Competitive Contracting in the Mass Transit Industry: Causes and Consequences

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Abstract

Public mass transit firms have experienced dramatic increases in costs and deficits during the past three decades. In an effort to reduce costs, many of these firms have experimented with competitive contracting of their service operations. Using a panel of more than 300 U.S. transit firms operating from 1994 to 1998, I find significant cost-savings attributable to contracting. Unlike previous studies, my analysis controls for both unobservable firm characteristics and the endogeneity of the contracting decision. Cost-savings are estimated at 14% of operating costs or approximately $3.7 million for the average public transit firm. In modeling the firm's decision to contract, I also determine that firms act strategically in adopting contracting. Firms are more likely to contract when internal labor is highly unionized relative to external private labor and when the contractor's bargaining power is low.

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1 Introduction

Although mass transit originated as a private undertaking, public transit agencies have dominated service provision for the past four decades. The Housing Act of 1961 granted cities $75 million to buy failing private transit firms. Three years later, the Urban Mass Transportation Act intiated federal funding of capital expenditures for bus and rail. The 1960s and 1970s witnessed the final stages of an ever-increasing government presence as the formerly private industry became dominated by public provision and federal funding. Government intervention was prompted not only by the social goals of universal service, but also by the industry's ailing infrastructure and increasing deficits. However, the change in ownership did little to restore financial health. The competing goals of universal service and economic efficiency were not resolved. As a result, deficits continued unabated and, in fact, increased substantially due to operating costs. Since 1970, operating costs have increased 400 percent relative to an inflation rate of 200 percent, and a 168 percent increase among private bus operators (Cox & Love 1996). At the same time, public provision also fell short of its social goals, particularly the goal of increasing transit use. From 1970 to 1980, transit experienced a 30 percent decline in market share; a further decline of 17 percent followed in the 1980s (Cox & Love 1996).

Critics of the current system have offered policy options to remedy the situation. Generally, these involve restructuring the industry to introduce competitive pressures. This may be accomplished by one of two means: a change in ownership via privatization or a change in service provision via competitive contracting or competitive bidding.[1] Contracting of services under public oversight seems to be the industry's preferred solution because it combines the competitive pressures of privatization with the coordination, scale economies, and social goals of public monopoly provision. During the past three decades, a growing number of public agencies have relied on contracting to provide an ever-increasing portion of their services.

While the theoretical and industry literature clearly support the use of contracting as a cost-saving device (Bajari & Tadelis 1999; APTA 1987), the empirical evidence thus far has been ambiguous. Initial accounting reports for individual transit firms provide mixed results (Price-Waterhouse 1992; Ernst & Young 1991, 1992; Coopers-Lybrand 1992). Case studies and time-series analysis of individual areas such as London (Gomez-Ibanez & Meyer 1993) and Indianapolis (Karlaftis et al. 1997) provide some evidence of cost-savings.[2] However, a cross-sectional study using a subset of U.S. transit firms found no significant impact on costs (McCullough 1997).

[1] For our purposes, contracting refers to competitive contracting and competitive bidding. The National Transit Database (NTD) identifies all contracted services as purchased services, so these terms will be used interchangeably. The NTD also does not distinguish franchised services - this issue will be discussed briefly in Section 3.1.1.

[2] However, Karlaftis et al. focuses on privatization rather than contracting.

The Federal Transit Authority (FTA) maintains a National Transit Database (NTD) which allows for panel data analysis of the impact of contracting on costs. The wealth of data allows for critical improvements in the analysis with regard to both firm heterogeneity and the endogeneity of the contracting decision. These issues have not been previously addressed by the empirical literature on contracting in the mass transit industry.

My analysis of a six-year panel of 319 public transit firms operating in the U.S. indicates statistically significant and substantial cost-savings attributable to the adoption of contracting in the motor bus mode.[3] This result is robust to specification changes and to corrections for unobservable firm heterogeneity and for the endogeneity of the contracting decision. A simultaneous equations model for operating costs and the decision to contract is estimated using full information maximum likelihood.

Estimating a reduced-form operating cost equation similar to a Cobb-Douglas using OLS, I find that firms experience substantial cost-savings (15%) due to contracting. However, a critical OLS assumption is violated because contracting is not an *exogenous treatment*. In fact, the public firms or the government officials overseeing these firms are expected to act strategically in adopting contracting.

The use of alternate samples and specifications provides insight on the existence of endogeneity of the contracting decision. Excluding firms that never contracted from the sample yields estimated cost-savings of 24 percent. This larger estimate indicates that selection to treatment is a serious issue. A fixed effects specification estimated on the full and restricted samples reinforces this concern. Unobservable firm characteristics and the decision to contract are highly correlated. Both results argue strongly for a means of incorporating the decision to contract structurally.

A structural approach to address the endogeneity incorporates the contracting treatment allocation. Specifically, a model of the firms' strategic decision to contract is added to the cost equation. The decision to contract is modeled as a function of strategic variables. These variables include internal and external unionization rates, competition among contractors, and transaction cost factors.

The system of simultaneous equations is estimated via full information maximum likelihood. This specification includes firm fixed effects to account for unobservable firm heterogeneity. The results indicate cost-savings of 14 percent.

While the cost-savings results are significant, estimating the contracting decision also confirms that public transit firms behave strategically in adopting contracting. The logit results indicate that the relative bargaining power of labor and contractors affect the firm's decision to contract. Firms contract to circumvent strong internal unions

[3] *Motor Bus:* Rubber-tired passenger vehicles operating on fixed routes and schedules over roadways. Buses are powered by fuel, diesel, gasoline, battery or alternative fuel engines contained within the vehicle.

in favor of weaker or non-unionized private labor.[4] They also adopt contracting when the number of contractors engaged in bidding is high, indicating that the contractors' bargaining power is low. The logit results are consistent with traditional transaction cost theory with respect to uncertainty, asset specificity, and frequency of or experience with contracting. Additional variables from the contracting literature such as scale and scope also enter significantly.

These results support the industry literature which predicts cost-savings from contracting to result from four areas: competition, labor cost differences, factor substitution, and scale economies. Unlike many studies modeling contracting behavior, the data used here are required administrative data and hence not subject to the survey non-response common in other studies.

Section 2 briefly reviews the history of this industry and its use of competitive contracting. Section 3 describes the National Transit Database and other data used in this analysis. Section 4 combines two strands of the make-or-buy decision literature: the consequences and causes of contracting. The consequences of contracting on firm's costs are outlined in a model by Bajari and Tadelis (1999). This section also summarizes the determinants of the firm's decision to contract from the transaction cost economics and firm organization literature. Section 5 specifies the two-equation simultaneous equations model and outlines the estimation strategy. The model contains a reduced form short-run cost equation with contracting as an endogenous treatment. An equation modeling the allocation of the contracting treatment is included in the system of equations to correct for endogeneity. Section 6 describes the empirical results from the estimation. First, the cost and decision to contract equations are estimated separately to calibrate the models. Then the system of simultaneous equations is estimated using full information maximum likelihood estimation. Section 7 concludes.

2 Contracting in the Mass Transit Industry

2.1 Industry Background

Unlike many publicly provided goods, nearly all mass transit services were originally privately provided. As early as 1890, transit services were provided by private firms operating with minimal or no public oversight. It was not until the early 1960s, with the Housing Act of 1961 and the Urban Mass Transportation Act of 1964, that federal and local government intervention significantly affected ownership and capital expenditures. Poor performance among private providers in the form of increasing

[4] This may be of interest to policy-makers as certain grant procedures give public transit union employees inordinate power over the firm's finances. On the other hand, legislation also encourages contracting, which in turn seems to weaken internal labor unions.

deficits and decaying infrastructure led the federal government to grant funding to local governments to take over transit provision. It was only at this point that most public transit providers were formed. The transformation occurred relatively quickly. In 1949, there were only 10 public transit firms. During the following decade, that number had increased to only 23. However, only four years after the Housing Act of 1961, 88 firms were public. The trend continued to 333 firms in 1975.[5] By the 1990s, nearly 90 percent of all transit firms were publicly owned.[6] In addition to public ownership, federal intervention in this industry increased via the provision of operating and capital subsidies enacted during the 1970s.

Traditional justifications for monopoly provision of local public transit include cross-subsidization, economies of scale, and coordination. It was believed that private firms would neglect less profitable areas or services. Cross-subsidization from profitable routes would be necessary for the provision of universal service. These subsidies could be more easily accomplished within a single public firm than with multiple private firms. There was also concern that smaller private firms would be unable to take advantage of economies of scale in the provision of services. Since transit facilities and infrastructure require large fixed costs, service provision was believed to display decreasing long-run average costs. Finally, there was the issue of coordination. The existence of multiple private firms, like those in New York City, created useless duplication in densely populated areas in an effort to exploit profitable routes. In contrast, a single firm would not be prone to cannibalizing its own ridership by duplicating routes. The increased coordination across routes and services under a single provider would increase the quality of transit and thereby its attractiveness to consumers.

There are other social welfare concerns inherent in mass transit provision which contributed to government intervention. Transit provision is used as a redistributive tool. Both transit users and non-users pay for transit because capital and operating expenditures are subsidized by federal, state, and local government revenues. For example, public transit firms receive tax revenues from state and local gasoline taxes. In this case, drivers who generally may not use transit subsidize transit users. The funds are used to increase service, lower fares, and provide what would otherwise be an unsustainable (or unprofitable) service.[7] The social goals of universal service benefit

[5] The number of public transit firms from 1949 to 1975 were taken from Pashigian (1976). The 88 public firms in 1965 comprised 44% of transit vehicles; the 333 public firms in 1975 comprise 85% of vehicles.

[6] Calculated using the National Transit Database. There were 494 public firms in the sample which accounted for more than 90% of transit vehicles.

[7] Lower fares and increased service are offered universally, not just to low-income individuals. Besley and Coate (1991) show that when the appropriate quality level is chosen, it is possible to achieve redistribution from rich to poor despite universal access. The requirement is that the goods are normal with respect to income. At appropriate quality levels, low-income residents will choose transit, while higher income residents will opt for the automobile.

not only low-income transit users, but also the environment and other commuters by lowering congestion and pollution levels in urban areas.

Despite these economic and social justifications for the public provision *solution*, it is now clear that local public monopolies did not solve the ills of the transit industry. Demand is decreasing and deficits are still increasing despite federal capital and operating subsidies. Proponents of privatization argue that low demand is due to public provision's failure to respond to consumer preferences and that deficits are caused by inadequate competitive pressure. Clearly privatization is the most obvious method for introducing competitive pressures and thereby reducing costs. However, this solution seems at odds with the social welfare goals of mass transit and the original justification for public provision. Does this mean that the social welfare and economic efficiency goals are inherently incompatible and that there can be no mediating solution? Recently many public agencies have experimented with competitive contracting as a means of achieving cost-savings while maintaining coordination and social goals.

2.2 Competitive Contracting and Competitive Bidding

2.2.1 How does Competitive Contracting Work?

Theoretically, a public agency or regional transit authority (RTA) would coordinate the provision of transit, but would not necessarily provide transit services directly. Instead local private firms, and possibly the public firm, would bid for routes and services. Actual or potential competition in the bidding process minimizes costs. The RTA would coordinate routes so that there would be no deterioration in coordination in moving from a single provider to multiple providers. Economies of scale in maintenance, facilities, and purchasing of vehicles could also be retained by allowing these areas to remain within the RTA's management.[8]

Allowing the RTA to coordinate routes and in some cases specify routes and fares may seem like a return to the regulatory environment of the early 1900s. However, there is recent evidence indicating that RTAs would allow input from private contracting firms in both service and fare decisions (Cox & Love 1996). Since the contracts are short, and hence bid often, any attempts by the RTA to enforce unprofitable services or rates would lead to a decrease in the pool of bidders.

Creating a pool of bidders may be difficult for certain transit modes, particularly those with high asset specificity. Trains and other larger vehicles with high asset specificity or which require a large capital investment could be provided by the RTA. Smaller vehicles, like vans, could be provided by contractors because investment costs are less prohibitive, operator skills are less specific, and the potential for alternate uses is higher. The RTA can lease the necessary capital to contractors to eliminate

[8]The RTA might also set fares in order to retain some redistributive element.

capital asset specificity, but the human asset specificity would remain.

There is some concern that private firms will only bid for profitable routes.[9] However, there is evidence that public transit firms have been successfully contracting out their deficits. They have contracted out routes and services that are the greatest contributors to their deficits: peak-period service, low-density service, and specialized (handicapped) services. Peak-period service is a major culprit. The incremental costs of peak period transit provision are approximately 2 to 4 times non-peak provision (Morlok et al. 1971; Cheworny 1981).[10] The incremental cost of peaking in travel demand is high because it incorporates the costs of additional vehicles that become unnecessary in off-peak hours and of additional drivers who are employed only part of the day but must be compensated for a full day or must be compensated generously to work split shifts. An example of successful contract provision of peak-period service is the NYBS, which provides express bus service to New York City from the suburban boroughs during peak commute times. This firm operates profitably during peak periods and alleviates the public transit firm from the burden of providing additional vehicles and manpower during peak periods (Morlok et al. 1985).

According to the industry literature, cost savings due to contracting are expected to result from the four main components listed below (Morlok et al. 1985). These components support the theoretical literature on the make-or-buy decision. Lack of excess capacity for peak period provision, economies or diseconomies of scale and scope, and capital or human asset specificity are put forth as main factors in the decision to contract. Labor cost differences and competition among contractors are consistent with the literature on firm organization.

1. *Competition:* Actual or potential competition provides costs pressure. While private firms can provide lower cost service, that does not mean that they will do so. Non-competitive contracting can lead to higher costs and declines in quality (Ho 1981). In New York City, private firms operating under monopoly franchises and subsidies have costs similar to public firms. Competition among bidders or contractors is necessary.
2. *Labor Cost Differences:* Studies indicate that transit wages are positively correlated with firm size. Studies of transit systems in Philadelphia and Boston find that drivers working for large public firms earned three times the private wage.
3. *Factor Substitution and Efficiency:* Contracted firms may have more flexibility in providing a similar level of service. For example, they may be more likely to vary inputs such as buses. Smaller vehicles may be more fuel efficient. There is also a lower skill requirement for drivers, which in turn lowers the wage bill.

[9] This practice is often referred to as cream-skimming.

[10] Two studies have attempted to quantify peak-period costs. Morlok et al. (1971) found that in Chicago the incremental cost of adding a bus run during peak periods was 3.6 times that of adding a bus run in non-peak hours. Likewise, Cheworny et al. (1981) found that peak costs were 2.4 times midday costs in Bradford, England.

4. *Scale Economies:* Viton (1981) found that average costs are decreasing for small firms, constant for intermediate firms, and increasing for large bus firms. By contracting, larger firms may lower total operating costs.

2.2.2 Experiences with Contracting

Contracting was permitted as early as the Urban Mass Transportation Act of 1964, but the federal government did not require grant recipients to develop programs with private providers until the Surface Transportation Act of 1983. Two years later, the federal government strengthened this commitment by awarding discretionary grants based on the firm's commitment to contracting. States reinforced federal requirements by enacting pro-contracting legislation (McCullough 1997).

In 1987, the American Public Transit Association (APTA) published *Public Transit Services: Considerations in Contracting*. The objective of this guide was to facilitate private-public partnerships in transit services particularly via competitive contracting or competitive bidding. The guide also included the results of a survey of 150 transit providers conducted in the previous year. Since the focus of this paper is the contracting of service provision, the following paragraph summarizes the survey results for this activity.[11]

More than half of the survey respondents (56%) contracted some revenue service. This is a substantial percentage. However, these firms undertook only 250 contracts for service with a total value of $200 million.[12] The median contract value for revenue service was $295,000. Of the systems contracting for revenue service in 1986, 60% contracted demand response service[13] and 33% contracted regular fixed-route (e.g. motor bus) service. Contracted service is more common in non-urban areas: 19% of contracted revenue services is operated in urban areas only, 32% in both urban and suburban, and 49% in suburban or rural areas only. Large urban areas with populations over 1 million contracted approximately 10% of total system miles. Systems in urban areas with populations between 200,000 and 1 million contracted only 4.5% of miles.[14]

[11]Other contracts are excluded. It is interesting to note, however, that revenue service is the most recent area for contracting. While maintenance and other activities such as administration were contracted out as early as 1928, the earliest recorded service contract in this sample was 1969. The fact that early contracting was concentrated in areas such as administration is consistent with recent findings in the empirical contracting literature such as Coles & Hesterly (1998a, 1998b) where less specific activities are more likely to be contracted.

[12]In contrast, the number of contracts in 1993 was approximately 1200 with a total value of $1.5 billion. This is, however, for a larger sample of 517 firms.

[13]*Demand Response:* Passenger cars, vans or Class C buses operating in response to calls from passengers or their agents to the transit operator who then dispatches a vehicle to pick up the passengers and transport them to their destinations. The vehicles (a) do not operate over a fixed route and (b) may be dispatched to pick up multiple passengers at different locations (NTD).

[14]There is a likely correlation between larger urban areas and large public firms, but the survey

Using the National Transit Database, I find that during the period from 1993 to 1998, contracting increased substantially relative to the levels reported in the 1986 APTA survey. During my sample, nearly two-thirds of all public transit firms contracted at least one mode of service relative to only 56% in the APTA survey. The average number of contracts in effect annually was approximately 1200. The total value of annual contracts averaged $1.5 billion in direct expenditures, more than seven times the sum reported in 1986.[15]

2.3 Empirical Evidence on Cost, Quality, and Demand

Contracting is not an immediate panacea. It takes time to develop the competition necessary to ensure an efficient outcome. Contract bidding in a non-competitive environment offers few benefits since costs are generally equivalent to provision by existing public firms. Where competitive contracting has been implemented, there is ambiguous evidence regarding cost savings.

Several accounting firms reported that public transit firms experienced cost reductions after contracting. A cost study of Los Angeles by Price-Waterhouse (1992) found cost-savings of 60-69% accompanied by both lower fares and better service, while another study of Los Angeles' Southern California Rapid Transit District (SCRTD) found cost savings of 40% (Ernst & Young 1991, 1992). However, a study of the same area by Coopers-Lybrand found no cost-savings. In Denver, 20% of bus service was contracted by 1988 and KPMG reported 31% cost savings by the second year (1991). The cost savings was accompanied by lower wages, but no change in quality and safety. However, there was an increase in employee turnover.

There is also case-study evidence that the cost-pressures of competitive contracting affect both private and public transit firms. In cities where competitive contracting has been implemented, public firms have reduced costs and been able to compete effectively with private firms. For example, San Diego's MTDB started contracting in the 1970s and the proportion of its contracted services has increased over time. But the public firm (SDTC) has won bids in the competitive contracting environment. Although some private firms' bids have been below the marginal cost of the public transit operator for a particular service, the public firm was able to compete effectively in other areas. About 63% of the contracts are privately contracted while 37% are awarded to the public SDTC (Hurwitz 1996).

Gomez-Ibanez and Meyer (1993) focus on England. Although contracting and privatization are common, fare and service coordination still exist as part of a unified

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results do not provide such details.

[15] This total covers more than three times as many firms: 517 firms in 1993 versus the 150 firms covered by the 1986 survey. Also, the total value of $1.5 billion does not include adjustments for fare revenue returned and retained and other expenses by the contractor. Including these factors, the total value of these contracts averaged $1.75 billion over the period 1993 to 1998.

system. Approximately 38% of London buses are competitively contracted to 29 different contractors. Cost savings are estimated at 20%. The public firm bids along with the private firms and has won a substantial number of contracts by reducing its costs by 25% since 1985 while increasing service-quality. Outside London, however, demand has fallen due to substantial declines in perceived service-quality and reliability.

Using time-series data on Indianapolis' transit system, Karlaftis et al (1997) compared pre- and post-privatization costs. They found increased cost efficiency and revenue generation. However the results on demand were less clear. The authors found that passenger miles increased substantially, but that passenger miles per vehicle mile decreased as did the firm's capacity.

McCullough (1997) tracked changes in mean unit costs measured as operating expenses per vehicle hour from 1989 to 1993 for a subset of U.S. firms.[16] He found that unit costs were initially lower for firms that did not contract and only slightly higher for firms that contracted all their services. Hybrid firms, which directly operate and contract simultaneously, had substantially higher costs. However, unit costs increased more quickly for the low cost firms than for the hybrid firms. For the hybrid firms, the costs of their contracted operations increased more quickly than their directly operated services. Using a cross-section for 1993, McCullough estimated unit costs on firm- and MSA-specific variables to control for service-quality and demographics.[17] McCullough found that contracting does not significantly impact cost-efficiency.

While the existing literature gives us a taste of contracting's impact on costs and demand, the analyses focus on case-studies, time-series, or cross-sections. These studies do not attempt any correction for unobservable firm heterogeneity or for contracting's endogeneity. Using a panel of 319 motor bus providers over a six year period from 1993 to 1998, I estimate the impact of contracting on costs using a simultaneous equations model controlling for both unobservable firm heterogeneity and for the endogeneity of the contracting decision.

3 Data

Transit firms that receive Urbanized Area Formula Program funds either directly or indirectly are required to file Federal Transit Administration's National Transit

[16]The data source for this analysis was the National Transit Database.

[17]The cost regression is not the typical cost regression from duality theory. Rather, the firm-specific explanatory variables capture vehicle scheduling, labor utilization, agency size, vehicle size, and peak to base service levels. Demographic factors include cost-of-living, population density, precipitation and snowfall levels, and unionization levels.

Database statistics (formerly, Federal Transit Act Section 15).[18] The purpose of the database is to create a uniform system of accounts for transit firms operating in the U.S. The database includes transit agencies which directly operate or contract out services, as well as operators of contracted transportation services under contract to beneficiaries of funds.

The primary data source for the empirical analysis reported below is the Federal Transit Authority's National Transit Database. This source contains firm-level capital, operational, and financial statistics, as well as contract-specific details. These data are supplemented with MSA- and state-level data: MSA-level demographic data from the Regional Economic Information System (REIS) and state and local political measures from the U.S. Statistical Abstract and the National Conference of State Legislatures. Union membership and coverage rates were calculated at the MSA-level using the CPS outgoing rotation.[19] A summary of variables available in the NTD and other sources can be found in Table 1. This is not an exhaustive list, but indicates the scope of the datasets.

[18]Firms with less than 6 vehicles operating in maximum service and those not receiving UMTA funding are exempt from the filing requirement. However, these firms may voluntarily report to the FTA.

[19]For MSAs not represented in the CPS outgoing rotation, state-level unionization rates were substituted for MSA unionization rates. The state data were likewise calculated from the CPS outgoing rotation.

Table 1: **Data Sources (1993-1998)**

Source	**Level**	**Variables**
NTD	Firm-Mode	*Identifiers:* ID #, MSA, service area & population, CEO *Service-Quality Provision:* revenue vehicle hours, revenue vehicle miles, scheduled vehicle miles, actual vehicle miles, actual vehicle hours, directional route miles, safety, security, fleet age, number of stations, accidents, road calls, crime *Capacity:* vehicles in operation, vehicles available, seats, standing-capacity *Output-Quantity Consumed:* passenger trips & miles *Revenues:* revenues & subsidies by source *Inputs & Cost:* employees, wages by function, gallons of fuel, fuel expenditures, expenditures on parts *Other:* contracting status, organization (e.g., public)
NTD	Contract	Contracting firm ID #s, number of vehicles in contract, vehicle loans, contract expenditures, type of contract
APTA	Firm-Mode	Base fare per trip, distance surcharges
REIS	MSA	Population, employment, average earnings (by SIC)
Stat Abstract	State	Party affiliation of state legislature (lower and upper houses), governor's political party affiliation
NCSL	State	State senate and house party affiliation, majority, margins
CPS	MSA	Union membership and union coverage

Stat Abstract: Statistical Abstract of the United States
NTD: National Transit Database
APTA: American Public Transit Association
REIS: Regional Economic Information System
NCSL: National Conference of State Legislatures
CPS: Current Population Survey

3.1 National Transit Database (NTD)

Annual NTD datasets are combined to create a panel of more than 500 firms over six years from 1993 to 1998. There are two levels of data available for each year: firm-mode level data and contract level data.

The firm-mode level data are comprised of one observation for each mode provided by a firm in each year. The data thus allow a firm's motor bus operations to be separated from its heavy rail services. Using the firm-mode level data from 1993 to 1998, variation in operating costs can be linked to changes in contracting behavior. The contract level data include one observation for each contract the firms undertake. These data include contract details such as the contract type, the size of the contract, and the identity of contractors.

3.1.1 NTD: Firm-Mode Level Data

The NTD contains data for more than 500 firms on an annual basis covering all modes of urban transportation. Modes include automated guideway, cable car, commuter rail, demand response, ferry boat, heavy rail, inclined plane, light rail, motor bus, trolley bus, and van pool. The data include each firm's contracting status. Firms report that they contract all services, some services, or no services.[20] Although consistent data are available annually as of 1983, detailed contract data are only available from 1993 to 1998. The database includes information on all aspects of the firm including finances and operations. Major data categories include: resources, inputs and costs, service provision characteristics, service consumed, organization characteristics, and limited demographic information.

1. *Resources:* revenues from operations, advertising, and concessions; subsidies for capital and operations by source (e.g. state, local, dedicated taxes)
2. *Inputs & Costs:* employees and wages; fuel consumption and fuel costs by fuel type; capital equipment balance sheets, depreciation, inventories and infrastructure
3. *Service Consumed:* passenger miles, passenger trips

[20] It is important to note that the NTD indicates that a service is contracted, but not necessarily *competitively contracted*. This is an important distinction since contracting without competition may not promote the same cost-savings. McCullough (1997) investigated this issue and found evidence that most of the contracts can be taken as competitively contracted. First, most of the contracts in his sample (early 1990s) were located in the Northeast and Southwest, where state-level pro-contracting legislation exists. Some states have legislated pro-contracting policies in support of existing federal requirements. McCullough (1997) specifically mentions pro-contracting policies in California, Connecticut, Massachusetts, New York, and Texas. There exists some regulated franchising in New York City and New Jersey; contracts in the states New York and New Jersey comprise only 7% of all contracts found in the contract level data (though they are among the larger contracts).

4. *Service Provision Characteristics:* vehicle miles and hours (actual, revenue, and scheduled); maximum vehicles in operation, vehicles available, seat-capacity, standing-capacity, number of directional route miles, fleet age, operating hours, injuries, collisions, road calls, injuries, violent crimes, non-violent crimes
5. *Organization:* contracting status, organization (e.g., private, public)
6. *Demographics:* urbanized area (MSA), service area size and population

Firm and industry structure variables such as single- versus multi-mode, and local monopoly indicators variables can also be constructed. Prices of inputs can be calculated using data on expenditures and input quantities.

Variables are disaggregated by mode so that each firm has at least one observation per mode.[21] If the firm contracts out any services, most variables are also broken out to distinguish contracted from directly operated services. Table 2 demonstrates the format of one year of data for Boston's MBTA. The MBTA contracted all demand response and ferry boat services, but directly operated all commuter rail, heavy rail, light rail and trolley bus services. Motor bus services are listed as both contracted and directly operated because the MBTA contracted out only a portion of these services.[22]

Table 2: **Data Format: Boston 1993**

Year	Firm	MSA	Mode	Miles	Trips	Contract
1993	1003-MBTA	Boston	Commuter Rail	2733164	21595852	0
1993	1003-MBTA	Boston	Demand Response	3104609	398203	1
1993	1003-MBTA	Boston	Ferry Boat	92219	407252	1
1993	1003-MBTA	Boston	Heavy Rail	5677730	190329520	0
1993	1003-MBTA	Boston	Light Rail	687197	26700000	0
1993	1003-MBTA	Boston	Motor Bus	25081068	92211744	0
1993	1003-MBTA	Boston	Motor Bus	3122449	2164605	1
1993	1003-MBTA	Boston	Trolley Bus	751870	3123129	0

[21]The exception is fare revenue. These data are available at the firm level for all firms, but some firms voluntarily reported fare revenue broken down to the mode level. In some cases, these data can be supplemented by data from APTA, which provides printed data on base fares per trip and on additional surcharges based on distance.

[22]The term *purchased* is equivalent to *contracted* in the NTD.
Purchased Transportation (PT) Service: Purchased or contracted transportation is service provided to a public transit agency or governmental unit from a public or private transportation provider based on a written contract.
Directly Operated (DO) Service: The NTD reporting agency, usually the public transit agency, uses its own employees to operate the transit vehicles and provide the transit service.

Table 3: **Percent of Vehicle Miles Contracted Out by Boston's MBTA**

Year	Commuter Rail	Demand Response	Ferry Boat	Heavy Rail	Light Rail	Motor Bus	Trolley Bus
1993	0	100	100	0	0	11.07	0
1994	0	100	100	0	0	11.15	0
1995	0	100	100	0	0	11.60	0
1996	100	100	100	0	0	11.04	0
1997	100	100	100	0	0	16.17	0
1998	0	100	100	0	0	13.15	0

Table 3 reports the changes in contracting behavior for Boston's MBTA from 1993 to 1998 for each mode. During this time, the MBTA contracted out all demand response and ferry boat services, while directly operating all heavy rail, light rail, and trolley bus services. There were changes in contracting in both commuter rail and motor bus services. Commuter rail was directly operated from 1993 to 1995, contracted in 1996 and 1997, and then directly operated again in 1998. The MBTA consistently contracted out a portion of its motor bus services. The percentage varied from 11 to 16 percent of motor bus vehicle miles.

The number of firms reporting NTD statistics varies from 517 in 1993 to 570 in 1998. Of these firms, an average of 88% are public. In each of the six years, approximately 64% of the public firms contracted services in at least one mode: 35% contracted services in one mode, 22% in two modes, and the remaining 7% in three or more modes.

The median number of modes for each firm is two, which generally consists of motor bus and demand response. Eighty-eight percent of the firm-mode-year observations are concentrated in the motor bus and demand response modes. No other mode represented more than 3% of the observations. Forty-five percent of firm-mode-year observations are contracted with 38% percent contracted always, 11% contracted sometimes, and 51% never contracted.

3.1.2 NTD: Contract Level Data

Beginning in 1993, the FTA also collected detailed information on individual contracts. These data detail the individual contracts that comprise the aggregate contracted services for each mode.

The six-year panel contains information on more than 7200 contracts: approximately 1200 contracts per year from 1993 to 1998. The individual contracts are concentrated in demand response (65%) and motor bus (30%) modes. Most of the contracts are fixed-price (65%) or cost-plus (22-27%).[23]

Contracting is present in nearly all U.S. states. The exceptions are Idaho and Mississippi. Most contracting occurs in California (13.5%) and Massachusetts (13%). No other state averages more than 7% of all contracts over the six years. Firms that contract are located in areas with population and land areas 2-3 times that of firms that do not contract.

Recall that the MBTA contracted out services in three modes in 1993: demand response, ferry boat, and motor bus. In the contract-level data, the MBTA must indicate the identity of the contracted firms, the mode of service, the size of the contract in terms of vehicles, the cost of the contract, and the contract type. Contract type details include whether the contract is a fixed-price or cost-plus contract. The firm must also specify additional details such as the inclusion of vehicles leased or loaned below market value.

[23] There is some ambiguity in the definition of cost-plus contracts because of a change in NTD reporting form. The database aggregates contracts that cover *some* or *all* of the contractor's operating deficit until 1994. After 1994, the *some* and *all* categories are reported separately. Depending on the definition chosen, the percent of contracts designated as cost-plus contracts is either 22% or 27%. The remaining contracts are cash reimbursement for reduced fare programs and other contract types.

Table 4: **Boston MBTA Contracts: 1993**

atick**Contracted Firm**	**Mode**	**# of Vehicles**	**Contract Amount $**	**Fare $ Retained**	**Fare $ Returned**	**C+**	**FP**	**Vehicle Loan**
Thompson Transit	DR	4	590416	0	0	0	1	1
North Shore Transit	DR	6	642671	0	0	0	1	1
Veterans Transp.	DR	12	1198074	0	0	0	1	1
Kit Clark Senior	DR	13	874662	0	0	0	1	1
Kiessling Transit	DR	13	962458	0	0	0	1	1
Share-A-Ride, Inc	DR	16	615833	0	0	0	1	1
Dave Transportation	DR	61	5262425	0	0	0	1	1
Boston Harbor Cr	FB	2	216187	183173	0	0	1	0
Boston Harbor Com	FB	5	2303488	1096073	0	0	1	0
Big W Transp.	MB	1	3338	5722	0	0	1	0
Cavalier Coach	MB	1	12430	37311	0	0	1	0
Town of Bedford	MB	1	17500	2050	0	1	0	0
American Eagle	MB	1	19841	11574	0	0	1	0
People Care-iers	MB	1	24810	27000	0	0	1	0
Town of Lynn	MB	1	35000	5000	0	1	0	0
Hudson Bus Lines	MB	1	50545	35875	0	0	1	0
Town of Dedham	MB	1	53000	10000	0	0	1	0
Town of Beverly	MB	1	60000	7300	0	1	0	0
Town of Framingham	MB	1	73844	9793	0	0	1	0
ranspTown of N	MB	1	76000	18000	0	0	1	0
Mission Hill Link	MB	1	80000	16000	0	0	1	0
Reliable Bus Lines	MB	1	115040	0	0	0	1	0
Hudson Bus Lines	MB	1	131223	20123	0	0	1	0
MVRTA (Reading)	MB	2	57989	26996	0	0	1	0
Brockton Area Trans	MB	2	74226	0	0	0	1	0
Michaud Bus Lines	MB	2	78019	28289	0	0	1	0
Wilson Bus Lines	MB	2	84197	5666	0	0	1	0
Brush Hill Transp.	MB	2	101847	41724	0	0	1	0
Plymouth&Brockton	MB	2	166575	7858	0	0	1	0
Town of Lexington	MB	4	80000	63000	0	1	0	0
Town of Framingham	MB	4	80000	97000	0	1	0	0
Carey's Bus Lines	MB	4	109922	183396	0	0	1	0
Peter Pan Bus Lines	MB	4	266013	131511	0	0	1	0
Interstate Coach	MB	5	63013	31385	0	0	1	0
Town of Burlington	MB	5	80000	13600	0	1	0	0
The Coach Company	MB	5	295231	312395	0	0	1	0
Bloom, Inc.	MB	6	65946	11574	0	0	1	0
Paul Revere T.	MB	6	578120	378358	0	0	1	0
Trombly Commuter	MB	7	102590	330691	0	0	1	0
Plymouth&Brockton	MB	10	336330	0	0	0	1	0

FP: Fixed-Price Contract
C+: Cost-Plus Contract
DR: Demand Response
FB: Ferry Boat
MB: Motor Bus
Fare Retained: Revenues retained by the seller.
Fare Returned: Revenues returned to the buyer.

Table 4 details the forty contracts that comprise the MBTA's contracted services in 1993. Most contracts are concentrated in the motor bus mode, while the largest contract is in the demand response mode. Most MBTA contracts are fixed-price and do not include vehicle leasing.

These data can be used to examine contracting further via comparison of services contracted under cost-plus and fixed-price contracts. The theoretical literature suggests that there are diverging incentives with regard to costs and quality (see Section 4). The disaggregated contract-level data can also be used in modeling the firm's decision to contract. Relevant variables include contracting experience and the number of contractors.

4 Theory

The theoretical literature on contracting addresses both the consequences of contracting on firm performance and the mechanism by which firms decide to contract. Combining these two strands of the literature, I investigate not only the impact of contracting on firm costs, but also the mechanisms by which contracting is adopted. The mechanisms behind the adoption of contracting are important sources of endogeneity of the *contracting treatment* and as such cannot be ignored when measuring the impact of contracting on firm costs.

4.1 The Make-or-Buy Decision: The Impact on Costs

4.1.1 The Bajari-Tadelis Model

Bajari and Tadelis (1999) provide a model of the *make-or-buy* decision, which can be applied to the transit industry. The authors model the make-or-buy decision as a choice between two contract types: fixed-price and cost-plus contracts.[24] The authors assume that cost-plus contracts are equivalent to internal production (i.e., cost-plus=*make*) while fixed-price contracts are equivalent to the *buy* option. Since a cost-plus contract is an agreement where the client agrees to cover all expenses incurred by the firm in providing the terms of the contract, cost-plus contracts have incentives similar to internal production. Specifically, all input costs will be reimbursed fully so there is little incentive to exert cost-reducing effort. The authors find

[24] A fixed-price contract is an agreement where a client procures services from the contractor for a specified amount, while a cost-plus contract is an agreement where the client agrees to cover all expenses incurred by the contractor in providing the terms of the contract. It is possible to create a cost-incentive contract that rewards cost under-runs and penalizes cost over-runs. However, these are generally harder to implement and as a result used less often than fixed-price and cost-plus contracts.

that fixed-price contracts minimize costs more effectively than cost-plus contracts, but that the cost-savings come at the expense of flexibility and quality. Changes to contracts are more difficult in a fixed-price setting because there are no pre-specified methods outlined in the contract to deal with unexpected changes. In a cost-plus setting, unexpected changes are more easily accommodated because the buyer is willing to pay for any additional relevant costs.[25]

Bajari and Tadelis model contracting in a two-phase time horizon: the first stage is the design and the second is provision. The buyer wants to hire the contractor to perform work, which will give the buyer a value of v if successful. In the first stage, the buyer decides to invest in a design of the project. The direct cost of design (d) is a function of the buyer's impatience and the complexity of the project.[26]

$d(\theta, \tau, T) > 0$

where:
θ = impatience
τ = probability of success without modification of design
T = amount of resources needed to design the product completely

The service is then performed by the contractor who can engage in cost-reducing effort (non-contractible) denoted by $e > 0$. The effort reduces the buyer's cost $c(e)$, but comes at a private cost to the contractor $g(e)$. The payoffs are:

Buyer: $u = v - p(c) - d(\theta, \tau, \mathrm{T})$ if design works
$u = 0 - p(c) - d(\theta, \tau, \mathrm{T})$ if design fails
Seller: $\pi = p(c) - c(e) - g(e)$

If the design fails, the contract can be renegotiated, such that the post-renegotiation (net) benefit is less than v. Let $0 < \sigma < 1$ be the intensity of friction in the renegotiations, which dissipates the benefit. The net benefit of renegotiation is then: $(1 - \sigma)v$. The expected payoffs are:

Buyer: $E(u) = \tau v - p(c) - d(\theta, \tau, T) + \frac{1}{2}(1 - \tau)(1 - \sigma)v$
Seller: $E(\pi) = p(c) - c(e) - g(e) + \frac{1}{2}(1 - \tau)(1 - \sigma)v$

Assume $E(\pi) = 0$ and then substitute $p(c)$ into $E(u)$ to obtain:

[25] The buyer is willing to pay for any costs incurred in a cost-plus contract for the original work contracted by the design and for any changes. Note that a cost-plus contract will likely involve more monitoring costs than a fixed-price contract to prevent opportunistic behavior.

[26] This first stage may be viewed as the planning or coordination of transit routes and services.

$$E(u) = v - g(e) - c(e) - d(\theta, \tau, T) + (1 - \tau)\sigma v$$

The buyer receives benefits v, but bears the costs of provision, effort, design, and friction if renegotiation occurs. This implies that competition causes the seller to give up his ex-post bargaining rents up-front. The buyer's maximization is then:

$$Max_{\tau,p(.)} v - c(e^*(p(.)), \tau, T) - g(e^*(p(.))) - d(\theta, \tau, T) + (1 - \tau)\sigma v$$

The seller's maximization involves the optimal choice of effort $e^*(p(.))$, which depends on the slope of the compensation scheme $p'(.)$ at the optimal solution. Assuming risk neutrality, we can focus on linear contracts of the form $p(c) = \alpha + \beta(c)$, where $\beta = 0$ is a fixed-price contract and $\beta = 1$ is a cost-plus contract. To solve, set $\beta = p'(c(e^*(p(.))))$ and then set α to maintain zero (or non-zero constant) profits.

From this model, the authors determine the impact of each contract type on various outcomes such as costs, flexibility, and quality. They find that fixed-price contracts minimize costs more effectively than cost-plus contracts. This result follows from the optimal choice of effort e, which depends on the slope of the compensation scheme (β). In turn, a cost-plus contract is more effective when there is a high probability of design failure $(1 - \tau)$ perhaps because less work has been done in the design process or because of greater uncertainty. A fixed-price (FP) contract is better at minimizing cost, but this comes at the expense of quality and flexibility. Since the model equates cost-plus ($C+$) contracts and directly operated (DO) service, the results imply we should find: $Costs_{DO} = Costs_{C+} > Costs_{FP}$

Table 5: **Fixed Price and Cost-Plus Incentives (Bajari & Tadelis 1999)**

Outcome/Incentive	**Fixed-Price**	**Cost-Plus**
Risk allocation on:	contractor	buyer
Incentives for quality:	less	more
Buyer administration:	less	more
Good to minimize:	cost	schedule
Documentation efforts:	more	less
Flexibility for change:	less	more
Adversarial relationship:	more	less

4.1.2 Repeated Games: Extending the Bajari-Tadelis Model by Distinguishing Contract Types

Most contracts listed in the NTD are either the fixed-price or cost-plus contracts found in the Bajari and Tadelis model.[27] An empirical inconsistency, which Bajari and Tadelis do not address, is why any firm would choose a cost-plus contract if the incentives and resulting costs are identical to internal production (i.e., directly operated service). One possible explanation may be that competition in a repeated bidding process leads to lower costs for cost-plus contracts relative to internal production.

Unlike a fixed-price contract, the amount of the cost-plus contract is not pre-specified. Consequently, there is an incentive for the contractor to undermine the competitive process after winning the bid. That is the nature of the Bajari-Tadelis result. However, in the transit industry, recommendations that contracts be small and re-bid often may attenuate such opportunistic behavior. Repeated contact between the transit agency and the contractors may introduce a secondary source of cost-pressure that differentiates the incentives of the cost-plus contract from internal production. As a result, we may find that cost-plus contracts lower costs relative to direct operation, though perhaps not to the same extent as fixed-price contracts. According to Bajari and Tadelis, fixed-price contracts lower costs relative to cost-plus contracts because of the structure of the contract payoffs. Within the context of the transit industry, however, we can extend the Bajari-Tadelis model to incorporate the additional competitive pressure provided by repeated bidding for both cost-plus and fixed-price contracts. If both contract types are subject to competitive pressures in the bidding process as well as repeated contact between buyers and sellers, then cost-plus contracts are no longer equivalent to directly operated services. Such a result is supported by Williamson (1979), where the frequency of contractual relations curbs opportunistic behavior.

By differentiating contracted service by the contract type, it is possible to determine whether the competitive bidding process differentiates cost-plus and fixed-price contracts as well as directly operated services in terms of their cost-saving incentives. We would then expect to find: $Costs_{DO} > Costs_{C+} > Costs_{FP}$.

4.2 The Make-or-Buy Decision: Organizational Choice

The transaction cost and firm organization literature defines conditions under which firms may prefer internal versus external production, specifically the make-or-buy decision. The firm's decision to integrate, to contract, or to engage in some combination

[27]In addition to cost-plus and fixed-price contracts, there are special school and charter contracts. These contracts are excluded from the analysis.

thereof, is driven by profit-maximization or cost-minimization concerns.[28] While market forces are generally considered to have the best incentives for cost-minimization, vertical integration is often preferred when opportunistic behavior may lead to less desirable outcomes for the firm. In effect, vertical integration is an internal substitute for contracts that cannot be completely specified or well-monitored.

4.2.1 Transaction Cost Economics

Williamson (1979, 1985) finds that the decision to contract is inversely related to the degree of *asset specificity*. The more specific the physical or human capital investment to that project, the less likely the firm will contract out the activity. Williamson also finds that the *uncertainty* decreases the probability of contracting because contracts involving uncertainty are harder to enforce and monitor externally. However, he finds that *frequency or experience* with contracting makes contracting more attractive by curbing opportunistic behavior.

Other authors have added to the list of possible contract determinants including scale, scope, reputation, and capacity shortages (Banerjee & Duflo 1999; Coles & Hesterly 1998a, 1999b; Gonzalez-Diaz et al. 2000). Reputation and capacity shortages increase the firm's propensity to contract. The impact of scale and scope depend upon the existence of economies or diseconomies.

4.2.2 Firm Organization: Lyons & Sekkat (1991)

Lyons and Sekkat (1991) add another dimension to the firm's strategic organizational choice. Specifically, they model the firm's choice as contingent not only on investment (i.e., asset specificity), but also on the relative bargaining power of the firm, the contractor, and labor unions.

In this model, the firm produces a product with two stages of production. The firm must choose its organizational structure: whether to produce at both stages of production with unionized labor at each stage or to contract out the second stage of production. To contract out the second stage, the firm must give up some share of the surplus. In return, however, it is relieved of making capital investments and dealing with the union for the second stage. The incentive for contracting results from the fact that the share of the surplus transferred in payment to the contractor comes from *both* the firm and the union(s).

If the firm remains vertically integrated, it receives α_I share of the profit, while the two labor unions receive $(1-\alpha_I)$. If the firm contracts, it receives α_S, the contractor receives β, and the single internal union now receives only $(1-\alpha_S-\beta)$.

[28] Although transaction cost economics focuses on the transaction as the unit of analysis, empirical analysis has been applied to firm-level decision-making.

The socially and privately preferred outcomes are a function of the relative bargaining power of the firm, the contractor, and the labor unions. For the firm to prefer contracting, α_S should be greater than or equal to α_I. The firm's share of the profits can be increased by contracting when internal labor unions are strong, especially relative to external labor, and when the contractor's bargaining power is weak. Both of these conditions can be reasonably applied to mass transit.

Labor in public transit firms is highly unionized and wages reflect this strong bargaining position. Due to the low (and in some cases, non-existent) unionization among contracted labor in this industry, there is a clear wage differential. The wage differential creates an incentive for the firm to circumvent the internal unions by contracting out services. A testable hypothesis from this model is that the firm behaves strategically in deciding to contract when its own labor is highly unionized, but the contractor's labor is not.

The use of competitive contracting to auction the right to supply services reduces the contractor's bargaining power when there is a sufficient supply of contractors. Lyons and Sekkat find that a competitive supply of contractors makes contracting more attractive by allowing the firm to capture a greater share of the profit. A testable hypothesis is that competition among bidders, measured as the number of contractors in an MSA, increases the firm's propensity to contract.

5 Model Specification and Estimation Strategy

5.1 Short-Run Operating Costs

Cost studies often focus on long-run costs. A necessary assumption to validate this methodology is that firms minimize long-run costs. Is that the case with transit? Probably not. In particular, it is unlikely that firms can optimize with respect to capital (e.g. rolling stock) in a short time frame.[29] In some cases, the process for ordering buses, trains, and other large equipment is a lengthy process that does not allow for changes within the usual observation windows. Capital funds and subsidies are often set apart from other operating expenses. The result is that the duality of production and costs does not hold with regard to long-run costs.

One solution is to specify a model where firms minimize short-run operating costs conditional on the level of capital stock. Including the level of capital rather than the price of capital transforms the long-run cost equation into a short-run cost equation. Similar specifications have been used by Williams (1979), Viton (1981), Berndt et al. (1993), and Friedlaender et al. (1993) in various transportation industries. An indicator variable for contracting (D) is included to measure the difference in operating

[29] Friedlaender et al. (1993) found that rail capital adjusted slowly.

costs across firms that engage in contracting and those that do not.

$$lnC_{ft} = \alpha_0 + \alpha_Y Y_{ft} + \alpha_K K_{ft} + \alpha_P P_{ft} + \alpha_Q Q_{ft} + \theta_D D_{ft} + \epsilon_{ft}$$

where:
C = operating costs
Y = vector of output measures
K = vector of capital measures
P = vector of input prices (labor, fuel, parts)
Q = vector of quality measures
D = contract indicator variable
f = firm
t = year

Based on the argument for competitive contracting and the Bajari and Tadelis model, I expect a negative coefficient on the contract indicator variable in the cost equation. Contracting should introduce competitive pressures relative to the excluded case (direct operation), thereby reducing costs. In addition, the contract variable can be disaggregated by contract type to differentiate cost-savings from cost-plus and fixed-price contracts. This will determine whether there are cost-savings from cost-plus relative to direct operation or whether savings from fixed-price contracts drive the result.

5.2 Endogeneity: The Decision to Contract

Measuring the true impact of contracting on costs is problematic because contracting is not randomly assigned to firms. Instead, the decision to contract may well be correlated with observable and unobservable factors that vary across firms. As a result, the endogeneity of the contracting decision will likely bias the estimated coefficient on contracting. The direction of the bias is unclear and reasonable arguments could be made for both a positive and a negative bias in the estimated coefficient.

The expected sign of the coefficient in the cost equation is negative, implying that contracting induces cost-savings. Endogeneity may cause the model to overestimate the impact. For example, the transit industry association, APTA, has endorsed competitive contracting as a means of reducing expenditures and, as a result, deficits. Does this mean that more fiscally responsible firms are likely to contract? If firms that have a predisposition toward financial conservatism choose to contract, then comparing firms that contract and those that do not biases the results toward finding a negative coefficient. On the other hand, it may be the case that the less efficient, high cost firms are more likely to adopt contracting in an effort to improve a precarious financial situation. This case would bias the results against finding a negative coefficient.

There are three means by which the remaining endogeneity can be explored: restricting the sample, including fixed effects, and modeling the decision to adopt contracting.[30]

In the first approach, the sample is restricted to include only the firms that contracted at some point during the six-year panel. Using this method, I compare only *similar* firms that differed with respect to the timing of adoption of contracting rather than in the decision to contract. While this method does remove some unobservable heterogeneity, its external validity is questionable. Firms that adopt contracting likely differ in terms of efficiency and other unobservables which are potentially related to the contracting treatment. Restricting the sample should illuminate some of these differences.

A useful alternative is to include firm-level fixed effects in the cost equation to eliminate time-invariant unobservable heterogeneity. If the selection to treatment is correlated with unobservable characteristics, this specification will yield estimates that are inconsistent with the OLS estimates.

A third and final approach to this problem is to model the firm's decision to contract structurally. Such an equation would follow the transaction cost and firm organization literature described in Section 4.2. Explanatory variables include internal and external unionization rates, the number of contractors, asset specificity, uncertainty, frequency, scale, and scope. Since political factors may also play a role in the adoption of contracting, the estimation will condition on the political make-up of both houses of the state legislature and of the governorship.[31]

$$D_{ft} = Prob(D_{ft} = 1) = D(UPUB_{mt}, UPR_{mt}, V_{ft}, F_{ft}, A_{ft}, S1_{ft}, S2_{ft}, N_{mt}, L_{mt}, U_{mt}, G_{mt}; \beta)$$

where:

D = contract indicator variable
$UPUB$ = MSA public unionization rate
UPR = MSA private unionization rate
V = variance of demand (uncertainty)
F = lagged number of contracts (frequency/experience)

[30] A related approach is to instrument for the contracting decision by finding a variable which is correlated with the treatment (i.e., contracting), but is not correlated with the error, or any unobservables it may contain, from the cost equation. Potential instruments include local political factors. In many metropolitan areas, transit administrators are appointed by elected officials at the state or local level, while in other areas, they are elected directly. In addition, some states have enacted legislation to encourage or require contracting. In both cases, the current political climate has either a direct or indirect impact on transit management and the decision to contract. However, since the change in political climate is unlikely to impact the productive efficiency of the firm, political factors may be valid instruments. State political variables include the make-up of the upper and lower state legislatures, the governor's political affiliation, local government fragmentation, and real government expenditures.

[31] McCullough(1997) notes that pro-contracting legislation has been passed in several states.

A = median vehicle size (asset specificity)
$S1$ = total firm vehicle miles (scale)
$S2$ = number of modes provided (scope)
N = MSA number of contractors (competition)
L = democrats in lower house of state legislature
U = democrats in upper house of state legislature
G = indicator variable for democratic governor
m = MSA or State
f = firm
t = year

As discussed in Section 4.2, most of these variables have well-defined impacts on the decision to contract in the theoretical literature. Strong government unions tend to increase the probability of contracting, while strong external private unions have the opposite effect. The number of contractors available in an MSA proxies for competition among bidders and hence will make contracting more attractive. The frequency of contracting is expected to increase the probability of contracting. Increased uncertainty and asset specificity decrease the propensity to contract. The ex-ante impacts of scale and scope are unclear. Economies of scale and scope will have positive impacts, while diseconomies will have the opposite effect. Political factors are included to control for variation in local support for contracting.

5.3 Simultaneous Equations

The cost and contracting decision equations can be combined to form a simultaneous equation system, where the contracting variable becomes an endogenous treatment. The system of equations can be estimated using full information maximum likelihood.

To account for firm heterogeneity in unobservables such as efficiency, the cost equation also includes firm dummies (not shown). Year dummies (not shown) are included in both the cost and contracting equations to take into account year-specific events such as technological changes.

$$lnC_{ft} = \alpha_0 + \alpha_Y Y_{ft} + \alpha_K K_{ft} + \alpha_P P_{ft} + \alpha_Q Q_{ft} + \theta_D D_{ft} + \epsilon_{ft}$$

$$D_{ft} = Prob(D_{ft} = 1) = D(UPUB_{mt}, UPR_{mt}, V_{ft}, F_{ft}, A_{ft}, S1_{ft}, S2_{ft}, N_{mt}, L_{mt}, U_{mt}, G_{mt}; \beta)$$

where:
C = operating costs
Y = vector of output measures
K = vector of capital measures
P = vector of input prices (labor, fuel, parts)

Q = vector of quality measures
D = contract indicator variable
$UPUB$ = MSA public unionization rate
UPR = MSA private unionization rate
V = variance of demand (uncertainty)
F = lagged number of contracts (frequency/experience)
A = median vehicle size (asset specificity)
$S1$ = total firm vehicle miles (scale)
$S2$ = number of modes provided (scope)
N = MSA number of contractors (competition)
L = democrats in lower house of state legislature
U = democrats in upper house of state legislature
G = indicator variable for democratic governor
m = MSA or State
f = firm
t = year

6 Estimation Results

Evidence from panel data regressions indicates significant cost-savings due to contracting. There is also evidence of strategic behavior by firms in the adoption of contracting. The results indicate cost-savings of approximately 14 percent when both unobservable heterogeneity and strategic behavior are taken into account.

The full sample used in the following estimations includes all public firms which provided motor bus services at some point during the panel and which reported input levels and expenditures for the three major input categories (i.e., labor, parts, and fuel).[32] Data for 1993 were excluded to allow for incorporating lagged contracting behavior in estimating the decision to contract. All variables are in logs, except uncertainty (i.e., change in demand), capacity shortages, and unionization rates which are measured as percentages.[33]

Section 6.1 reports results from the initial estimates of the reduced form cost regression using OLS, the restricted subsample, and fixed effects specifications. In Section 6.2, results from standard and random effects logits modeling the decision to con-

[32] These restrictions reduce the sample to 319 firms. Although these regressions exclude firms which failed to report input expenditures and levels, the regressions in Table 6 were re-estimated to include all firms with dummy variables to indicate each missing input price. The results from the cost regressions were similar.

[33] Uncertainty and capacity measures are often negative. Uncertainty is measured as the percentage change in demand (passenger trips) from the previous period. Capacity or vehicle shortages are measured as the difference between vehicles in operation and vehicles available normalized by vehicles available.

tract are discussed. Finally, Section 6.3 reports the results from the simultaneous estimation of the decision to contract and the reduced form cost regression.

6.1 Empirical: Evidence of Cost-Savings from Panel Data

Using a panel of 319 firms from 1994 to 1998, I estimate the cost-savings resulting from contracting for motor bus providers using a reduced form cost equation similar to a Cobb-Douglas. The results from the OLS, restricted subsample, and fixed effects regressions can be found in Table 6.

Table 6: **Operating Costs Regressions**

(All variables in logs; standard errors in parentheses)

	OLS Full Sample	**OLS Subsample**	**Fixed Effects Full Sample**	**Fixed Effects Subsample**
Contract Dummy	−0.151***	−0.239***	−0.001	−0.028
	(0.034)	(0.059)	(0.015)	(0.018)
Price of Labor	0.787***	0.489***	0.278***	0.308***
	(0.052)	(0.123)	(0.034)	(0.061)
Price of Fuel	−0.168*	−0.011	0.012	0.009
	(0.096)	(0.114)	(0.023)	(0.027)
Price of Parts	0.246***	0.318***	0.067***	0.050***
	(0.020)	(0.045)	(0.008)	(0.017)
Passenger Miles	0.006	0.020	0.001	0.011**
	(0.008)	(0.021)	(0.002)	(0.005)
Passenger Trips	0.163***	0.091	−0.077***	−0.307***
	(0.029)	(0.062)	(0.019)	(0.040)
Fleet Passenger Capacity	0.424***	0.474***	0.083***	0.206***
	(0.021)	(0.053)	(0.012)	(0.027)
Vehicles in Max Operation	0.140**	0.368***	−0.042	0.005
	(0.056)	(0.127)	(0.028)	(0.068)
Service Area Miles	0.159***	0.222***	−0.002	−0.015
	(0.012)	(0.027)	(0.012)	(0.020)
Vehicle Miles Provided	0.329***	0.199	0.330***	0.529***
	(0.061)	(0.125)	(0.030)	(0.072)
Directional Route Miles	−0.312***	−0.364***	−0.010	0.008
	(0.025)	(0.047)	(0.010)	(0.018)
Total Collisions	0.089***	0.065**	0.006	0.005
	(0.013)	(0.026)	(0.004)	(0.008)
Total Road Calls	0.080***	0.100***	0.005	0.010
	(0.013)	(0.027)	(0.005)	(0.012)
Constant	0.986*	2.674**	10.096***	10.123***
	(0.558)	(1.197)	(0.326)	(0.768)
Year Dummies	*.Yes.*	*.Yes.*	*.Yes.*	*.Yes.*
Adjusted R-squared	0.925	0.927	0.867	0.823
Sample Size	1457	407	1457	407

Significance levels: *** 0.01 ** 0.05 and * 0.10.

The OLS estimates indicate a significant negative impact of contracting on operating costs of approximately 15% in the full sample. This result is robust to specification and methodological changes.[34] Most of the explanatory variables have the expected sign.

Coefficients on input prices for labor and parts are significant and positive as expected. The coefficients on fuel prices have the wrong sign in the OLS regressions, but are not significant at traditional significance levels.[35]

Output consumed measured in passenger trips significantly increases operating costs. The coefficient on passenger miles, another measure of output consumed, is also positive but not significant due to the high correlation with passenger trips.

The coefficient on directional route miles indicates that network size is negatively and significantly related to operating costs. Miles of service area is positively related to operating costs.

All other capital and service-quality measures are positively related to operating costs. The number of vehicles operated in maximum service, fleet passenger capacity, and vehicle miles provided are positively and significantly related to operating costs. The total number of collisions and road calls likewise significantly increase costs perhaps due to increased expenditures on parts, maintenance, and insurance.

While the OLS results support the hypothesis that contracting has improved incentives for cost-savings, the treatment is not exogenous. Selection to treatment would bias the estimates. There are three methods to explore this endogeneity. Two simple techniques involve restricting the sample to exclude firms that never engaged in contracting and including fixed effects in the regression. Both of these options reduce the significant heterogeneity present in this sample. The third option models the decision to adopt contracting thereby modeling the treatment's allocation. This approach will be discussed and estimated in the following section.

Subsampling includes only firms that engaged in contracting at some point during the sample in order to compare similar firms that differ only in the timing of contract adoption. Restricting the sample to only firms that contracted at some point during the six-year panel yields qualitatively similar results to the OLS estimation. However, the coefficient on the contracting variable indicates higher cost-savings of approximately 24%. This result is quite similar to cost-savings estimated by the accounting firms and case studies described in Section 2.3. This result is clearly not

[34]The cost regressions were re-estimated with three fundamental changes. Additional quality variables including reliability, age of fleet, and vehicle hours were added to the specification. MSA-level average earnings for transit workers was substituted for firm-specific labor prices. And, as mentioned earlier, observations dropped due to missing input prices were included with an indicator variable for the missing price(s). None of the specification changes qualitatively altered the results shown in Table 6.

[35]Fuel expenses comprise only 6% of total operating costs and fuel prices have little variation.

externally generalizable as firms that contract are likely to differ from firms that did not. The regression indicates that contracting firms became more cost efficient after adoption. However, the higher coefficient also indicates that they were high costs firms relative to firms that never contracted.

Fixed effects removes the time-invariant portion of the unobservables by differencing out the mean of all variables at the firm level. The cost-savings are identified using only the remaining within variation. Re-estimating the equations with fixed effects eliminates the impact of contracting for both the full and restricted samples. This result is not unexpected. Fixed effects removes the endogeneity only when the treatment allocation is based on fixed firm characteristics. However, fixed effects is generally inappropriate when the treatment is dynamically allocated. The resulting estimated treatment impact is downward biased. In general, removing the between variation tends to reduce the estimated impact. The loss of variation reduces the signal-to-noise ratio and any measurement error is exacerbated.

The estimates thus far indicate selection to treatment. The unobservable firm characteristics are correlated with the contracting treatment. The results from both the restricted sample and the fixed effects specifications argue strongly for incorporating the decision to contract into the model. A structural approach to modeling the endogeneity is required to account for the firms' strategic behavior in deciding to adopt or not to adopt contracting.

6.2 Empirical: Decision to Contract

A logit equation predicting the decision to contract supports the hypothesis that firms act strategically in selecting the contracting treatment. A random effects logit correcting for unobservable firm heterogeneity likewise supports this conclusion. The results for both specifications can be found in Table 7. Due to the similarity of the qualitative results, the two specifications will be discussed simultaneously.[36] The estimation is conducted on the same sample of 319 firms over the period from 1994 to 1998.

[36]Use of the probit instead of the logit does not significantly alter the results.

Table 7: **Logit - Decision to Contract**

(Variables in logs except uncertainty, capacity shortages & unionization (percent); standard errors in parentheses)

	Standard Logit	**Random Effects**	**Standard Logit**	**Random Effects**
Vehicle Hours (Scale)	0.228***	0.985***	0.464***	0.471**
	(0.074)	(0.270)	(0.063)	(0.229)
Median Vehicle Capacity (Specificity)	−0.350	−2.831**	−1.131***	−1.115
	(0.356)	(1.177)	(0.295)	(1.039)
Number of Modes (Scope)	−1.804***	−5.619***	0.399	−6.181***
	(0.489)	(1.304)	(0.368)	(1.327)
Vehicle Shortages (Capacity Shortages)	0.900	2.549	1.050	−0.829
	(0.948)	(2.573)	(0.788)	(2.401)
Variance of Demand (Uncertainty)	−0.002	−0.003	−0.002	−0.002
	(0.011)	(0.054)	(0.009)	(0.019)
Lagged # of Contracts (Frequency/Experience)	2.092***	5.156***	*n.a.*	*n.a.*
	(0.147)	(0.674)	*n.a.*	*n.a.*
MSA Number of Contractors (Competition)	0.113	1.243***	0.419***	3.930***
	(0.095)	(0.357)	(0.070)	(0.448)
MSA Govt Employee Unionization (Internal Labor)	2.299***	5.382**	1.709***	−0.259
	(0.683)	(2.380)	(0.594)	(1.792)
MSA Priv Employee Unionization (External Labor)	−5.623**	−13.607	−5.217***	−15.068**
	(2.243)	(10.159)	(2.023)	(5.906)
Lagged Number of Upper House Democrats	0.762**	0.691	0.194	4.112***
	(0.315)	(0.974)	(0.264)	(0.983)
Lagged Number of Lower House Democrats	−0.276	0.289	−0.021	−0.350
	(0.224)	(0.744)	(0.190)	(0.622)
Lagged Democratic Governor	−0.323*	0.683	−0.239	−3.738***
	(0.195)	(0.713)	(0.165)	(0.603)
Constant	−4.148**	−9.632	−3.862***	−15.305***
	(1.765)	(5.896)	(1.421)	(5.589)
Year Dummies	*.Yes.*	*.Yes.*	*.Yes.*	*.Yes.*
Sample Size	1457	1457	1457	1457

Significance levels: *** 0.01 ** 0.05 and * 0.10.

The Lyons & Sekkat model shows that a firm's incentives to contract depend on its relative bargaining power with the unions and contractors. They determine that a firm has incentives to circumvent strong internal labor unions. The incentive will be greater when the firm's labor has greater bargaining power than the contractor's labor. That is, when the public firm's union is strong, there will be greater incentive to contract, but a strong private union will undermine the cost-savings as the wage differential will be small. By including both government and private unionization rates to proxy for the strength of internal and external labor respectively, I find that the firms exhibit this strategic behavior. Both the standard and the random effects logit confirm that a public transit firm is significantly more likely to contract when its own unionization rate (i.e., government unionization) is high, but less likely to contract when the alternate (private) labor is highly unionized. The coefficient on the government unionization rate is positive and highly significant, while the coefficient for private unionization rate is negative and highly significant. This evidence is consistent with the hypothesis that firms use contracting to reduce the wage-bill by trading off employment from a high-power labor segment to a low-power segment. This result is supported by McCullough (1997) who found significant public-private wage differentials in compiling wage comparisons between public and private providers.

Lyons and Sekkat also show that firms will contract when the bargaining power of contractors is low. The contractors found in the dataset are aggregated to the MSA level to proxy for competition among bidders. The greater the number of contractors, the less bargaining power each contractor wields.[37] As expected, this measure increases the firm's propensity to contract. However, it is significant only in the random effects specification.

Median vehicle capacity, which measures asset specificity, indicates that firms are less likely to contract when asset specificity is high. Higher median vehicle capacity not only indicates greater physical capital specificity because the vehicles are larger and more specific to mass transit activities, but also indicates higher human capital specificity. Larger vehicles require more skilled labor and such human capital investment is more easily obtained internally. A significant relationship is found only in the random effects specification.

Frequency of or experience with contracting significantly increases the firm's current propensity to contract. The number of contracts the firm engaged in during the previous year is significantly and positively related to the decision to contract in the current year.

Uncertainty here is measured as the percent change from the previous year in ridership.[38] High levels of uncertainty indicate that monitoring costs may be high. Both

[37]This variable is calculated from the contract-level data. This variable is the count of unique contractors found in each MSA. Aggregation to the MSA level removes some of the endogeneity of this variable.

[38]Ridership is the number of trips taken by passengers.

parties will be unable to determine the value of the contract due to the inclusion of fare revenues as part of the c value. In service contracts, many firms specify that fares are retained by the contractor or returned to the firm. If ridership levels are uncertain, revenues may vary widely. While the coefficient has the expected negative sign, it is insignificant in both specifications.

Capacity shortages also affect the contracting decision. Recall that peak-period service provision is more expensive than off-peak due to the incremental cost of adding additional vehicles and drivers which become unnecessary in off-peak hours. A measure of capacity (vehicle) shortages indicates that firms are more likely to contract when they hold less excess capacity.[39] While the coefficient for this variable has the expected sign, it is never significant.

Scale is positively and significantly correlated with the decision to contract in both the standard logit and the random effects logit specifications. While the theoretical literature is ambiguous on the direction of this relationship, it is well-documented that firm size is positively related to wages in this industry (Morlok et al. 1985). If, as expected, firms contract to reduce the wage-bill, it is reasonable that the coefficient is significant and positive. In addition, Viton (1981) found diseconomies of scale in busing that would also induce larger firms to contract.

The number of modes a firm provides significantly reduces the adoption of contracting. This result suggests economies of scope. Likely, the presence of other modes, which are generally more asset specific than motor bus, reduces the firm's overall tendency to contract. There may be an increased need for coordination across modes. For example, feeder buses for heavy rail require coordination of schedules between the two modes of service.

Finally, controls for local political factors are included to account for the influence of local politics on firm behavior. These variables were generally insignificant.

The number of contractors the firm engaged in during the previous year might be considered endogenous. To account for this, both the standard and random effects logits are re-estimated without this variable. The results are very similar.

Several previous studies have estimated models of contracting behavior for other industries with a subset of these variables, particularly the transaction cost factors (Coles & Hesterly 1998a, 1998b; Banerjee & Duflo 1999; Gonzalez-Diaz et al. 2000). Many of these studies rely on voluntarily-reported survey data subject to significant non-response levels. The data used here, however, are administrative records required of nearly all public mass transit firms operating in the U.S.

[39]It is possible that the true causality is reversed in that firms that contract hold fewer surplus vehicles because they contract.

6.3 Empirical: Cost-Savings Revisited

Using full information maximum likelihood (FIML), the cost equation is re-estimated with contracting as an endogenous treatment. Simultaneous estimation of the cost equation and the contracting decision supports the OLS and restricted sample results regarding cost-savings. The results can be found in Table 8.

The cost equation includes firm fixed effects to account for unobservable (time-invariant) firm characteristics. Both the cost and contracting decision equations include time fixed effects. Where indicated, the standard errors have been corrected and observations have been clustered at the firm level.

Full information maximum likelihood estimates the cost-savings from contracting at just over 14 percent. The result is significant at the 1% level even after the standard errors are corrected and the observations clustered at the firm level. The estimated coefficient on contracting is remarkably similar to the OLS estimate of 15 percent.

It is important to note that the cost regression in the FIML estimation now includes firm-level fixed effects. Recall that in Section 6.1, the inclusion of fixed effects eliminated the impact of contracting on costs. Unobservable firm characteristics and contracting could not be distinguished. However, in the simultaneous equation estimation, modeling the endogeneity of the contracting decision allows identification of contracting's impact even with the inclusion of firm-specific effects.

Again, the model is re-estimated without the potentially endogenous lagged number of contracts. The estimated cost-savings are still significant, but larger at 18%.

Table 8: **FIML: Operating Costs & Decision to Contract**

(Variables in logs except uncertainty, capacity shortages & unionization (percent); standard errors in parentheses)

	Standard	**Robust Errors**	**Robust & Cluster**	**Robust & Cluster**
Operating Costs Equation				
Contract Dummy	−0.142***	−0.142***	−0.142***	−0.177***
	(0.015)	(0.032)	(0.042)	(0.042)
Price of Labor	0.274***	0.274***	0.274***	0.277***
	(0.026)	(0.034)	(0.043)	(0.039)
Price of Fuel	0.014	0.014	0.014	0.019
	(0.015)	(0.011)	(0.015)	(0.015)
Price of Parts	0.060***	0.060***	0.060***	0.060***
	(0.007)	(0.009)	(0.012)	(0.012)
Passenger Miles	0.000	0.000	0.000	0.000
	(0.001)	(0.002)	(0.002)	(0.002)
Passenger Trips	−0.070***	−0.070**	−0.070	−0.071*
	(0.015)	(0.032)	(0.044)	(0.040)
Fleet Passenger Capacity	0.072***	0.072***	0.072***	0.071***
	(0.011)	(0.020)	(0.023)	(0.022)
Vehicles in Max Operation	−0.013	−0.013	−0.013	0.000
	(0.024)	(0.060)	(0.052)	(0.053)
Service Area Miles	−0.002	−0.002	−0.002	−0.001
	(0.009)	(0.013)	(0.017)	(0.016)
Vehicle Miles Provided	0.284***	0.284***	0.284***	0.279***
	(0.026)	(0.050)	(0.070)	(0.064)
Directional Route Miles	−0.006	−0.006	−0.006	−0.011
	(0.008)	(0.012)	(0.012)	(0.012)
Total Collisions	0.006**	0.006*	0.006	0.005
	(0.003)	(0.003)	(0.004)	(0.004)
Total Road Calls	−0.001	−0.001	−0.001	−0.003
	(0.004)	(0.007)	(0.007)	(0.007)
Constant	13.567***	13.567***	13.567***	13.633***
	(0.304)	(0.626)	(0.904)	(0.818)
Year & Firm Dummies	*.Yes.*	*.Yes.*	*.Yes.*	*.Yes.*
Contracting Decision Equation				
Vehicle Hours (Scale)	0.177***	0.177***	0.177***	0.253***
	(0.038)	(0.037)	(0.065)	(0.061)
Median Vehicle Capacity (Specificity)	0.154	0.154	0.154	−0.033
	(0.172)	(0.200)	(0.337)	(0.303)
Number of Modes (Scope)	−0.763***	−0.763***	−0.763**	0.196
	(0.245)	(0.242)	(0.361)	(0.277)
Vehicle Shortages (Capacity Shortages)	0.143	0.143	0.143	0.223
	(0.429)	(0.443)	(0.583)	(0.596)
Variance of Demand (Uncertainty)	−0.000	−0.000	−0.000	−0.000
	(0.004)	(0.000)	(0.000)	(0.000)
Lagged # of Contracts (Frequency/Experience)	0.895***	0.895***	0.895***	*n.a.*
	(0.073)	(0.128)	(0.183)	*n.a.*
MSA Number of Contractors (Competition)	−0.009	−0.009	−0.009	0.129*
	(0.049)	(0.049)	(0.083)	(0.073)
MSA Govt Employee Unionization (Internal Labor)	1.115***	1.115***	1.115**	0.787*
	(0.339)	(0.353)	(0.517)	(0.437)
MSA Priv Employee Unionization (External Labor)	−1.871*	−1.871	−1.871	−1.657
	(1.121)	(1.188)	(1.835)	(1.485)
Lagged Number of Upper House Democrats	0.158	0.158	0.158	−0.108
	(0.158)	(0.150)	(0.261)	(0.217)
Lagged Number of Lower House Democrats	−0.048	−0.048	−0.048	0.040
	(0.116)	(0.113)	(0.204)	(0.165)
Lagged Democratic Governor	−0.118	−0.118	−0.118	−0.089
	(0.094)	(0.095)	(0.147)	(0.126)
Constant	−4.124	−4.124***	−4.124***	−4.074***
	(0.872)	(0.910)	(1.560)	(1.265)
Year Dummies	*.Yes.*	*.Yes.*	*.Yes.*	*.Yes.*
Sample Size	1457	1457	1457	1457

Significance levels: *** 0.01 ** 0.05 and * 0.10.

7 Conclusion

The transit industry is facing twin crises in the form of decreasing demand and increasing deficits. Economic theory, as well as industry associations and government legislation, advocate the use of competitive contracting to curb costs. Despite such ex-ante support, the empirical evidence for contracting's impact on costs has been ambiguous. Previous studies tended to focus on case studies, time-series, or cross-sections. These studies failed to account for unobservable firm heterogeneity and for the endogeneity of the contracting treatment.

Combining the literature on the impact of contracting on costs (Bajari & Tadelis 1999) with the literature on transaction costs and firm organization (Williamson 1979, 1985; Lyons & Sekkat 1991) enables proper estimation of the cost-savings resulting from contracting. The transaction cost and firm organization literature detail strategic factors in the firm's decision to contract. The decision to contract can then be incorporated and modeled as an endogenous treatment when estimating the cost-savings.

Using a sample of 319 U.S. motor bus operators, I estimate a system of simultaneous equations modeling costs and the decision to contract. By estimating a fixed effects reduced form cost regression with contracting as an endogenous treatment, I account for firm heterogeneity as well as the endogeneity of contracting. These issues have not previously been addressed by the empirical literature on contracting in the mass transit industry.

The results from full information maximum likelihood estimation of this system indicate substantial and significant savings due to contracting. The estimated cost-savings are 14 percent. The sum of operating costs for all firms in the estimation sample was \$7 trillion in 1993 and \$8.5 trillion in 1998. The mean firm in the estimation sample has annual operating costs of approximately \$26.6 million. For the mean firm, the estimated cost-savings due to contracting is \$3.7 million.

The estimated coefficient is somewhat smaller than estimates using the less sophisticated techniques of OLS (15%) and subsampling (24%). The estimated cost-savings are also smaller than those found in accounting reports and case studies.[40] Not surprisingly, these earlier studies found cost-savings similar in size to the results found using the restricted sample of contracting firms. The combination of these findings indicate that high cost firms tend to adopt contracting.

While competitive contracting offers a viable solution to the large deficits present in the mass transit industry, it is important to note that logit regressions indicate that firms act strategically when adopting contracting. Firms respond not only to incentives such as competition among potential contractors and diseconomies of scale, but also to wage-bill issues. Public firms in areas where government worker unionization rates are high and private unionization rates are low are significantly more likely to adopt. Similarly, larger firms with higher average costs, in part due to higher wages, are also more likely to contract. In effect, the cost-savings may come at the expense

[40] This refers to only studies which found significant cost-savings. There are also accounting reports and cross-sectional studies which found no cost-savings.

of labor. The decision to contract seems linked to efforts by transit firms to side-step internal unions in favor of less organized, cheaper private sector labor. This issue must be considered when advocating the use of contracting.

8 Future Work

The analyses contained in this paper do not take advantage of the ability to differentiate between contract types.

As discussed in Section 4.1, the incentives for cost-savings differ between fixed-price and cost-plus contracts. However, these differences can be mitigated by the competition and the repeated contact introduced by the bidding process. A priori, it is unclear whether the cost-savings found in the above analyses differ based on the type of contract implemented.

Approximately 89% of the contracting firms used fixed-price contracts during the sample, while less than 42% used cost-plus contracts.[41] A number of firms used both contract types. With this variation in implementation, it should be possible to determine whether the estimated cost-savings are driven by fixed-price contracts or whether the bidding process equalizes the two contract types.

[41] These percentages refer only to firms included in the full sample. The percentages are reported at the firm level, but there exists additional variation across firm-years.

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