contracting for service, there are two agencies that contract some routes -- the Charlotte, North Carolina Transit System and the Louisville Transit Authority

Chapter 4

IS CONTRACTING MORE COST EFFICIENT?

This study examines whether contracting for fixed-route bus transit by public agencies is more cost efficient than directly operating the same service If contracting is inherently more cost efficient, then those operators that contract for all of their transit services should be more cost efficient than those doing no contracting In addition, operators contracting for some transit services should experience cost savings over time. On the other hand, if contracting is not more cost efficient, then might there be strategies other than contracting to improve cost efficiencies?

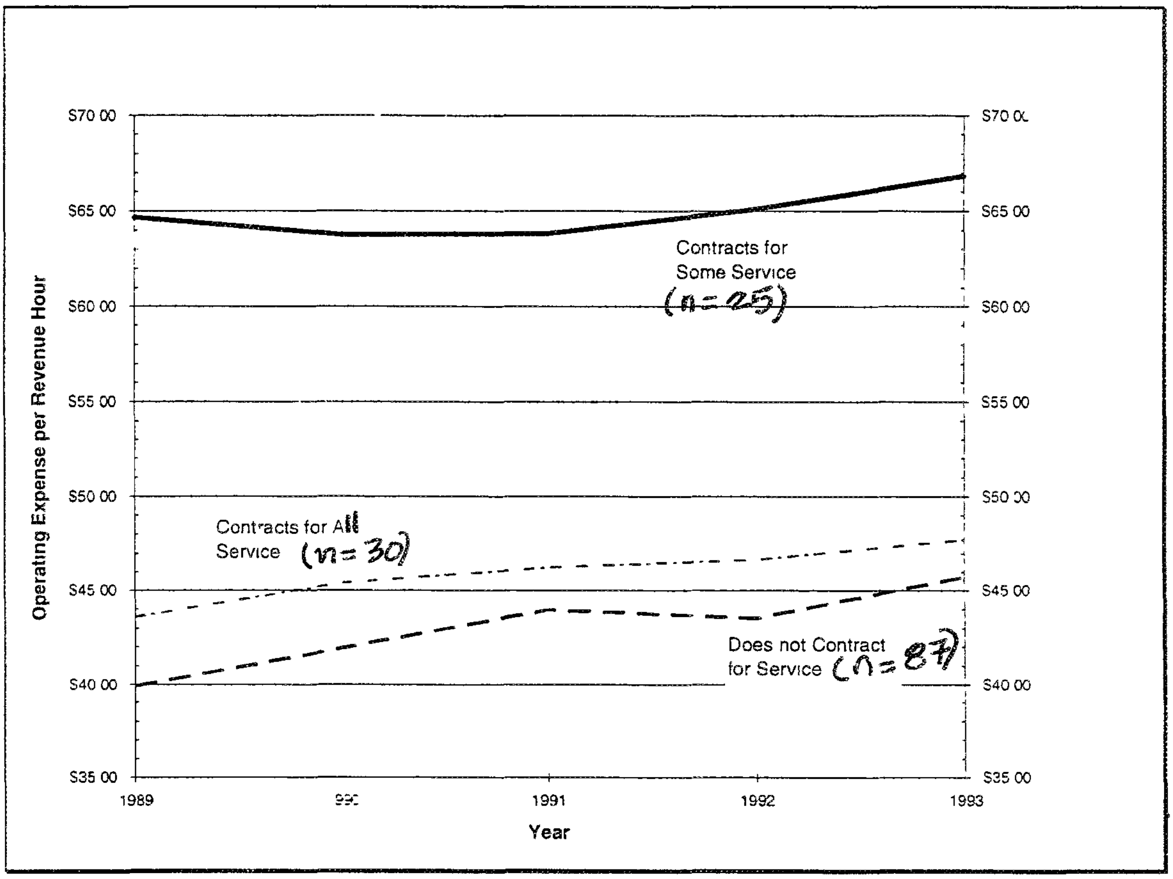
The dataset of 142 operators developed in the previous chapter covering the period 1989 to 1993 was used to test this hypothesis These operators were categorized into one of three general groups. The first group consisted of 30 operators contracting for all transit services between 1989 and 1993 The second group contained 87 operators doing no contracting, and the final group of 25 operators contracted for some portion of their services over the entire five year period

This research concludes that in the aggregate there is no evidence to support the hypothesis that fully contracted services are more cost efficient than services operated by public agencies In fact, agencies doing no contracting over the analysis period may be more cost efficient than those contracting all of their fixed-route transit services In contrast, agencies contracting a portion of their routes may have experienced improvements in overall cost efficiency due to contracting between 1989 and 1991, but since 1991 these gains have diminished because contracted unit costs for these agencies are rising faster than the rate of inflation The models developed here also suggest that in 1993 the amount of contracting done by an agency had no impact on costs per revenue hour of service They do suggest, however, that inefficient vehicle scheduling and driver work rules contribute greatly to high unit operating costs apart from the issue of contracting Estimated elasticities for these factors indicate that a ten percent decrease in deadheading can potentially lower unit costs by 19 percent while a 10 percent decrease in operator pay hours relative to driving hours can reduce costs by around 6 percent

Cost Efficiency Trends

Is contracting for public transit services more cost efficient than providing the service in-house? If this is the case then one would expect agencies contracting all of their transit services to be more cost efficient than those doing no contracting One would also expect that agencies contracting some transit services would show declining unit costs. The evidence does not bear this out, however (Figure 1)

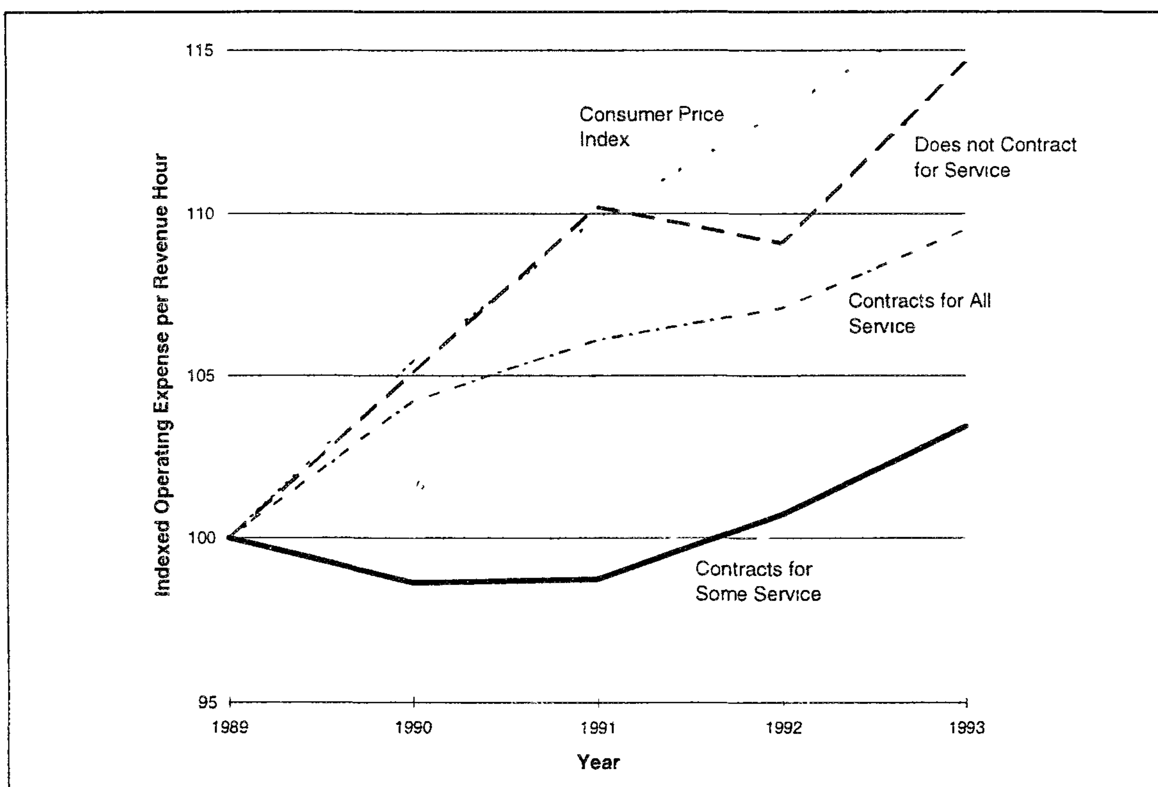
Figure 1: System Operating Costs per Revenue Hour



Operators that contract for some of their services operate at much higher unit costs than those doing no contracting or those contracting all services The least expensive operators are those doing no contracting This result is only statistically significant at the 90 percent confidence level in 1990 (t=1.71, α=0 10) when the difference between operators contracting all services and those not contracting was $5.64 per hour Therefore, the hypothesis that the private sector is inherently more cost efficient than the public sector is not valid in the aggregate

When viewed in relation to the rate of inflation, all three groups have performed well (Figure 2). Each has kept cost increases below inflation, but the group doing no contracting has shown cost increases at a much higher rate over the five years than the other two groups Unit costs for the group that contracts some services declined between 1989 and 1991, but since 1991 costs have increased at a rate higher than for the other two groups (Table 1)

Figure 2: Operating Costs per Revenue Hour Indexed to Inflation



Note Consumer Price Index is for All Urban Consumers.

Table 1: Operating Costs per Revenue Hour

Operator Classification	N	Year 1989	1990	1991	1992	1993	Percent Change 1989-1993	1991-1993
No Contracting	87	$39 90	$41 93	$43 96	$43 52	$45 74	14 6%***	4 0%**
Some Service Contracted	25	$64 64	$63 75	$63 82	$65 10	$66 84	3 4%	4 7%*
All Service Contracted	29	$43 58	$45 41	$46 23	$46 66	$47 71	9 5%*	3 2%
CPI - All Urban Consumers		124 0	130 7	136 2	140 3	144 5	16 5%	6 1%

* - $p<0\ 05$ ** - $p<0\ 01$ *** - $p<0\ 001$

Because cost efficiencies for operators contracting some transit services improved for a period suggests that contracting has had some impact on their abilities to lower costs The years in which costs declined were a period of expanding contract services for these operators (Figure 3). Between 1989 and 1990 this group expanded hours under contract, increasing service by a median of 13 percent while publicly provided routes showed no increase. A survey by Goldstein and Luger (1990) supports this finding, with respondents citing service expansion as a principal reason for contracting, second only to cost cutting By 1991, however, publicly operated routes comprised 50 percent of the service expansions and since 1991 directly operated services have comprised the bulk of the added service.

Figure 3: Cumulative Change in Revenue Hours for Operators Contracting Some Routes

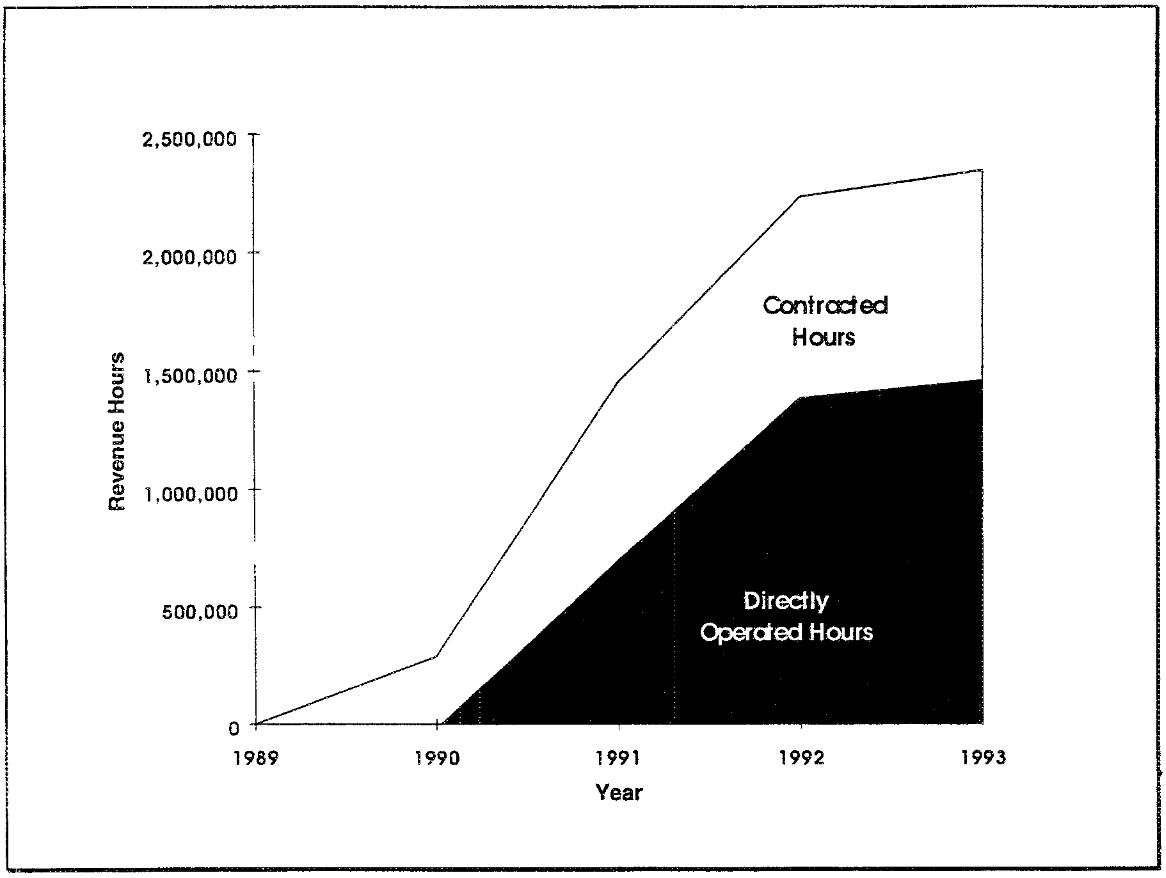


Table 2 demonstrates the impact of contracting on those operators outsourcing some of their routes Only three years of data were available for this study because prior to 1991 the Federal Transit Administration did not require operators reporting under Section 15 to allocate all costs associated with contracting such as contract administration and monitoring to the "purchased transportation" companies Before 1991 only the contract value was required plus any fares retained by the contractor

Table 2: Operating Costs per Revenue Hour for Operators Contracting Some Routes

Service Type	1991	1992	1993	Percent Change 1991-1993
Directly Operated Routes	$ 65 65	$ 67 58	$ 68 93	5 0%*
Contracted Routes	$ 46 77	$ 49 13	$ 50 39	7 7%
CPI - All Urban Consumers	136 2	140 3	144 5	6 1%

* - $p<0.05$ ** - $p<0.01$ *** - $p<0.001$

Over the three year period operating costs per revenue hour of contracted services increased 2 7 percent more than directly operated transit, and between 1991 and 1993 contract costs as a percentage of directly operated costs increased from 71 to 73 percent These increases by the contract operations should be viewed with caution as this growth rate is not statistically significant given the wide range of cost changes in the sample. This wide variation is demonstrated by operators such as Portland's Tri-Met which showed contracting cost increases of over 143 percent for its 6 contracted peak vehicles. Capital Metro of Austin, Texas, running 108 peak vehicles under contract experienced cost increases of 43 percent In contrast, Oklahoma City's contract costs for its 14 peak vehicles declined by 46 percent. In general, contracting appears to have played a role in reducing costs between 1989 and 1991 for those agencies that contract for some services However, this trend has been reversed, and since 1991 costs appear to be increasing for these operators

This analysis raises some interesting questions. Why is the group of agencies that contracts for *some* service decidedly more expensive than the other two groups? Even more interesting is why agencies which do no contracting are, at the very least, no more expensive than agencies that contract for all of their services? Since the evidence presented in this analysis does not support the notion that contracting is more cost efficient than not contracting, what factors might contribute to higher operating costs per hour of service provided? To answer this question a linear multiple regression model was developed to examine factors that contribute to operating costs

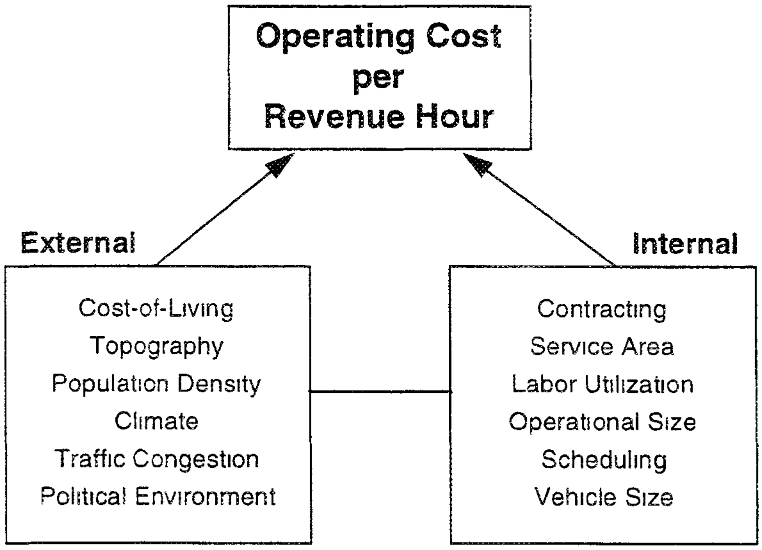
Modeling Cost Efficiency

There are many dimensions affecting the production costs of transit in addition to the extent of contracting done by an agency. These factors can be generalized as fitting into two categories - factors external to the operator and factors internal to the operator (Figure 4). Factors external to the operation are those that lie beyond the agency's control Internal factors are those under the direct control of the agency or its board

Many of these factors are not mutually exclusive and influence one another Contracting is one such element It is categorized as being internal to the operation because the board may have control over the extent of contracting, how it is carried out, and under what circumstances services will be contracted This decision, however, is often made at the state level Colorado and Massachusetts have state laws mandating contracting for public agencies

California and the federal government also have transit funding policies encouraging service provision by the private sector

Figure 4: Factors Influencing Unit Operating Costs



External factors include those elements of costs such as the peaking of travel Travel is concentrated in two peak periods commonly known as the *rush hours* In addition to work trips, other trips tend to be concentrated in time as well such as school trips and increasingly "chained" trips such as dropping young children at daycare or attending to personal needs.

To meet this peak demand, the transit agency must purchase additional vehicles, and drivers must be found to operate the vehicles Because demand levels do not remain steady throughout the day, much of the equipment required to meet peak demand is idle during the midday period In addition, long established labor work rules that seek to protect jobs may place limitations on the number of part-time drivers an agency can hire to work exclusively in the peak periods. These work rules may also place a premium price on full-time drivers who must work "split" shifts (Fielding, 1987, Chomitz, Giuliano, *et. al*, 1985).

Cost-of-living differences between metropolitan areas also contribute to cost differences between operators from different parts of the country Mountainous or hilly terrain reduces speeds and fuel economies and increases maintenance requirements High density areas can be characterized as having mixed land uses and closer traveler origins and destinations resulting in shorter transit runs and more efficient use of drivers and vehicles Inclement weather causes accidents, reduces speeds, and may require costly preventive measures against corrosion brought on by road salting during winter. Traffic congestion also increases the risk of accidents and reduces travel speeds resulting in scheduling, fuel. and maintenance inefficiencies

The political environment also plays a prominent role in operating costs (Berechman, 1993, Adler. 1990, Walther, 1990, Fielding, 1987). Emphasis on social equity and universal access by the public may require the agency to provide cost inefficient services. Transit performance can and should be measured in other ways than cost efficiency so there is no inherent superiority to providing cost efficient service at the expense of other important criteria However, as pointed out in the previous chapter, it can be argued that the decision to contract is based primarily on the cost efficiency criterion, and for this study contracting will be viewed in that way. Another political factor that influences transit operations might be a union-friendly population such as can be found in many Northeastern cities and in other cities such as San Francisco, California Such a populace tends to be supportive of policies that improve the position of unionized employees In general, larger populations representing diverse communities and interests may also be considered a part of the political landscape. Each community may have its own goals and objectives for public transit service Therefore, service areas with large populations may have to answer to a diverse set of interests which may negatively influence cost efficiency

The transit operator and its board also have many elements of cost under its direct control, although the distinction between external and internal factors is not often clear Contracting has been mentioned as one such element, but service area and agency operating size may also be decided by state law On the other hand, the transit board has the authority to extend or drop services and may dictate how services are to be structured, whether through smaller scale independent transit operations or through one large regional provider Such decisions are influenced by external factors, but they also depend on the internal operating capabilities and desires of the agency

Other elements of cost such as labor and vehicle scheduling also remain under the control of an agency as is the decision of which vehicles to purchase

Smaller vehicles are generally less costly to operate and maintain than larger vehicles costing as much as 65 percent less to operate than larger (Pucher and Lefèvre, 1996). Most of this difference can be attributed to the lower skill levels needed to operate the smaller vehicle resulting in lower wages (Berechman, 1993 Morlok and Viton, 1985). Also, unlike larger buses that are often custom built to specifications, smaller vehicles are mass produced with spare parts more easily obtained. Mechanics are more easily trained to repair these vehicles and the labor supply of both drivers and mechanics is larger. Finally, smaller vehicles are more fuel efficient than bigger buses further reducing their relative costs (Berechman, 1993) Is there any evidence that mini-buses are more cost efficient than larger vehicles? According to Walter (1981), whenever private operators in other parts of the world have a choice, they select smaller vehicles because they react to consumer preferences

To explore how these internal and external factors influence transit costs for this sample in 1993, a linear multiple regression model was developed using data obtained from the National Transit Database (NTD), the Cost-of-living Index (COLI) from the American Chamber of Commerce Research Associates (1994), union membership data for 1990 produced by Hirsch and Macpherson (no date), and mean annual snow and rainfall statistics from the National Oceanic and Atmospheric Administration (1996) (Table 3).

Table 3: Variables Used in Linear Multiple Regression Model

Model Variables	Definition	Measures	Expected Influence on Unit Costs
Dependent			
OPCST93	Operating Expense per Revenue Vehicle Hour	Cost Efficiency	
Independent			
AREA93	Operator service area per Federal Transit Administration guidelines	Service Area	+
COL94	ACCRA Composite Cost of Living Index, Third Quarter 1993	Cost-of-Living	+
DENSE93	Inhabitants per square mile of service area	Population Density	-
HRRATIO	Ratio of total vehicle hours to total revenue hours	Vehicle Scheduling	+
OPHR93	Ratio of driver pay hours to total vehicle hours (excluding charter service)	Labor Utilization	+
PCH93	Ratio of purchased revenue hours to total bus system revenue hours	Contracting	-
PKBASE	Ratio of vehicles in maximum service to vehicles operated at midday	Peaking	+
PKVEH93	Number of peak vehicles	Agency Size	+
POP93	Service area population	Political Environment (Population)	+
PREC	Mean annual precipitation in inches over a thirty year period	Climate (Precipitation)	+
SEATSTO	Average vehicle seating capacity weighted by vehicle hours	Vehicle Size	+
SNOW	Mean annual snowfall in inches over a thirty year period	Climate (Snowfall)	+
SPD93	Bus system operating speed in 1993	Traffic Congestion (Speed)	-
UNION90	Metropolitan Statistical Area unionization rates for 1990	Political Environment (Unionization)	+

The dataset for the regression model consisted of 61 operators The only factor not represented by the model was terrain, for which no representative variable was found Nonetheless, 24 of the sixty-one operators did no contracting over the period between 1989 and 1993, 23 contracted for some services, and 14 contracted all services over the five year period

For this analysis two variables in particular limited the dataset to 61 operators The COLI is based on voluntary reporting of data from Chambers of Commerce (See Chapter 3). Despite making assumptions about regional costs which increased the sample size, this variable was available for only 98 operators The second variable limiting the dataset was the labor utilization variable (*OPHR93*) representing operator pay hours to total vehicle hours Agencies operating fewer than 25 peak vehicles are not required to report this statistic to the Federal Transit Administration Since over half of the operators in this sample are very small this limits the dataset significantly

One assumption was made to increase the number of valid data points for this variable Contract operations were assumed to have a ratio of operator pay hours to total vehicle hours of 1 0 This assumption is reasonable because the contracting agency is not responsible for scheduling drivers for its contractors, and does not concern itself with how labor is utilized by the contractors The contracting agency is only paying for services provided. Therefore, the operator pay hours are irrelevant to the contracting agency and one can assume that the operator pay hours are equal to the revenue hours being produced

Results of the Model

Does contracting lead to improved operating cost efficiency? If so, then contracting would be an influential variable in the production costs of transit services If not, then what factors best explain cost inefficiency in public transit? The hypothesis that contracting is inherently more cost efficient is not borne out by the linear multiple regression model (Table 4). Surprisingly, the extent of contracting performed (*PCH93*) has the least impact of all the variables tested and is not statistically relevant The variables that best explain cost inefficiencies are the vehicle scheduling (*HRRATIO*) and the labor utilization (*OPHR93*) variables

The vehicle scheduling variable is by far the strongest predictor of operating costs per revenue hour with 78 percent more predictive power than the labor utilization variable, and well over twice the predictive power of any other variable Only one statistically significant variable did not influence costs in the direction expected from Table 3 The *SNOW* variable actually shows a downward influence on costs This finding reflects the generally higher density urban forms found in many older Northeastern cities of the U S , which supports the notion that compact urban areas are operationally more conducive to public transit than the more dispersed metropolitan areas of the American Southwest

Table 4: Results of Linear Multiple Regression Model, 1993

Model Variable	Measure	Coefficient	Standard Error	Beta
Dependent				
CSTHR93	Cost Efficiency			
Independent				
HRRATIO***	Vehicle Scheduling	95.401	13 411	0 500
OPHR93***	Labor Utilization	27.459	8 102	0 281
COL94**	Cost-of-Living	0 308	0 107	0 219
PKVEH93*	Agency Size	0 011	0 005	0 215
SEATSTO**	Vehicle Size	0 543	0.197	0.205
SNOW**	Snowfall	-0 137	0 047	-0 204
SPD93*	Speed	-1 235	0.581	-0 191
UNION90**	Unionization	47.612	18.571	0 187
DENSE93	Population Density	-0 001	0.001	-0 106
PREC	Precipitation	0.118	0.092	0.085
POP93	Population	0 000	0.000	-0 059
AREA93	Service Area	0 001	0.003	0.055
PKBASE	Peaking	-0.346	2.158	-0 013
PCH93	Contracting	-0 052	3 760	-0 001
CONSTANT***		-127.888	20.068	

R-Squared	0.88
Adjusted R-Squared	0 84
Standard Error	6 95
F-Statistic	24 15

* - p<0 05 ** - p<0 01 *** - p<0 001

The vehicle scheduling variable is also referred to as a *deadheading* variable and measures scheduling efficiency In general, agencies with high ratios are those that provide transit to a dispersed area. Buses must accrue deadhead miles to reach starting points for runs or to return to the garage after runs have been completed. Some buses may be *interlined*, that is they continue operating as another route after the express run has been completed The number of routes that can be interlined, however, may be small due to scheduling or labor agreement constraints. For example, many labor agreements limit driver runs to one route or place minima on the number of *straight runs* that an agency must provide for drivers (Fielding, 1987)[5] Fielding also notes that during the 1970s and 1980s advances in service supply analysis did not keep pace with advances in demand forecasting Coupled with the increase in suburban express services over the past few decades, there is reason to suspect that deadheading is not being adequately addressed as an element of transit operating costs

In addition to driving deadheading vehicles, drivers may receive an allowance for traveling between the base facility and the beginning of the run, which is also an unproductive use of driver time Thus, serving dispersed areas also results in reduced labor productivity captured in the labor utilization variable As with the vehicle scheduling variable, this variable also reflects advantageous work rules negotiated by unions on behalf of drivers This is further supported by the statistically significant unionization variable which represents generalized unionization rates in the metropolitan area served by the transit operator It should be noted that the labor utilization variable has a higher Pearson's correlation with operating costs among agencies that perform no contracting (X^2=-0 74, p=.000) than it does in agencies that contract a portion of their routes (X^2=-0 28, p= 181). This might reflect contracting's effect on

[5] A *straight run* is one in which the driver works a full eight hour day with paid lunch break and no midday layoff

improving overall operator efficiency in these agencies Evidence from San Diego, Denver, and the Tidewater Transit District in Virginia suggest that the public operators have become more competitive with the initiation of contracting in those areas (McCullough, 1996d; Hurwitz, 1995, Talley, 1991) [6]

One way to provide a rough estimate of the impacts of changes for these two variables is to develop "elasticities" for them That is, for a 10 percent reduction in a variable what would be the percent reduction in operating expense per revenue hour? For this model, reducing deadheading (HRRATIO) by 10 percent would lead to a 19 percent reduction in unit operating costs, while a 10 percent improvement in driver scheduling efficiency (*OPHR93*) produces a cost reduction of around 6 percent

This analysis concludes that cost efficient transit operations can be found in public agencies and are not the sole domain of the private sector The trend analysis even suggests that public operators that do no contracting may be more cost efficient in the aggregate than those contracting for all their services. Contracting for transit services does not appear to be the panacea that is often suggested by advocates On the other hand, the analysis reveals that vehicle

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[6] To become more cost competitive with private operators, the Denver and San Diego public agencies created a new classification of "community-based" drivers These drivers are paid significantly lower wages and receive fewer benefits than full-time public operators All new drivers to the agency must rise through the ranks of the "community-based" drivers, a term having little to do with any community-based operation The concept originated in San Diego where these drivers were only allowed to provide service within a particular city In Denver "community-based" drivers also originally operated the Boulder shuttle routes In both regions, however, the role of the "community-based" driver has been expanded to win back routes lost to low-cost private providers (McCullough, 1996c, 1996d)

scheduling and inefficient use of labor contribute greatly to higher costs This implies that other solutions to high operating costs may be more effective than contracting. The next chapter explores two options which may prove effective at improving operating efficiencies -- decentralization and altering the craft structure of public transit

Chapter 5

DEVELOPING A NEW APPROACH TO PUBLIC TRANSIT

For the 142 operators examined in this study, there is no evidence that contracting for general fixed-route transit services is inherently more cost efficient than providing the same services by the public sector Operators doing no contracting over the period may be less costly than agencies contracting all transit services Agencies contracting some services either to reduce costs or expand services have managed to lower unit operating costs between 1989 and 1991 However, since 1991 these agencies showed aggregate cost increases which exceeded the increases for the other two groups of operators This finding supports an argument that cost reductions due to contracting are short-term and do not hold over time.

The principal factor contributing to high unit operating costs is scheduling inefficiency. Deadheading has almost twice the predictive power with respect to costs than the next highest variable tested in this analysis The estimated elasticity for this variable shows that a 10 percent reduction in deadheading may reduce costs by around 19 percent Labor utilization inefficiencies also contribute to high operating expenses The elasticity for the labor utilization variable demonstrates that a 10 percent reduction in driver pay hours relative to total vehicle hours may result in a 6 percent decline in operating expenses per revenue hour

Excessive deadheading arises in three ways Providing services to outlying communities or in a dispersed, low density region can tax the ability of an agency to efficiently schedule runs from a fixed number of bus garages Long distance commuter services are generally uni-directional and concentrated during peak commute periods Buses running these routes can park in a downtown area until the afternoon peak, make a return trip to the beginning of the run with no or few passengers, or interline as another route The more dispersed the service area, the greater difficulty an agency will have in efficiently scheduling vehicles for both local and suburban services

The second cause of deadheading comes through poor scheduling of vehicles Transit scheduling or *runcutting* is both an art and a science Highly skilled schedulers are perhaps some of the most important members of any agency, and this thesis suggests that perhaps not enough attention is paid to these individuals Finally, restrictive labor agreements may limit or prohibit interlining of routes Bus drivers prefer straight runs along the same route, and some labor agreements may reflect this preference (Fielding, 1987, Chomitz, Giuliano *et. al*, 1985) Furthermore, labor contracts may require that part-time drivers be used only on garage to garage runs which effectively limits interlining (Chomitz, Giuliano *et al*. 1985).

To improve cost efficiencies, transit operators can adopt a number of strategies. Agencies should reconsider commitments to serving low density suburban areas with fixed-route services The common solution to the high costs associated with this type of service has been to contract these routes Unfortunately, this study suggests that in the long-term this strategy may not prove viable.

This study did not examine fare policy or subsidy issues, but other evidence suggests that politically popular, yet poorly utilized suburban services are cross-subsidized by highly productive inner-city routes generally serving poorer, more transit dependent customers In examining the Los Angeles Metropolitan Transportation Authority policies, Luhrsen and Taylor (1996) found that more affluent suburban riders were subsidized at much higher rates than low income riders in more centralized urban neighborhoods

Other examinations of subsidy policies in the U S found that smaller, generally less service productive urban areas receive nearly 4 times the federal operating subsidy of large transit rich cities (Taylor, McCullough *et al.*, 1996) Furthermore, suburban operators in California may receive up to five times the state subsidy per passenger as larger systems serving high service productive markets (Taylor, 1993) Finally, Gómez-Ibáñez (1996) has explored deficits in Boston's MBTA, which grew from $21 million in 1965 to $575 million by 1991 He questions policies attempting to increase ridership by expanding suburban services Instead of adopting a policy of service expansion, Gómez-Ibáñez suggests that MBTA should use other policies such as congestion pricing for automobiles to manage travel demand into the congested urban core. He believes that transit would be more effectively utilized by serving the traditional transit markets in the city center

Policies which could improve MBTA's financial situation like pricing automobiles commuting into the downtown core, implementing more equitable fares, and reducing unit operating costs are the most politically unpopular strategies even though they would have positive or only slightly negative impacts on transit ridership (Gómez-Ibáñez, 1996) Other transit systems grapple with these political influences in adopting strategies for service provision. As discussed earlier, Portland's Tri-Met countered opposition to its rail construction program by diversifying its bus operations to serve suburban centers not receiving rail lines (Adler and Edner, 1990) Along with service expansions, Tri-Met reduced suburban commuter fares to prop up declining ridership, much as MBTA had done

An Argument for Decentralization

A strategy that transit authorities might utilize to alleviate political objectives, yet improve cost efficiency, is decentralization. A policy of decentralization might involve the creation of "transit zones" which correspond to geographic or geo-political regions of the service area. Each zone would be directed by its own local board of elected or appointed officials and would be responsible for the operation of local transit services Funding for transit zones would be administered by the regional authority and could be based on service efficiency and effectiveness criteria established by the authority to meet regional goals and objectives

Transit zones are worth consideration for several reasons. There is a body of evidence that discusses the impacts of private competition on operating efficiencies (Gómez-Ibáñez and Meyer, 1993, Berechman, 1993, Teal, 1988, Morlok and Viton, 1985) However, little research has been conducted on the influence of competition for funds within the public sector Public operators within city governments have to compete for general funds with other departments of the city which leads to cost conscious attitudes for transit managers (McCullough, 1996a, 1996c)

In California, state Transit Development Act (TDA) funding has facilitated the growth of suburban operators creating cost awareness (not to mention outright fiscal crisis) in large urban operators (Taylor, 1993). The return-to-source funding allocation methodology is not performance based leading to severe inequities in funding levels Basing funding on performance criteria for service effectiveness, cost efficiency, and cost effectiveness would make the smaller semi-autonomous transit zones act competitively

Greater community involvement in the decision making process might also allow for more innovative service provision better suited for that operating area Low density suburban communities might rely more heavily on demand responsive services, vanpools, or deregulated taxis Decentralization may also create smaller, better managed work units with more flexible work rules than those of larger transit agencies

There is evidence to support a claim that smaller operators are more cost efficient than larger operators, although the conclusions vary from study to study. Some argue that economies-of-scope can be found in agencies operating more than one transit mode [7] Many researchers also claim that economies-of-scale may be sacrificed for one mode to the benefit of the system as a whole.

Viton (1993) looked at opportunities for consolidation in the San Francisco Bay Area and found that a few combinations would result in cost savings for the region Using the National Transit Database, Viton compared potential mergers in the region to other U S multi-service agencies of similar size and modal composition He found few viable mergers, but concluded that mergers between the Bay Area Rapid Transit District, the high speed regional rail system, and some of the smaller bus operators (e.g , Golden Gate Transit. Santa Rosa Transit) might prove feasible He cautioned, however, that average wage rates might increase as the lower wage agency adopts the wage rates of the higher wage agency

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[7] Economies-of-scope are achieved by a transit agency when that agency is able to reduce systemwide unit costs by utilizing a range of transit modes For example, operating both paratransit and fixed-route services may reduce the total unit cost of providing equivalent services by only one of the modes

In another study, Colburn and Talley (1992) found little evidence of economies-of-scope in the Tidewater Transportation District Commission (TTDC) for all possible modal compositions They did conclude that TTDC could possibly achieve some returns to scope by providing regular transit along with elderly and disabled service and vanpools They advised that TTDC contract for dial-a-ride service which is a common practice in multi-service transit firms

The results of these two studies imply that limitations exist as to the number of modes that can be utilized to achieve scope economies, though these two works also do not shed enough light on the subject to draw any conclusions. Merging two distinct entities radically disrupts organizational structures and some agencies that have merged operations or functions have yet to shed duplicative departments For example, Houston Metro, formed in 1979, has two distinct departments performing capital projects planning and design (Booz•Allen & Hamilton, 1992) Moreover, adding a transit mode to an agency not familiar with the technology may incur costs until the agency has adapted its organization to the technology Rail, fixed-route bus, and demand response services each require different management approaches and operational skills

Besides the inconclusive research on scope economies, research on economies-of-scale in transit also varies Studies done in Great Britain and India show constant or declining returns to scale for public transit (Hibbs, 1975. Lee and Steedman, 1970) Other studies of inter-city bus operations also show mixed returns (Favel, Tauchen, *et. al.*, 1980) Berechman (1993) reviewed several agency size studies concluding that results are mixed and largely depend on the methods and data used for the analysis He did add, however, that very large agencies (exceeding 500 peak vehicles) tend to operate at decreasing returns to scale while smaller agencies tend toward increasing or constant returns

The findings of this thesis support the body of evidence that increasing agency size is associated with increasing unit costs In looking at Philadelphia area operators, Morlok and Viton (1985) showed that driver pay rates, a major cost component for any agency, tend to be a function of agency size In studying several public agencies, Viton (1981) also discovered scale economies in medium sized and small agencies Agencies operating fewer than one million revenue miles showed declining unit costs with increasing service output. Agencies operating between one and five million revenue miles maintained stable unit costs, and larger agencies exhibited higher costs per unit of output. Fielding (1987) developed a typology of motorbus operations and used it to show returns to scale for agencies operating fewer than 250 peak vehicles In Great Britain, Wabe and Coles (1975) also demonstrated declining returns to scale for larger agencies

Given this evidence, how have decentralization policies performed in practice and what are the prospects for future implementation? There are few examples of transit zones in the U.S , but the history of the Foothill Transit Zone in Southern California is instructive In 1986 the Los Angeles County

Transportation Commission established guidelines so that local jurisdictions could control transit services operating within their boundaries If the jurisdiction could meet one of four cost savings criteria by contracting for transit services, then that jurisdiction could act as an operator (Nelson\Nygaard, 1994, Richmond, 1992) In 1988, 20 San Gabriel Valley cities and some unincorporated parts of Los Angeles County formed Foothill Transit and took over 19 lines operated by the Southern California Rapid Transit District (SCRTD) Foothill Transit was immediately successful in reducing operating subsidies for the former SCRTD routes by between 24 and 34 percent Ridership also increased by 30 percent from 6 8 million annual boardings to over 9 7 million (Richmond, 1992, Nelson\Nygaard, 1996). In contrast, the SCRTD has lost over 22 million annual riders, or 5 4 percent of its ridership since 1989 (Taylor, McCullough, *et al.*, 1996)

Foothill Transit is privately managed and all services are contracted suggesting that privatization has proven successful Yet when Foothill Transit is compared with the similarly sized, publicly operated Santa Monica Municipal Bus Lines also operating in the Los Angeles basin, the superiority of contracting *per se* remains unclear In 1994, Santa Monica Transit recovered 5 percent more of its operating expenses from directly generated revenues than did Foothill Transit Santa Monica's subsidy per passenger mile was also 3 percent less than Foothill's (U S Department of Transportation, 1995). Nonetheless, Foothill Transit has proven remarkably successful when compared to the previously operated SCRTD routes This new operator in Los Angeles County has also increased competition for funding between the operators in the basin, and this may foster more cost efficient services throughout the region, although this has not been proven

The Benefits of Eliminating an Outdated Craft Structure

Implementing a transit zone concept will be difficult given labor related constraints. Adler and Edner (1990, p 110) write

> Spatial competition produces tendencies to disaggregation, which are reinforced by the differing technical/design requirements of downtown- and suburban-oriented transit Disaggregation will exacerbate the already intense pressures bearing on organized transit labor The wage gains, protections, and work rules secured by labor during the transition from a private to a governmental industry and advanced when subsidies were plentiful constitute barriers to implementing the new elements

Labor has restricted contracting in many agencies and is often blamed for impeding even modest measures to improve transit performance (Love and Seal, 1991, Adler and Edner, 1990, Chomitz, Giuliano *et al.*, 1985, Rottenberg, 1985) To combat the problem of declining worker productivity, agencies have resorted to contracting, which has not fulfilled its promise because labor unions are too powerful. Of 118 agencies providing contracted fixed-route bus service in 1993 that reported according to Section 15, very few have been able to contract for more than 30 percent of their routes (Figure 5).[8] When this threshold of thirty

[8] The New York City Department of Transportation and New Jersey Transit are the only two operators reporting in accordance with Section 15 whose contracts are not represented on this

percent is reached, agencies are likely to contract for all of their service The Goldstein and Luger survey (1990) also indicates that 29 percent of the respondents doing no contracting cited union stipulations Although strikes in transit occur less frequently than in other industries, workers are increasingly willing to walk off the job to prevent large scale contracting In Los Angeles, a recently negotiated contract resulting from a nine day walkout prohibits the Los Angeles County Metropolitan Transportation Authority from laying off any employees as a result of contracting (Cimini and Muhl, 1994) This union action was influenced by the success of the Foothill Transit Zone

There is little evidence that private operators can remain profitable in large scale transit operations In England where national deregulation completely privatized all public transit outside of London, private companies have shown profits of around only 2 percent per year There also has been little investment in capital equipment by these operators (Pucher and Lefèvre, 1996) Furthermore, the principal cause of labor inefficiency is the spatially and temporally peaked nature of transit which conflicts with a system of outdated work rules Peaking has been estimated to cost transit agencies from 2 to 5 times more than a constant level of service throughout the day (Black, 1995, Morlok and Viton, 1985, Oram, 1980)

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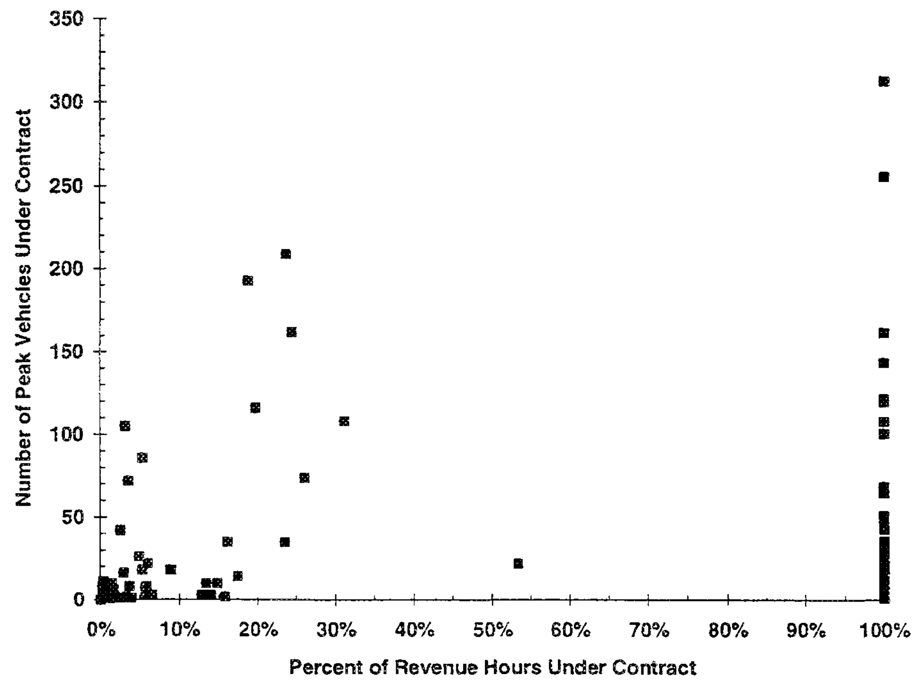
figure New York contracts for over 900 peak vehicles while New Jersey Transit contracts for over 1,000 Most of these operators are regulated franchise operators.

Figure 5: The State of Contracting, 1993



The reason for this phenomenon is that weekday travel is concentrated into two peak periods commonly known as the *rush hours* and weekend transit trips are greatly diminished To meet this peak demand, the transit agency must buy vehicles and hire personnel to drive them Because travel demand does not remain steady throughout the day or week, much of the equipment required to meet peak demand is idle during midday and on weekends. When transit was the predominant travel mode around the turn of the century this was not the case Demand remained relatively flat throughout the week as morning commuters were replaced by midday shoppers and evening pleasure seekers.

Weekends were spent shopping downtown along with visits to parks, zoos, and other entertainment spots

Conflicts with labor pre-date modern transit systems The earliest horsedrawn omnibuses were manned by poorly paid immigrant workers who labored for 14 to 16 hours per day under abusive conditions By the era of the streetcar, transit companies suffered low morale and had trouble keeping quality employees By 1910, the street railway industry was one of the most unionized in the U S. Unions negotiated work rules to protect workers from exploitation and from working the excessive days common in the industry at the time (Jones, 1985)

These long established work rules were reasonable in an era of low wages, exploited labor and steady demand However, these rules are ill-suited to today's transit reality For example, work rules place limitations on the number of part-time drivers an agency can hire to work exclusively in the peak periods These work rules may also place a premium price on full-time drivers who must work "split" shifts (Fielding, 1987, Chomitz, Giuliano *et al*, 1985) A driver reporting for work at 6:00 a.m working the morning peak for 3 hours and returning in the afternoon to work 4 hours during the evening rush hours until 6 00 p m receives not only full-time pay for only seven hours of work, but may also receive a premium for the two hours of work exceeding a "spread" of ten hours

On the other hand drivers, who make up the majority of transit employees, work irregular hours and many have to report to work before 4:00 a.m. in order to begin their morning peak runs The workday can be quite long, often spread over a ten to twelve hour period. Furthermore, the transit work environment is highly controlled, punctuality is strictly enforced, and the driving routine seldom varies (Fielding, 1987)

Although it requires relatively little training and is repetitive in nature, driving a transit bus is stressful The driver is the point of contact between the public and the agency who must deal with irate passengers, graffiti taggers, and transients on a daily basis. He also deals with traffic congestion, noxious exhausts and sometimes must work nights in dangerous neighborhoods Transit drivers have some of the highest rates of absenteeism of any industry and experience higher rates of cardiovascular disease, hypertension, gastrointestinal, and musculoskeletal problems than other workers with similar skills (Carrère *et al*, 1991) Thus, it is not the point of this thesis to defend actions to greatly reduce compensation for performing this important task

Nonetheless, despite the tough conditions that drivers face, work rules have had deleterious impacts during the era of transferring transit properties from private to public ownership during the 1960s and 1970s Federal, state, and local subsidies applied to public transit systems were absorbed by wages rather than being used to improve transit service (Pucher, Markstedt, *et. al*, 1983). Schwarz-Miller and Talley (1995) found that during the 1980s public unionized drivers were "consistently paid a significant wage premium" over both non-union drivers and unionized private sector drivers. They did find a decline in wage rates for 1990, but have not investigated differences during this decade Coupled with the findings of this study, there may be reason to believe that the dip in wages in 1990 observed by Schwarz-Miller and Talley may have been only temporary This research does not investigate the wage issue, but since labor expenditures are the predominant factor in transit costs - comprising up to 75 percent of all operating costs - the linkage may exist

Such wage differentials can occur because transit workers are for the most part represented by a few large national organizations· the Amalgamated Transit Union, the Transport Workers Union, and the Teamsters These unions have highly specialized bargaining units that can bring resources to bear on agencies with fewer resources and skills in collective bargaining The general trend in transit has been for pattern bargaining for standardized wage rates This is a union strategy designed to take labor out of competition with itself (Freeman and Medoff, 1984) Thus, national wage rates for unionized transit workers tend to be similar regardless of the cost-of-living differences between regions For example, driver wage rates at San Francisco's Muni are set by its labor agreement to be the average wages paid by the top two highest wage transit systems in the country (Taylor, McCullough, *et al.*, 1996).

Many critics of labor practices also cite the effects of Section 13(c) of the Urban Mass Transportation Act of 1964 as being a major contributor to high transit costs (Chapin, 1994, Love and Seal, 1991; Rottenberg, 1985) Section 13(c) is a labor protection clause mandating that no recipient of federal monies can "worsen the position' of transit employees. Its detractors claim that labor unions have used Section 13(c) to delay or prevent funding of vital transit projects, in particular those projects which might improve labor efficiencies There is, however. little quantitative evidence to confirm this Of over 800 cases filed with the Department of Transportation between 1964 and 1975, only three grant applications have ever been denied There have even been a few cases where the union's opposition was over-ruled (Barnum, 1977 cited in Black, 1995). However, Section 13(c)'s detractors assert that the clause allows unions a *de facto* veto power over management decisions They claim that the union does not necessarily have to file a grievance, but the mere threat of one can delay projects and even financially cripple the agency (Love and Seal, 1991, Fielding, 1987)

Management and labor must realize that a new era of cooperation and flexibility are needed in the public transit industry Labor in particular needs to have a greater stake in the success of the organization and more incentives to improve productivity The current craft structure of the transit industry is inconsistent with work structures in other industries and current ideas about work Recently, the Commission on the Future of Worker and Management Relations (1994) (Dunlop Commission) completed its report calling for the modernization of national labor and employment policies The Dunlop commission calls for more employee participation in workplace decision-making and more flexibility by unions in dispute resolution and collective bargaining This report could serve as a starting point for improvements in transit productivity and job protections

Coupled with a policy of decentralization, the transit industry might follow the lead of General Motors and the United Auto Workers Before opening the Saturn Corporation, both sides negotiated a new labor agreement for that plant which was voted on by the workforce after the factory opened (Kochan, 1995) The arrangement was unique in that it allowed a firm with an existing bargaining agreement to open a new facility and implement a new set of work-rules that reflect the contemporary workplace Workers were given more say in their jobs and participated in cooperative committees to resolve workplace disputes

Jones (1985) claims that the craft structure of the transit industry is archaic and should be restructured. He argues that the hallmark of the public transit industry is its limited skill levels for drivers and little room for upward mobility The resulting compressed wage scale does not allow for merit promotions and requires that worker standards-of-living be raised primarily through increases in the base wage He proposes a system in which workers improve themselves through promotions to positions of increasing skill and responsibility For example, entry level drivers might begin their careers on micro- or mini-buses or as part-time employees With increasing skills and time on the job they might be promoted to larger vehicles working more difficult routes. The next level would involve training as a mechanic These workers would spend the midday period performing minor repairs and maintaining vehicles The final step up the career ladder would be to move into the ranks of the higher paid mechanics (Jones, 1985)

Conclusions

The issue of transit contracting is highly charged Strong advocates have painted a picture of dramatic improvements in efficiency and effectiveness through contracting Opponents portray contracting as a union busting strategy designed to circumvent the social contract with labor Both sides do not consider the total reality surrounding transit service in the U S Evidence from this research suggests that contracting for transit services may not be the most effective way to reduce operating cost inefficiencies The most promising policies to reduce inefficiencies appear to be those that deal directly with the issue of deadheading Minor reductions in deadheading can produce dramatic declines in the cost of providing an hour of service This study also found continued inefficiencies in labor productivity Thus, no side appears to have a complete understanding of the realities of public transit service in the United States -- the peaked nature of transit and attempts to serve ever more dispersed populations using traditional modes New approaches to transit provision need to be examined Principal among these are strategies to promote decentralized operations and to develop a new structure for transit labor Although such a major overhaul of the transit industry would be extremely difficult to implement, this analysis shows that relatively small improvements in scheduling and labor productivity could result in dramatic improvements in cost efficiencies

Areas for Future Research

This study has proposed solutions for improving public transit in the U S Unfortunately, this study was unable to provide a complete picture of contracting in the U S One of the key weaknesses of this research is that it may be too aggregate in its approach. The operators presented in the analysis offer a rich portfolio of approaches to contracting For some operators, contracting has improved cost efficiencies dramatically while for others contracting costs are approaching those of directly operated services Moreover, this study assumes a certain degree of homogeneity among unionized operators More research into the impacts of unions on transit operations needs to be conducted

This thesis also does not examine the important issue of public subsidy in public transit The available data do not readily allow for a complete investigation of subsidies for particular modes Many researchers have found evidence of a negative influence on subsidies in public transit

Finally, few studies examine the role of capital subsidies for public transit. This is probably one of the most neglected areas of research since capital expenditures can dwarf operating subsidies by 2 to 5 times The full impacts of any privatization policy cannot be known unless the effects of capital expenses are investigated.

APPENDICES

Appendix A: List of Operators in the Dataset

FTA ID Code	Operator Name	City	St	Grp	Peak Vehicles 1993	Percent Contracted 1993	TOEXHR93
9129	City of Mesa Dial-A-Ride	Mesa	AZ	ALL	9	1 000	$37 93
9131	Scottsdale Transit Dept	Scottsdale	AZ	ALL	2	1 000	$29 90
9136	Phoenix RTA	Phoenix	AZ	ALL	17	1 000	$26 12
9003	San Francisco-BART	Oakland	CA	ALL	35	1 000	$52 31
9028	Vallejo Transit	City Vallejo	CA	ALL	36	1 000	$44 21
9077	Los Angeles Cnty Trans Co	Los Angeles	CA	ALL	33	1 000	$49 20
9088	Napa City Bus	Napa	CA	ALL	13	1 000	$47 57
9089	Sonoma County Transit	Santa Rosa	CA	ALL	34	1 000	$55 11
9090	Woodland-Yolobus	Woodland	CA	ALL	13	1 000	$59 19
9093	Redding Area Bus Auth	Redding	CA	ALL	9	1 000	$40 72
9095	San Diego Region TS	San Diego	CA	ALL	120	1 000	$36 55
9121	Antelope Valley TS	Lancaster	CA	ALL	29	1 000	$54 81
9127	City of Chico TS	Chico	CA	ALL	12	1 000	$31 65
1063	Middletown TD	Middletown	CT	ALL	7	1 000	$47 06
3047	Dover-Delaware TA	Wilmington	DE	ALL	10	1 000	
5102	Hammond Transit System	Hammond	IN	ALL	9	1 000	$45 92
7035	Johnson County Trans	Olathe	KS	ALL	18	1 000	$59 50
1007	Berkshire Regional TA	Pittsfield	MA	ALL	14	1 000	$48 86
1008	Pioneer Valley TA	Springfield	MA	ALL	144	1 000	$40 78
1061	Montachusett Reg TA	Fitchburg	MA	ALL	17	1 000	$44 26
5092	City of Rochester	Rochester	MN	ALL	18	1 000	$34 16
1086	Durham-COAST	Durham	NH	ALL	10	1 000	$50 56
1087	Nashua Transit System	Nashua	NH	ALL	4	1 000	$40 24
2072	Hauppage-Suffolk Transit	Yaphank	NY	ALL	122	1 000	$47 67
2084	Pomona-Transp of Rockland	Pomona	NY	ALL	30	1 000	$92 34
2096	Putnam Area Rapid Transit	Carmel	NY	ALL	12	1 000	$38 92
5090	Richland Cnty Transit Brd	Mansfield	OH	ALL	8	1 000	$40 99
3023	Beaver County-BCTA	Rochester	PA	ALL	13	1 000	$49 73
3044	Westmore County TA	Greensburg	PA	ALL	12	1 000	$56 32
5094	Waukesha Cnty TD	Waukesha	WI	ALL	30	1 000	$81 07
6034	Pine Bluff Transit	Pine Bluff	AR	NONE	8	0 000	$34 46
9033	City of Tucson Mass Transit System	Tucson	AZ	NONE	157	0 000	$43 16
9008	Santa Monica Municipal Bus Lines	Santa Monica	CA	NONE	106	0 000	$52 36
9021	Los Angeles County Metropolitan	Los Angeles	CA	NONE	1912	0 000	$88 16

FTA ID Code	Operator Name	City	St	Grp	Peak Vehicles 1993	Percent Contracted 1993	TOEXHR93
9022	Norwalk Transit System	Norwalk	CA	NONE	15	0 000	$71 27
9035	South Coast Area Transit	Oxnard	CA	NONE	29	0 000	$51 22
9039	Culver City Municipal Bus Lines	Culver City	CA	NONE	24	0 000	$60 06
9041	Montebello Bus Lines	Montebello	CA	NONE	36	0 000	$62 77
9043	City of Commerce	Commerce	CA	NONE	6	0 000	$60 48
9050	Simi Valley Transit	Simi Valley	CA	NONE	6	0 000	$56 51
9062	Monterey-Salinas Transit	Monterey	CA	NONE	48	0 000	$55 64
9119	Laguna Beach Municipal	Laguna Beach	CA	NONE	3	0 000	$63 00
8010	City of Greeley-The Bus	Greeley	CO	NONE	10	0 000	$34 61
3030	Washington Metropolitan Area	Washington	DC	NONE	1339	0 000	$87 49
3031	Delaware Administration for	Wilmington	DE	NONE	96	0 000	$64 82
4030	Gainesville Regional Transit System	Gainesville	FL	NONE	30	0 000	$46 29
4050	Smyrna Transit System	New Smyrna Beach	FL	NONE	2	0 000	$49 70
4024	Columbus Transit System	Columbus	GA	NONE	19	0 000	$37 02
4047	Athens Transit System	Athens	GA	NONE	16	0.000	$29.68
7019	University of Iowa - CAMBUS	Iowa City	IA	NONE	14	0 000	$ 20 11
0011	Boise Urban Stages	Boise	ID	NONE	23	0 000	$45 64
0022	City of Pocatello,	Pocatello	ID	NONE	8	0 000	$25 89
5047	Bloomington-Normal Public Transit	Bloomington	IL	NONE	14	0 000	$35 42
5060	Champaign-Urbana Mass Transit	Urbana	IL	NONE	60	0 000	$44 53
5065	Pekin Municipal Bus Service	Pekin	IL	NONE	2	0 000	$42 56
5041	City of Anderson Transportation	Anderson	IN	NONE	6	0 000	$41 64
5044	Fort Wayne Public Transportation	Fort Wayne	IN	NONE	20	0 000	$65 70
5051	Greater Lafayette Public	Lafayette	IN	NONE	34	0 000	$36 43
5054	Muncie Indiana Transit System	Muncie	IN	NONE	18	0 000	$45 08
6023	Lake Charles Transit System	Lake Charles	LA	NONE	6	0 000	$50 33
6025	City of Alexandria	Alexandria	LA	NONE	10	0 000	$35 28
6026	City of Monroe Transit System	Monroe	LA	NONE	16	0 000	$40 03

FTA ID Code	Operator Name	City	St	Grp	Peak Vehicles 1993	Percent Contracted 1993	TOEXHR93
1006	Southeastern Regional Transit	New Bedford	MA	NONE	70	0 000	$47 56
3040	Annapolis Department of Public	Annapolis	MD	NONE	12	0 000	$45 98
3041	Allegany County Transit Authority	Cumberland	MD	NONE	7	0 000	$33 85
3042	Washington County Transportation	Hagerstown	MD	NONE	10	0 000	$35 54
3043	The Columbia Transit System	Columbia	MD	NONE	6	0 000	$51 54
1016	Greater Portland Transit District	Portland	ME	NONE	17	0 000	$ 51 15
1096	City of Bangor, The Bus	Bangor	ME	NONE	10	0 000	$26 50
5029	Bay Metropolitan Transportation	Bay City	MI	NONE	25	0 000	$40 98
5030	Battle Creek Transit	Battle Creek	MI	NONE	16	0 000	$44 33
5034	City of Jackson Transportation	Jackson	MI	NONE	8	0 000	$49 41
5039	Saginaw Transit System	Saginaw	MI	NONE	35	0 000	$46 27
5119	City of Detroit Department of	Detroit	MI	NONE	412	0 000	$73 05
7003	City Utilities of Springfield	Springfield	MO	NONE	19	0 000	$47 47
7016	Columbia Area Transit System	Columbia	MO	NONE	10	0 000	$61 99
4014	Mississippi Coast Transportation	Gulfport	MS	NONE	18	0 000	$19 26
8009	Missoula Urban Transportation Distr	Missoula	MT	NONE	15	0 000	$41 36
4006	Wilmington Transit Authority	Wilmington	NC	NONE	9	0 000	$37 10
4009	Fayetteville Area System of Transit	Fayetteville	NC	NONE	12	0 000	$48 83
4010	Gastonia Transit	Gastonia	NC	NONE	5	0 000	$37 45
6049	Las Cruces Area Transit - Roadrunner	Las Cruces	NM	NONE	8	0 000	$36 27
2004	Niagara Frontier Transit Metro	Buffalo	NY	NONE	307	0 000	$62 07
2007	Metropolitan Suburban Bus Authority	Garden City	NY	NONE	265	0 000	$93 84
2009	City of Poughkeepsie	Poughkeepsie	NY	NONE	7	0 000	$36 86
2010	Dutchess County Division of Mass	Poughkeepsie	NY	NONE	21	0 000	$57 97
2015	City of Rome, VIP Transportation	Rome	NY	NONE	7	0 000	$42 97
2021	Utica Transit Authority	Utica	NY	NONE	32	0 000	$36 81

FTA ID Code	Operator Name	City	St	Grp	Peak Vehicles 1993	Percent Contracted 1993	TOEXHR93
2071	Huntington Area Rapid Transit	Huntington	NY	NONE	10	0 000	$80 58
2085	Clarkstown Mini-Trans	Nanuet	NY	NONE	5	0 000	$47 78
2089	Village of Spring Valley Bus	Spring Valley	NY	NONE		0 000	$42 27
2113	Regional Transit Service, Inc &	Rochester	NY	NONE	178	0 000	$64 87
5011	Canton Regional Transit Authority	Canton	OH	NONE	29	0 000	$46 10
5019	City of Middletown-Middletown	Middletown	OH	NONE	4	0 000	$38 28
5024	Western Reserve Transit Authority	Youngstown	OH	NONE	28	0 000	$46 67
5093	Allen County Regional Transit	Lima	OH	NONE	7	0 000	$25 27
5097	Campus Bus Service	Kent	OH	NONE	21	0 000	$52 73
5142	Steel Valley Transit Corporation	Steubenville	OH	NONE	4	0 000	$43 23
0025	Salem Area Mass Transit District	Salem	OR	NONE	44	0 000	$49 29
4053	Greenville Transit Authority	Greenville	SC	NONE	18	0 000	$37 36
4056	Pee Dee Regional Transportation	Florence	SC	NONE	4	0 000	$18.24
4002	Knoxville Transit	Knoxville	TN	NONE	51	0 000	$36 45
4054	Johnson City Transit System	Johnson City	TN	NONE	6	0 000	$33 33
4057	Jackson Transit Authority	Jackson	TN	NONE	9	0 000	$33 00
6001	Amarillo Transit System	Amarillo	TX	NONE	13	0 000	$34 06
6009	Laredo Municipal Transit System	Laredo	TX	NONE	26	0 000	$36 93
6010	City Transit Management Company Inc	Lubbock	TX	NONE	31	0 000	$29 02
6012	Waco Transit System Inc	Waco	TX	NONE	10	0 000	$36 51
6016	Beaumont Transit System	Beaumont	TX	NONE	12	0 000	$40 73
6035	Wichita Falls Transit System	Wichita Falls	TX	NONE	9	0 000	$29 77
6040	Abilene Transit System	Abilene	TX	NONE	10	0 000	$28 10
3008	Greater Lynchburg Transit Company	Lynchburg	VA	NONE	21	0 000	$36 10
0005	Everett Transit	Everett	WA	NONE	35	0 000	$70 99
5008	Milwaukee County Transit System	Milwaukee	WI	NONE	460	0 000	$54 89

FTA ID Code	Operator Name	City	St	Grp	Peak Vehicles 1993	Percent Contracted 1993	TOEXHR93
3001	Kanawha Valley Regional	Charleston	WV	NONE	43	0 000	$42 34
3003	Mid-Ohio Valley Transit Authority	Parkersburg	WV	NONE	7	0 000	$35 08
3035	Ohio Valley Regional Transportation	Wheeling	WV	NONE	16	0 000	$25 75
9014	Alameda-Contra Costa TD	Oakland	CA	SOME	614	0 005	$69 96
9016	San Fran-Golden Gate TD	San Francisco	CA	SOME	247	0 029	$ 91 91
9031	Riverside Transit Agency	Riverside	CA	SOME	60	0 133	$58 76
9036	Orange County TD	Orange	CA	SOME	410	0 025	$ 71 17
8006	Denver-RTD	Denver	CO	SOME	663	0 244	$78 63
5113	Chicago-Suburban Bus Div	Arlington Heights	IL	SOME	584	0 187	$68 26
4018	Louisville-TA River City	Louisville	KY	SOME	248	0 017	$57 03
1003	Boston-MBTA	Boston	MA	SOME	841	0 054	$80 55
1014	Worcester RTA	Worcester	MA	SOME	42	0 017	$55 37
3034	Baltimore-MTA	Baltimore	MD	SOME	722	0.035	$72 61
3051	Rockville-Ride-On	Rockville	MD	SOME	204	0 161	$73 62
5031	Detroit-SEMTA	Detroit	MI	SOME	233	0 235	$74 96
5035	Kalamazoo Metro TS	Kalamazoo	MI	SOME	28	0 065	$57 07
5027	Minneapolis MTC	Minneapolis	MN	SOME	855	0 003	$73 74
7005	Kansas City Area TA	Kansas City	MO	SOME	208	0 004	$68 15
4008	Charlotte TS	Charlotte	NC	SOME	135	0 004	$51 86
6017	Central Oklahoma PTA	Oklahoma City	OK	SOME	65	0 174	$44 82
0008	Portland-Tri-Met	Portland	OR	SOME	468	0 006	$63 66
3010	Allentown-LANTA	Allentown	PA	SOME	55	0 058	$51 36
3014	Harrisburg-CAT	Harrisburg	PA	SOME	52	0 012	$66 80
3025	Scranton-Lackawanna TA	Scranton	PA	SOME	30	0 028	$47 44
6048	Austin-Capital MTA	Austin	TX	SOME	244	0 312	$57 83
6051	Corpus Christi RTA	Corpus Christi	TX	SOME	54	0 059	$54 82
0001	Seattle Metro	Seattle	WA	SOME	906	0 049	$111 27
0003	Tacoma-Pierce Cnty Trans	Tacoma	WA	SOME	147	0 060	$69 38

Appendix B: Regional and Agency Size Distribution for Dataset

Size \ Region	Mid-West	North Central	Northeast	Northwest	South Central	Southeast	Southwest	Size Total
Does Not Contract for Service								
<25	3	11	12	3	5	18	7	**59**
25-49		5	1	2	2	2	3	**15**
50-99		1	2			1		**4**
100-249			1				2	**3**
250-499		2	2					**4**
500-999								**0**
1000+			1				1	**2**
Regional Total	**3**	**19**	**19**	**5**	**7**	**21**	**13**	**87**
Contracts for All Service								
<25	1	3	9				7	**20**
25-49		1	1				5	**7**
50-99								**0**
100-249			2				1	**3**
250-499								**0**
500-999								**0**
1000+								**0**
Regional Total	**1**	**4**	**12**	**0**	**0**	**0**	**13**	**30**
Contracts for Some Service								
<25								**0**
25-49		1	2					**3**
50-99			2		2		1	**5**
100-249	1	1	1	1	1	2	1	**8**
250-499		1		1			1	**3**
500-999		1	2	1			2	**6**
1000+								**0**
Regional Total	**1**	**4**	**7**	**3**	**3**	**2**	**5**	**25**
Total Dataset								
<25	4	14	21	3	5	18	14	**79**
25-49		7	4	2	2	2	8	**25**
50-99		1	4		2	1	1	**9**
100-249	1	1	4	1	1	2	4	**14**
250-499		3	2	1			1	**7**
500-999		1	2	1			2	**6**
1000+			1				1	**2**
Regional Total	**5**	**27**	**38**	**8**	**10**	**23**	**31**	**142**

Appendix C: Results of T-tests for Cost Efficiency Trends

21 Jun 96 SPSS for MS WINDOWS Release 6 1
t-tests for Independent Samples of TYPE

Variable	Number of Cases	Mean	SD	SE of Mean
TCEAHR89				
TYPE ALL	30	43 5758	17 827	3 255
TYPE NONE	87	39 9008	14 563	1 561

Mean Difference = 3 6751

Levene's Test for Equality of Variances F= 1 444 P= 232

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	1 12	115	264	3 271	(-2 805, 10 155)
Unequal	1 02	43 11	314	3 610	(-3 605, 10 955)

Variable	Number of Cases	Mean	SD	SE of Mean
TCEAHR90				
TYPE ALL	29	47 5679	17 826	3 310
TYPE NONE	87	41 9277	14 559	1 561

Mean Difference = 5 6401

Levene's Test for Equality of Variances F= 759 P= 385

t test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	1 71	114	091	3 308	(- 912, 12 192)
Unequal	1 54	41 17	131	3 660	(-1 750, 13 030)

t-tests for Independent Samples of TYPE

Variable	Number of Cases	Mean	SD	SE of Mean
TCEAHR91				
TYPE ALL	30	46 2328	15 504	2 831
TYPE NONE	87	43 9648	14 423	1 546

Mean Difference = 2 2680

Levene's Test for Equality of Variances F= 398 P= 529

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff

Equal	73	115	468	3 113	(-3 898, 8 434)
Unequal	70	47 47	485	3 225	(-4 219, 8 755)

Variable	Number of Cases	Mean	SD	SE of Mean
TOEXHP92				
TYPE ALL	30	46 6578	15 395	2 811
TYPE NONE	87	43 5182	14 873	1 595

Mean Difference = 3 1396

Levene's Test for Equality of Variances F= 021 P= 886

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	99	115	325	3 177	(-3 154, 9 433)
Unequal	97	48 96	336	3 232	(-3 355, 9 634)

t-tests for Independent Samples of TYPE

Variable	Number of Cases	Mean	SD	SE of Mean
TOEXHP93				
TYPE ALL	29	47 7115	13 809	2 564
TYPE NONE	87	45 7405	15 161	1 625

Mean Difference = 1 9710

Levene's Test for Equality of Variances F= 941 P= 334

t-test for Equality of Means

Variances	t-value	df	2-Tail Sig	SE of Diff	95% CI for Diff
Equal	62	114	537	3 182	(-4 333, 8 275)
Unequal	65	52 27	519	3 036	(-4 120, 8 062)

t-tests for Paired Samples

OPERATORS DOING SOME CONTRACTING

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TOEXHP89				64 6367	25 788	5 158
	25	516	008			
TOEXHP93				66 8421	14 592	2 918

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-2 2053	22 131	4 426	- 50	24	623
95% CI (-11 341, 6 930)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TOEXHR91	25	896	000	63 8239	16 173	3 235
TOEXHR93				66 8421	14 592	2 918

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-3 0182	7 193	1 439	-2 10	24	047
95% CI (-5 987, - 049)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
DOEXHR91	25	909	000	65 6479	17 273	3 455
DOEXHR93				68 9258	15 418	3 084

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-3 2779	7 187	1 437	-2 28	24	032
95% CI (-6 245, - 311)					

t-tests for Paired Samples
OPERATORS DOING SOME CONTRACTING

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
PTEXHR91	25	854	000	46 7743	23 365	4 673
PTEXHR93				50 3889	24 303	4 861

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-3 6146	12 925	2 585	-1 40	24	175
95% CI (-8 950, 1 720)					

t-tests for Paired Samples
OPERATORS DOING NO CONTRACTING

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TOEXHR89	87	913	000	39 9008	14 563	1 561
TOEXHR93				45 7405	15 161	1 625

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-5 8397	6 241	669	-8 73	86	000
95% CI (-7 170, -4 510)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TCEXHR91	87	927	000	43 9648	14 423	1 546
TCEXHR93				45 7405	15 161	1 625

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-1 7757	5 708	612	-2 90	86	005
95% CI (-2 992, - 559)					

t-tests for Paired Samples
OPERATORS CONTRACTING ALL SERVICES

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TCEXHR89	29	861	000	43 7559	18 115	3 364
TCEXHR93				47 7115	13 809	2 564

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-3 9556	9 381	1 742	-2 27	28	031
95% CI (-7 524, - 387)					

Variable	Number of pairs	Corr	2-tail Sig	Mean	SD	SE of Mean
TCEXHR91	29	891	000	46 4871	15 714	2 918
TCEXHR93				47 7115	13 809	2 564

Paired Differences Mean	SD	SE of Mean	t-value	df	2-tail Sig
-1 2243	7 136	1 325	- 92	28	363
95% CI (-3 939, 1 490)					

Appendix D: Descriptive Statistics for Linear Multiple Regression Model

Number of valid observations (listwise) = 61.00

Variable	Mean	S.E. Mean	Std Dev	Range	Minimum	Maximum
CSTHR93	56 14	2 25	17 60	93 03	$18 24	$111 27
PKVEH93	226 59	45 60	356 12	1910 00	2 0	1912 0
PREC	30 46	1 63	12 73	48.10	3 3	51 4
SNOW	23 64	3 37	26 29	96 20	0	96 2
COL94	108 96	1 60	12.53	50 60	91.5	142 1
SPD93	14.51	35	2 72	10 91	10 2	21 1
OPHR93	1 20	02	18	1 11	1 00	2.11
HRRATIO	1 11	01	09	45	1 00	1 45
PKBASE	1.73	.09	67	2 63	1 00	3 63
SEATSTO	39 66	85	6 64	34 33	20.58	54 92
POP93	1013774 2	201735 27	1575602 84	8555000.0	71600	9.E+06
AREA93	563 28	94 97	741 72	4055 70	14	4,070
DENSE93	2606 72	249 78	1950 88	9271 71	204	9476
UNION90	17	01	07	28	031	310
PCH93	26	05	41	1 00	000	1 000

Appendix E: Results of Linear Multiple Regression Analysis

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Listwise Deletion of Missing Data

Multiple R .93820
R Square .88023
Adjusted R Square .84377
Standard Error 6.95465

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	14	16351.00801	1167.92914
Residual	46	2224 89026	48 36718

F = 24.14714 Signif F = .0000

Equation Number 1 Dependent Variable CSTHR93

------------------------ Variables in the Equation --------------------

Variable	B	SE B	Beta	Tolerance	VIF	T
PKVEH93	010619	004646	214927	294481	3 396	2 286
PREC	117980	091861	085330	589853	1 695	1 284
SNOW	- 136651	047228	- 204193	522812	1 913	-2 893
COL94	308227	106844	219496	449767	2 223	2 885
SPD93	-1 235287	580855	- 190841	323340	3 093	-2 127
OPHR93	27 456603	8 102369	280814	379223	2 637	3 389
HRRATIO	95 401408	13 410558	500111	526847	1 898	7 114
PKBASE	- 345738	2 157714	- 013191	384187	2 603	- 160
SEATSTO	542912	197262	204960	469501	2 130	2 752
POP93	-6 56935E-07	1 3312E-06	- 058826	183251	5 457	- 494
AREA93	001295	002586	054598	219056	4 565	501
DENSE93	-9 55508E-04	6 9859E-04	- 105941	434010	2 304	-1 368
UNION90	47 611999	18 571274	186615	491424	2 035	2 564
PCH93	- 051634	0 759745	- 001210	335442	2 981	- 014
(Constant)	-127 887659	20 067557				-6 373

------ in -------

Variable	Sig T
PKVEH93	0269
PREC	2055
SNOW	0058
COL94	0059
SPD93	0388
OPHR93	0014
HRRATIO	0000
PKBASE	8734
SEATSTO	0084
POP93	6240
AREA93	6189
DENSE93	1780
UNION90	0137
PCH93	9891
(Constant)	0000

Collinearity Diagnostics

Number	Eigenval	Cond Index	Variance Proportions Constant	PKVEH93	PREC	SNOW	COL94	SPD93
1	11 14240	1 000	00002	00067	00058	00117	00005	00008
2	1 37170	2 850	00002	03915	00188	00741	00001	00008
3	87918	3 560	00000	02230	00258	00926	00000	00019
4	59507	4 327	00002	00037	00297	26297	00010	00009
5	37415	5 457	00007	05153	00724	16647	00008	00130
6	27614	6 352	00000	34633	00043	02853	00002	00008
7	10740	10 186	00000	00290	38758	06477	00014	00015
8	10067	10 521	00010	00262	11315	08669	00030	00004
9	06746	12 852	00016	14603	03175	02891	00008	00044
10	04776	15 274	00258	00025	30791	22429	00440	02769
11	01432	27 890	00529	10604	00930	00079	02390	14709
12	00991	33 528	01515	02751	00735	01383	16918	34523
13	00765	38 160	00067	00736	00328	00089	03409	09600
14	00490	47 701	02397	02678	06138	10399	44880	25394
15	00130	92 464	95194	22017	06260	00002	31887	12761

Number	OPHR93	HRRATIO	PKBASE	SEATSTO	POP93	AREA93	DENSE93	UNION90
1	00006	00003	00037	00010	00043	00053	00078	00051
2	00003	00002	00003	00004	03105	02470	00155	00052
3	00007	00000	00061	00006	00587	00927	00408	00036
4	00012	00002	00028	00005	00095	01446	08353	00054
5	00060	00013	00341	00041	02075	04622	09162	00300
6	00002	00003	0435	00006	05885	04408	07006	00744
7	00012	00005	02130	00215	26373	18232	07670	00389
8	00003	00028	0852	00030	01114	06510	14998	45043
9	00043	00010	41545	00073	20342	22183	00757	12348
10	01222	00360	20370	00072	12058	18488	18909	08119
11	04588	00014	12287	47144	15807	12005	19845	13180
12	01777	00207	12202	35132	01321	02945	02885	00003
13	69089	08105	15608	06302	01326	00442	01061	01930
14	01261	30221	11035	00097	07083	02451	04971	07171
15	21916	61028	43066	10865	02785	02819	03741	10578

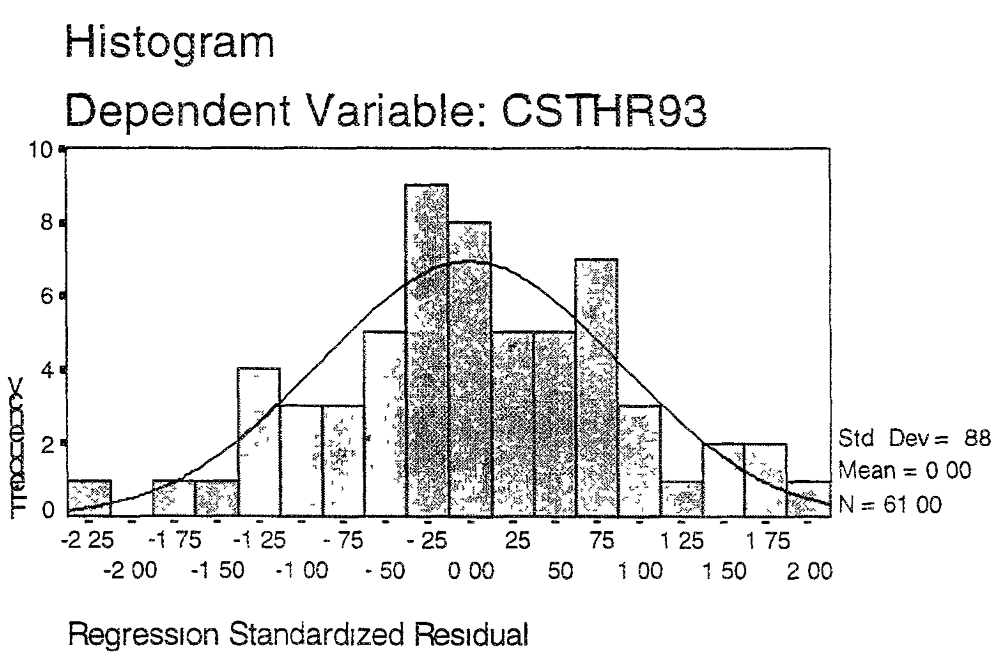
	PCH93
1	00054
2	00621
3	18639
4	00013
5	05911
6	09654
7	00006
8	00494
9	00219
10	15001
11	00006
12	01623
13	41338
14	03762
15	02658

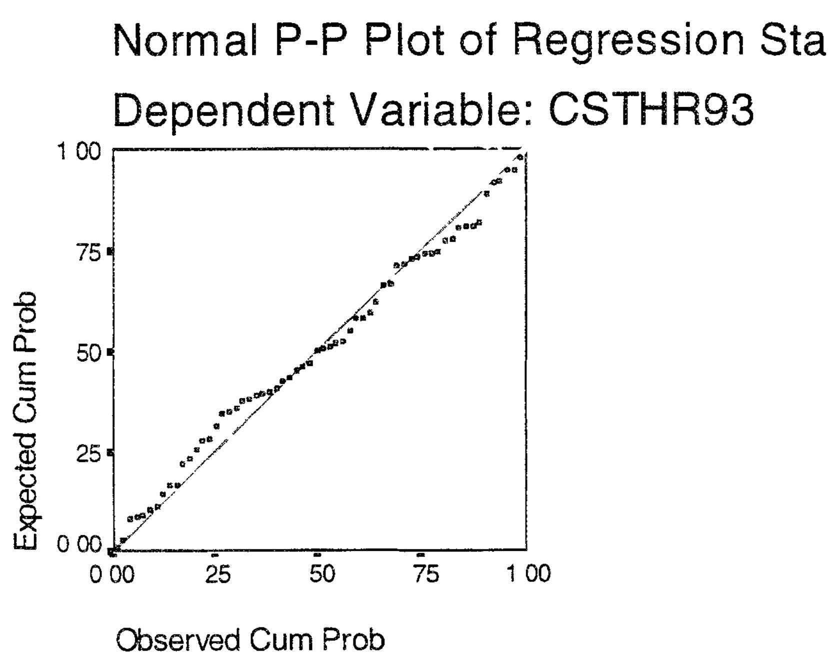
>No outliers found No casewise plot produced

Residuals Statistics:

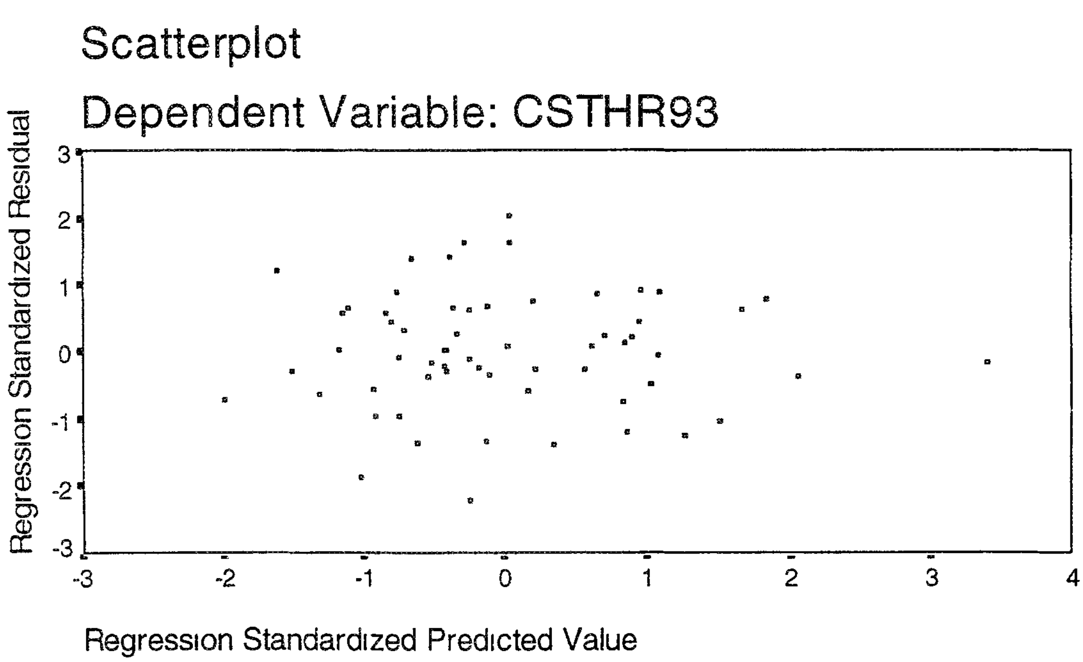
	Min	Max	Mean	Std Dev	N
*PRED	23 2776	112 3994	56 1411	16 5081	61
*RESID	-15 5030	14 1627	0000	6 0895	61
*ZPRED	-1 9907	3 4079	0000	1 0000	61
*ZRESID	-2 2291	2 0364	0000	8756	61
Total Cases =		142			

Durbin-Watson Test = 2 1419





Normal P-P Plot of Regression Sta
Dependent Variable: CSTHR93
1 00
75
50
25
0 00
Expected Cum Prob
0 00
25
50
75
1 00
Observed Cum Prob



Scatterplot
Dependent Variable: CSTHR93
3
2
1
0
-1
-2
-3
Regression Standardized Residual
-3
-2
-1
0
1
2
3
4
Regression Standardized Predicted Value

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