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The estimated cost impact of privatizing student transportation in Minnesota school districts

Owen Thompson

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Abstract Student transportation makes up a substantial portion of a typical school district's operating budget, and sub-contracting bus service to private firms has been advanced by some as a way to reduce transportation costs. Previous studies have found conflicting evidence regarding the cost impact of privatization. This paper seeks to improve on previous studies by estimating cost equations using data that spans six school-years. The primary result is that privatization acts to substantially increase transportation costs. Estimates using a pooled cross section predicted that going from fully outsourced to fully in house reduced costs by approximately 15.8%, while the analogous estimate using a first-differenced equation was a savings of 20.7%.

Keywords Privatization · Student transportation · Education · School bus · Contracting

1 Introduction

The privatization of services traditionally provided by the public sector is an issue that often evokes strong ideological responses. When viewed in the broadest possible terms, the issue of privatization raises fundamental questions about the proper roles of government and private enterprise. Rather than speaking to these ideological questions, this study seeks to use available data to gain empirical insights into one small but important component of the privatization debate: the effect of privatization on costs in the student transportation industry.

The student transportation industry is the single largest carrier of passengers in the United States, transporting approximately 25 million students on 475,000 busses every school day, according to a recent estimate by the American School Bus Council (ASBC 2009). While

As of fall 2009 the author is a doctoral student in the Department of Economics at the University of Massachusetts, Amherst. The majority of the research for this paper was conducted when the author was a masters student in the Hubert H. Humphrey Institute of Public Affairs at the University of Minnesota, Twin Cities.

O. Thompson (✉)
4200 13th Ave South, Minneapolis, MN 55410, USA
e-mail: owen@econs.umass.edu

student transportation has rightly not received the same amount of public attention that other more fundamental issues in education have, its impact on the budgets and financial health of school districts with limited resources is substantial. A January 2008 report by the Minnesota Office of the Legislative Auditor (the same state analyzed in this study) found that Minnesota school districts spent approximately $446 million on student transportation, making up between 5% and 8% of general education spending annually (Office of the Legislative Auditor 2008). The sheer scale of the industry means that any policy changes that may lead to cost savings are of considerable practical importance and are worthy of careful study.

The State of Minnesota is an ideal geographic area to study the effects of privatization on student transportation costs for several reasons. First, as of fiscal year 1997 Minnesota has given transportation funding to school districts as part of their general education revenues, whereas prior to 1997 districts had received dedicated transportation funding. This means that for the past eleven years any transportation cost reductions a district achieved increased the available funds for other activities dollar for dollar. This gave administrators a strong incentive to provide student transportation as efficiently and cheaply as possible, be it in-house or through a private contractor. Second, Minnesota school districts have pursued a wide range of contracting policies, with a large number of districts opting to provide transportation in-house, through a contractor, and in various combinations of the two. Finally, the Minnesota Department of Education has maintained and published reliable data on student transportation for several years, allowing for both cross-sectional and longitudinal analysis of privatization and cost data.

This paper proceeds in six sections. First, I review the results of other studies that investigated the effect of privatizing student transportation services on costs, and discuss how those studies dealt with the primary methodological difficulties that arose. Second, I describe the source and nature of the data used in the paper. Third, I outline the principal methodology used and present the primary results. Fourth, I discuss some further econometric issues such as measurement error and endogeneity. In the fifth section, I suggest possible explanations for the results and discuss policy implications. The sixth section concludes.

2 The current state of the literature

A number of studies have been conducted to measure the cost effects of privatization in the student transportation industry. Those studies produced conflicting results, with four studies finding contractors to be more cost effective (Bails 1979; McGuire and van Cott 1984; Ross 1988; Damask 2000) and six studies finding in-house operations to be more cost effective (Alspaugh 1996; Harding 1990; Hutchinson and Pratt 1999; Cassell 2000; Lazarus and McCullough 2005; Hutchinson and Pratt 2007). The magnitudes of the savings over the alternative method were generally estimated to be in the range of 5% to 20%.

It is not practical to review the methodology, data, units of observation, etc. of all ten previous studies in detail in this space. However, the study by Lazarus & McCullough (hereafter L&M) investigates the same geographic area as this study (Minnesota), and this study also relies on some of L&M's results. As such, it is worth reproducing a basic outline of their work. L&M used data on all 343 school districts in Minnesota during the 1999–2000 school year, drawn from both the Department of Education's routine data collection and from a special one-time study ordered by the state legislator and conducted in 2001.

L&M's variables included, for each district, the average wage and fuel price, the total miles of roads and number of students, a dummy variable for urban districts, the number of different types of busses used, and the percentage of students requiring special transportation

services due to a disability, as well as a measure of variable cost and a dummy variable for privatization. To determine the impact of privatization on costs, L&M used OLS regression to estimate a variable cost function with privatization included as one of the independent variables, and found that its coefficient was positive and statistically significant, implying that privatization increased variable costs.

All previous studies, as well as this study, shared the common goal of measuring the effect of contracting on costs holding all other cost determinants constant. The basic methodology used to accomplish this has mostly been similar to that used by L&M: estimate some form of a cost function with a measure of privatization included as one of the independent variables, then evaluate the sign, magnitude and statistical significance of the estimated coefficient on it. This methodology has the potential to produce reliable ceteris paribas estimates of privatization's cost effects, but the potential for bias remains for several reasons. Primarily, bias may be introduced by the omission of important independent variables and by error in the measurement of the cost variable: the remainder of this section will primarily be concerned with how those issues were addressed in previous studies.

Among the studies that used a state-level cross section to estimate cost functions with OLS regression,[1] the independent variables chosen by the authors measured a wide range of cost determinants. These ranged from relatively obvious factors such as square miles and student head counts, the number of different types of busses, the number of miles traveled, and the prices of labor and diesel fuel, to more subtle factors such as total rainfall, the average year of manufacture for busses used, and the average salary of full-time teachers in the district.

When considering the relative strengths of the independent variables used in the previous studies, it important to note that many critical cost determinants are very difficult or even impossible to measure with any degree of accuracy. Two such determinants that this study will address in detail are the competence of administrators and managers and the competitive environment in which contracting occurs. Other variables that were by necessity omitted in all previous studies may include, for example, the topographies of routes in a district or the degree of oversight exercised by school boards.

Given the relatively small magnitudes of privatization's cost impact estimated by previous studies, the bias caused by omitting important variables may change of even reverse some previous results. One important contribution of this study is to estimate models with first-differenced data to control for district specific effects that are difficult or impossible to control for in the simple cross-sections used by previous studies.

The most important independent variable is of course the measure of privatization, and here it is important to note that all previous studies except Ross (1988) defined the privatization variable as either a dummy variable that designated districts as in-house or contractor, or as a categorical variable that had an entry for districts that used contractors for some but not all of their transportation operations. This choice in defining the policy variable is important because modeling privatization discretely fails to measure the effect of what is often substantial variation in that institutional arrangement among districts that use both contrac-

[1] Several previous studies did not use the basic regression methodology outlined above. Specifically, three studies (McGuire and van Cott 1984; Cassell 2000; and Damask 2000) simply compared the mean or median costs of in-house and privatized districts, sorting the districts into sub-groups to control for other factors that may affect costs. Bails (1979) used a standard regression method but compared county level transportation costs in three states that he designated as in-house states and three states that he designated as contractor states, even though all six states used some combination of the two methods of provision. Given these major flaws, I chose not review these studies in detail here.

tors and in-house operations. As such, this study follows the methodology of Ross (1988) by defining privatization continuously.

The other major issue that any credible study of privatization in the student transportation industry must take into account is the fact that the costs reported by districts that provide transportation in-house are likely to be measured in a systematically different way than the costs of districts that use contractors. Specifically, under the public accounting practices commonly used by school districts, overhead[2] and capital costs are included in the total expenditures reported by districts using contractors, since they are implicitly included in the bid amounts of those contractors. They are not, however, included by those running operations in-house. If the reported cost figures are not adjusted for this critical accounting difference, it could make in-house operations appear far cheaper than they actually are.

Of the previous studies, four made no attempt at all to adjust reported costs. Of the remaining six, various adjustment methods were used, ranging from simple straight line depreciation (Harding 1990; Hutchinson and Pratt 1999) to more sophisticated methods involving the estimation of opportunity costs and capital recovery approaches (McGuire and van Cott 1984; L&M). In general, we should bear in mind that school districts are part of large and complex government organizations that have numerous funding sources and complex accounting standards, and that their reported costs are subject to both human decisions and human error. The repercussions of these facts for the measurement of costs have been well summarized by Harvard professor Jonathan Richmond (1992):

> "Cost analysis is art, not science. In complex organizations, large numbers of assumptions must be made about how costs which are incurred are to be allocated to various parts of the organization. Many costs are shared by a number of services, and there is often no one obvious way of assigning them to their sources."

As a result of the innate complexity involved in measuring and assigning costs, even the most sophisticated method of equating the costs of in-house and privatized districts may not be satisfactory. The resulting situation is not unlike the issue of omitted variables discussed above, in that it may be impossible to correct for in a simple cross section, even though it is of clear importance. Fortunately, the cost measurement issue is also similar to the omitted variable issue in that it is largely resolved by using first differenced data.

To summarize, previous studies have produced conflicting conclusions about the impact of school bus privatization on costs. The explanation for the mixed results could very well lie in the diversity of methods used to deal with the two most serious problems that arise in studies of this nature: not controlling for important cost determinants and problems in measuring costs for in-house versus contracted districts. The efforts made by previous studies to resolve these issues were usually the best available given data restrictions, but ultimately had major shortcomings. The data available for this study will allow the use of techniques that help mitigate these shortcomings.

3 Data

Most of the data used in this study was collected and published by the Minnesota Department of Education. The Department drew the information from the Pupil Transportation Annual Report Form and the Uniform Financial Accounting and Reporting Form, both of which are

[2] Overhead costs in this context include any possible long-term pension and health care obligations owed to transportation related employees.

statutorily required to be filed annually by every school district in the state. The districts are routinely audited by the Department of Education and there is no reason to suspect that the data set is not comprehensive or is grossly inaccurate.

Six full school-years of data were used in all, beginning with 2001–02 and going through 2006–07. The variables of interest were, for each district and year, the total miles travelled by all school buses, the total number of students transported, the total number of school days,[3] the area of the district in square miles, the number of school buses owned by the district and by the district's contractors, and total transportation expenditures. To account for the potential impact of being located within the Minneapolis/St. Paul metropolitan area, I added a dummy variable that was set equal to one if the district was located in whole or in part in one of the following nine counties: Hennepin, Ramsey, Washington, Anoka, Carver, Scott, Dakota, Wright or Sherburne, and zero otherwise.

To gain a measure of student density, the total miles traveled variable was divided by the student head count for each district. Also, the number of busses owned by the district was divided by the total number of busses owned by the district and its contractors to create a continuous variable measuring the degree to which transportation was provided in-house (that is, not privatized).

While the Department of Education reports data for every district, districts with the following characteristics were excluded from this study: an area of zero square miles, zero total district owned and contractor owned busses, zero reported miles traveled, and zero total transportation expenditures. The vast majority of the excluded districts were charter schools that had no defined geographical service area.[4] The other exclusions are assumed to be districts that utilize public transportation systems or districts in which all students walk to school or are transported in private vehicles.

Because the data used ranges over several years, an inflation adjustment to the cost variable was necessary. To create a price index specific to the student transportation industry in the state, the total transportation costs of all districts combined was divided by the total number of students transported by all districts for each year included in the study. The price index was used to convert expenditures for all years to the dollars used to measure school year 2006–07 expenditures.[5]

In addition to price level changes, one must account for the differences in the way districts report in-house versus contractor expenditures. The previous study that used the most advanced method of correcting for these reporting differences was L&M, who estimated that including capital and overhead costs added 29.5% to student transportation expenditures for the average district that provided student transportation in-house. To make expenditures comparable between all districts, I added to the reported expenditure for each district the product of the district's total expenditures, the proportion of operations conducted in-house,

[3] In districts where different grade levels had different numbers of school days, the average number of days over all grade levels was used.

[4] There were originally 2,373 observations over the six school years. 314 observations were eliminated because they reported no area, and a further 48 were eliminated for one of the other reasons given, bringing the total sample used to 2,011.

[5] Note that this index reflects not only inflation as measured by changes in the prices of inputs, but changes in the industry cost structure as well. For example, regulatory changes that have an impact on costs would affect the index. Since such changes are generally statewide and relatively small, the conversion of reported costs as described will not meaningfully misrepresent the price level faced by any particular district.

Table 1 List of variables

Variable	Description
Expenditures	Total expenditures of the district, adjusted for price level and accounting differences
Students	Number of students transported
School days	Number of school days, averaged across grades
Area	Area of district in square miles
Metro	Dummy variables set to one if the district is in the metro area and zero otherwise
Miles per student	Miles traveled by all busses in district per student
Percent in house	Percentage of total busses used in the district that are owned by the district

Table 2 Descriptive statistics for Minnesota school districts, school years 2001–02 through 2006–07

Variable	Mean	Standard deviation
Expenditures	$724,514	$101,2370
Students	2,045	3,510
School days	171.88	2.16
Area	250	340
Metro	.18	.39
Miles per student	181.40	103.19
Percent in house	.549	.451

and 0.295.[6] That is, the Expenditures variable was calculated as follows:

$$Expenditures = Reported\ Expenditures\left(1 + \left[\frac{District\ Owned\ Busses}{All\ Busses}\right] * 0.295\right)$$

The fraction of busses used in the district that is district-owned measures the proportion of operations conducted in-house. For obvious reasons the results of this study are sensitive to this adjustment, and both the possibility and implications of measurement error in the Expenditure variable are considered in greater detail in Section Four.

The number of special education students transported by a district is an important cost determinant as well. However, the state of Minnesota funds the transportation needs of special education students separately, and those costs are not included in Expenditure variable used here. This makes it unnecessary to include an independent variable measuring special education.

To summarize, all the variables used in the study are listed in Table 1, and the mean and standard deviation of each variable are given in Table 2. Additionally, Fig. 1 shows the distribution of the privatization variable, Percent In House, and indicates that the majority of districts elected to operate mostly in-house or mostly privatized, with a substantial minority relying on both methods in sizeable quantities.

We can see from Table 2 that about half of all student transportation services statewide for the study period were provided in-house, and that Expenditures varied considerably by

[6] Using the estimates from Lazarus and McCullough (2005) has the added advantage that their study took place in Minnesota and is relatively recent.

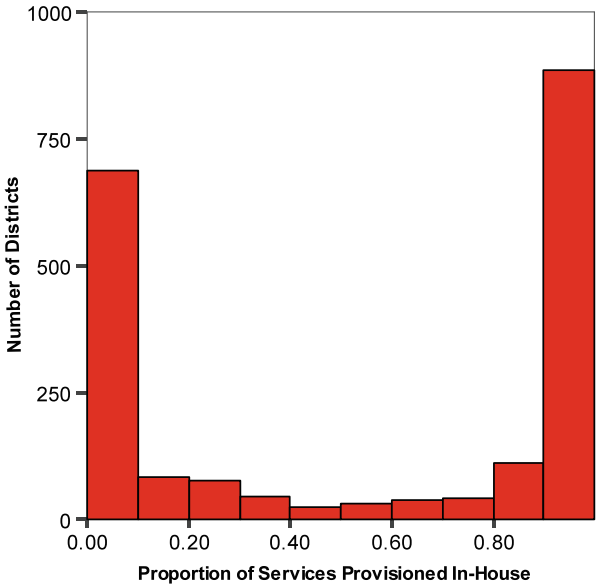

Fig. 1 Distribution of percent in house for Minnesota school districts, school years 2001–02 through 2006–07

district. There was also a great deal of variation in the student head counts, geographic areas and population densities of districts.

4 Methodology and results

Previous studies of privatization in the student transportation industry have all utilized a single school-year of data. This research takes advantage of having multiple years of data to first estimate cost equations with six years of data pooled as a single cross section, and then by using a panel structure to estimate first-differenced models.

4.1 Pooled cross-sectional estimates

One criticism of using a single year of data is that contracts between districts and private firms usually fix a rate of compensation for the service to be provided. If there is an unexpected cost increase after the contract is in place (for example from unexpectedly good or bad weather or unforeseen fuel cost fluctuations) contractors may still be forced to provide the services at the originally contracted rate, making them appear to be a lower cost option when in fact they have not achieved any greater efficiency in the transport of children. An unexpected decrease in costs would have the opposite effect, lowering the expenditures of in-house districts relative to contracted districts without any accompanying changes in efficiency.

The misleading effect on reported expenditures which potentially could be caused by unexpected cost fluctuations that are unrelated to operational efficiency may in turn impact the size of the coefficient on the privatization variable. Indeed, I estimated regressions for each of the six years individually and there were relatively small but still meaningful annual fluctuations in the size of the Percent In House coefficient.[7] The obvious way to dampen

[7]These regression results are available from the author upon request.

the effect of stochastic factors not related to efficiency is to pool all the years into a single regression. Results from such a regression under seven separate specifications are reported in Table 3.

The first column of Table 3 reports a base specification that includes all the independent variables discussed thus far. We see that all of the coefficients are significant at beyond the 1% level. The R-Squared of 0.9449 shows that the independent variables explain virtually all of the variation in the expenditures from district to district. The most important result is the coefficient on Percent in House, which is negative, of an economically meaningful magnitude, and resoundingly significant, with a t-score of −14.242. This result suggests that going from wholly in house to wholly privatized bus services increases costs per student by 15.8 percent for the average district.

The significant coefficient on the Metro dummy variable suggests that being in the metro area does have a ceteris paribus effect on transportation costs. The positive coefficient is somewhat unexpected, but is not unreasonable if we keep in mind that student count and density are held constant. If the metro area and out-state markets do differ in some fundamental way not measured by the other explanatory variables, for example in the wages paid to drivers or the rents paid to lease a bus yard, estimating the equation for the groups separately may affect the results. To evaluate this theory, columns 2 and 3 estimate the basic specification for metro area and non-metro area districts, respectively. The results show that, while privatization may increase costs somewhat more for out-state districts than for metro area districts, the effect of providing student transportation in-house on costs is large, negative and statistically significant for both types of districts.[8]

As I will discuss in some detail below, two possible omitted variables are the degree of professionalism among the administration of a district and the degree of competition for the provision of transportation services in a particular district. We would expect both administrative professionalism and competition, among other factors, to change as the size of a district increases, and so there may be some fundamental differences in the relationship between privatization and expenditures for larger or smaller districts. To test if the effect of privatization is influenced by the size of a district as measured by the number of students, column 4 estimates the base specification with the addition of an interaction of Percent in House and Students. We can see that the coefficient on the interaction term is equal to zero to four decimal places and that it is not significant at any conventional level. Also, the coefficient on the Percent in House variable remains large and significant.

One possible criticism of the way the data are constructed is that the number of busses owned by the district versus contractors in not a good measure of Percent in House, since the district owned busses may be systematically used for different types of routes or purposes. The issue of measurement error in the Percent in House variable is an important one, and it will be taken up in detail below, but for now we can resolve it in a simple way: we can exclude districts that are partially in house and partially contractor, so that there is no doubt as to the proportion of operations that are performed in-house. Column 5 does this by restricting the sample to districts that were either entirely in-house or entirely privatized, as measured by bus ownership. The results show that privatization increased costs by a large

[8] While it is not the primary focus of this paper, it is interesting to note that the larger magnitude of the negative coefficient on Percent in House for non-metro area districts supports a hypothesis that there is less competition among private contractors for outstate contracts. This may be why the cost increase associated with privatization is relatively large for non-metro districts. This was the primary conclusion of the study be Lazarus and McCullough (2005), and will also be relevant when this paper discusses policy implications in its final section.

Table 3 Determinants of log expenditures, pooled data

	Base specification	Metro districts	Non-metro districts	Interaction included	Mixed districts excluded	Alternate measure of students	Alternate measure of density
Constant	5.92***	3.96***	5.68***	5.97***	5.96***	4.053***	7.81***
	(.479)	(1.07)	(.573)	(.485)	(.576)	(.435)	(.517)
School Days	−.0086***	.0058	−0089***	−.0087***	−.0094***	−.0026	−.0078***
	(.0026)	(.0063)	(.0029)	(.0026)	(.0031)	(.0026)	(.0029)
Metro	.0622***	–	–	.0620***	.1176***	−.0700**	.1257***
	(.0205)			(.0204)	(.0239)	(.0215)	(.0242)
ln(*Area*)	.0976***	.0525***	.1244***	.0994***	.0929***	.0443***	–
	(.0130)	(.0156)	(.0219)	(.0135)	(.0124)	(.0091)	
ln(*Students*)	.9095***	.9076***	.9118***	.9048***	.9050***	–	.9976***
	(.0132)	(.0141)	(.0250)	(.0151)	(.0128)		(.0091)
ln(*Miles Per Student*)	.3529***	.2906***	.3783***	.3492***	.3744***	.4652***	–
	(.0362)	(.0406)	(.0597)	(.0374)	(.0303)	(.0259)	
Percent in House	−.1727***	.1318***	.1840***	−.1808***	.1565***	−.1388***	−.1859***
	(.0121)	(.0325)	(.0137)	(.0150)	(.0142)	(.0141)	(.0140)
Percent in House*Students	–	–	–	.0000 (.0000) $t = .909$	–	–	–
ln(*Students Per Square Mile*)	–	–	–	–	–	–	−.2084*** (.0085)
R-Squared	.9449	.9448	.9228	.9449	.9445	.6081	.9311
n	2011	364 (Metro)	1647 (Non-Metro)	2011	1347	2011	2011
Dependant variable	ln(*Expenditures*)	ln(*Expenditures*)	ln(*Expenditures*)	ln(*Expenditures*)	ln(*Expenditures*)	ln(*Expenditures Per Student*)	ln(*Expenditures*)

Notes: Standard errors are HC3 heteroscedasticity robust. *, **, and *** indicate significance at the .1, .05 and .01 levels, respectively

and statistically significant amount in this subsample of districts for which measurement of Percent in House is not an issue.

Since number of students is the single most important cost determinant in all of the specifications, it is natural to ask if the results are sensitive to specifications where Students enters in a different form. One obvious alternative is to make the dependant variable ln(*Expenditures Per Student*) while removing ln(*Students*) from the right hand side of the regression equation. Column 6 estimates this specification and finds that the signs and general magnitudes of the important coefficients remain largely unchanged.

Finally, all of the results so far show that, after the log form of student count, by far the most important determinant of costs is the density variable, ln(*Miles Per Student*). This naturally leads one to suspect that changes to the way this variable is constructed or enters the equation may lead to dramatic changes in the results as a whole. To address this concern, column 7 estimates the equation with an alternative measure of density: the natural log of students per square mile. We can see that the explanatory power of ln(*Miles Per Student*) is largely shifted to the new density variable[9] and that the magnitude and significance of the policy variable, Percent in House, remain largely unaffected under this alternative specification.

4.2 First differenced estimates

The estimate of the effect of privatization on transportation costs reached using the pooled cross sectional data appears quite robust. Still, there remains the possibility that important variables are omitted, leading to biased and inconsistent estimators. As I noted briefly above, two possibly important omitted variables are the competence/professionalism of the district administrators and the degree of competition among student transportation providers. In general, we would expect these omitted variables, as well as most other subtle and difficult to measure cost determinants, to remain mostly constant from school year to school year. Administrative turnover or shifting competitive environments are certainly plausible, but they are unlikely to be dramatic in any particular school year.

The critical question for our purposes is what impact omitting variables to measure administrative competency and competitive environment will have on the coefficient of Percent in House. It is straight forward to calculate the expected sign of the omitted variable bias's impact on the coefficient of Percent in House. Recall that the impact of omitted variable bias on the coefficient of a particular included variable is equal to the product of the omitted variable's coefficient in the original specification and the simple correlation coefficient between the omitted and included variable. Symbolically, the omitted variable bias exerted on the coefficient of a given included variable equals

$$(\beta_{\text{omitted variable}}) * (r_{\text{ommited variable, included variable}})$$

In general, we would expect competition to be negatively correlated with both Expenditures and Percent in House. Indeed, this is the essence of the argument for privatization: reducing Percent in House should increase competition, which will in turn reduce expenditures. Since the product of two negative numbers is positive, the omission of a variable

[9] The estimated impact of Students increases considerably as well. This is probably due to the fact that the Miles Per Student density measure had Students in the denominator, so that there was significant multicollinearity between Students and Miles Per Student. In any event, this alternative specification has little impact.

measuring competition exerts a positive bias on Percent in House, causing its coefficient to be a smaller negative number than the true coefficient.

The impact of omitting a variable measuring administrative competence is less clear, but it seems likely to exert a positive bias on the coefficient of Percent in House as well. The impact of competence on Expenditures is clearly negative, so the critical task in determining the sign of the omitted variable bias is determining the sign of the simple correlation coefficient between competence and Percent in House. If we believe that districts with low levels of administrative competence and professionalism are more likely to contract out student transportation services (a hypothesis I will take up in more detail when I discuss endogeneity and selection bias issues below), then the impact on Percent in House of omitting a competence variable is positive. This would again cause the coefficient on Percent in House to be a smaller negative number than the true coefficient.

Luckily, we are not left to simply speculate about the impact of these or other omitted variables on the coefficient of Percent in House. Having six full years of data allows us to control for the fixed effects of omitted variables for which data are not available. To do so, I assembled the data in panel form, keeping only districts for which data were available for all six school-years, then took first differences and estimated an equation with only time-variant independent variables included.

If the model for each school district i in time t is given by:

$$\ln(Expenditures)_{it} = \beta_{0i} + \beta_1 School\ Days_{it} + \beta_2 Metro_{it} + \beta_3 \ln(Area)_{it} + \beta_4 \ln(Students)_{it} + \beta_5 \ln(Miles\ Per\ Student)_{it} + \beta_6 Percent\ In\ House_{it}$$

then by subtracting the value of each variable in time $t-1$ from its value in time t, we can effectively hold constant all district fixed effects, including unobserved ones. The first differenced equation is given below, where the observed fixed variables ln(*Area*) and Metro (along with all unobserved fixed variables) are no longer in the equation:

$$\Delta \ln(Expenditures) = \beta_0 + \beta_1 \Delta School\ Days + \beta_2 \Delta \ln(Students) + \beta_3 \Delta \ln(Miles\ Per\ Student) + \beta_4 \Delta Percent\ in\ House.$$

There were 312 districts that did not merge with other districts, come into being, or cease to exist over the period of school-years 2001–02 through 2006–07. First differencing eliminates one year of data, so the sample size used for the first differenced estimated was $312 \times 5 = 1560$ observations. For the most part, districts do not make dramatic changes in their degree of privatization from year to year. Still, of the 1560 observations in the first-differenced sample, there were 497 that had some variation in the Percent in House variable, and of those 497, there were 92 instances of a district increasing Percent in House by 10 percentage points or more and 89 instances of districts decreasing Percent in House by 10 percentage points or more. This proved to be sufficient variation in the independent variable of interest to yield reliable results. The results from estimating the equation above are given in the first column of Table 4.

All of the variables except School Days are significant at beyond the 1% level and of the expected signs. Most importantly though, the Percent in House variable is statistically significant and its coefficient predicts that going from all contractor to all in-house reduces the expenditures of the average school district by 20.7 percent, holding constant student count, miles traveled per student, number of school days and all fixed effect-variables. This result seems to confirm my prediction that controlling for the effects of administrative competence and competitive environment would increase the estimated saving associated with operating transportation services in-house.

Table 4 Fixed effects estimates of log expenditures

Variable	Base specification (bus-count based Percent in House)	Miles-based Percent in House	Sample restricted to districts with changes in Percent in House	Sample restricted to districts with increases in Percent in House
Constant	.0255***	.0097	.0139	.0137
	(.0080)	(.0014)	(.0200)	(.0252)
Δ*School Days*	−.0014	−.0070	−.0028	−.0066***
	(.0018)	(.0068)	(.0043)	(.0023)
Δln(*Students*)	.4577***	.2467	.3015***	.1800
	(.1133)	(.1658)	(.1142)	(.1500)
Δln(*Miles Per Student*)	.2372***	.1351	.2717***	.2950***
	(.0654)	(.0950)	(.0651)	(.0823)
Δ*Percent in House*	−.2330***	−.3438	−.2347***	−.3250**
	(.0858)	(.3210)	(.0841)	(.1294)
R-Squared	.087	.055	.097	.211
n	1559	310	497	256

Notes: Regressions in first, third and fourth columns include year dummies. Standard errors are robust to both heteroscedasticity and autocorrelation. *, **, and *** indicate significance at the .1, .05 and .01 levels, respectively

5 Further econometric issues

5.1 Measurement error in expenditures

In addition to holding all fixed effects constant and eliminating any bias caused by the omission of time-constant variables, taking first differences goes a long way towards resolving the issue of possible measurement error in the dependant variable. Recall that to adjust for accounting differences between contracted and in-house operations, the Expenditures variable I use in this study is defined as follows:

$$Adjusted\ Expenditures = Reported\ Expenditures\left(1 + \left[\frac{District\ Owned\ Busses}{All\ Busses}\right] * 0.295\right)$$

where 0.295 is the estimate from L&M of the proportion of costs not reported by in-house operations. If the 0.295 estimate is wrong, it could potentially bias the results. To show why taking first differences largely resolves this serious issue, it is first necessary to define some notation. Let the adjusted level of expenditures for school district i in year t be E_{it}, the reported expenditures be R_{it}, the Percent in House variable be α_{it}, the adjustment to reported costs (0.295 above) be θ, and let variables with stars* represent the 'true' (not subject to measurement error) values. Then, as is derived in the footnote below,[10] the measurement

[10] Begin with the Adjusted Expenditures equation written in the notation described in the text: $E_{it} = R_{it}(1 + \alpha_{it}\theta)$. Taking logs gives $\ln E_{it} = \ln R_{it} + \ln(1 + \alpha_{it}\theta)$. Next, observe that if $\alpha_{it}\theta$ is small then $\ln E_{it} \approx \ln R_{it} + \alpha_{it}\theta)$. Taking first differences gives $\Delta \ln E_{it} = \Delta \ln R_{it} + \ln(1 + \alpha_{it}\theta) - \ln(1 + \alpha_{i,t-1}\theta)$, which

error in the first differenced equation can be written as

$$\Delta \ln E_{it}^{*} - \Delta \ln E_{it} = (\alpha_{it} - \alpha_{i,t-1})(\theta^{*} - \theta)$$

so that overall measurement error, $(\theta^{*} - \theta)$, is reduced by a factor $(\alpha_{it} - \alpha_{i,t-1})$, which is the year over year change in Percent in House. In general, year over year changes in Percent in House were quite small, with a mean of just −0.000273. Thus, any possible measurement error in the dependant variable is greatly reduced by taking first differences, and the credibility of the first differenced equation's estimate of privatization's impact on expenditures is increased.

5.2 Measurement error in percent in house

Unfortunately, the policy variable Percent in House potentially suffers from measurement error as well, and that potential error cannot be easily removed by first differencing. With the simple pooled cross-section, we were able to eliminate problems regarding measurement error in Percent in House by restricting the sample to those districts that were completely in-house or completely privatized. But when using first differences, such districts are of no interest because they will have no variation in Percent in House, except in the rare case of a district going from fully in-house to fully privatized (or vice-versa) in a single year.

Fortunately, there are sound reasons to believe that potential measurement problems in Percent in House would not significantly change the result. If what Percent in House is supposed to measure in principle is the proportion of operations that are performed by the district versus a contractor, then there is in general no reason to believe that the number of busses owned by the district and by contractors is not an accurate and unbiased proxy for the true Percent in House. Still, there may be other, more accurate measures of Percent in House which are more accurate such as, for example, the number of students transported, miles traveled, or labor hours utilized by the in-house and contracted portions of the operation. Unfortunately, none of these other measure were available for the entire study period.

However, for the 2005–06 and 2006–07 school years, the Department of Education did collect data on the number of miles traveled by district and contractor busses, in addition to the number of busses owned by each group. This allowed me to calculate Percent in House on both a bus count basis and miles traveled basis for two complete school years. Simple descriptive statistics show that the two measures were broadly similar over that period, with the bus count method producing a statewide average of 0.513 for Percent in House and the miles count method producing a statewide average of 0.544.

Despite this broad similarity, there were some substantial differences between the Percent in House measures produced by the two methods within particular districts. To test the sensitivity of my primary result to using miles instead of bus counts, I re-estimated my basic first-differenced equation using a miles based measure of Percent in House, and the results are reported in the second column of Table 4.

We can see that the sign and size of the coefficient on Percent in House is comparable when it is calculated on a miles basis instead of a bus count basis. Unfortunately, due to the reduction of the sample size from 1,559 to just 310, none of the variables achieve statistical significance in this specification, including Percent in House. The Department of Education

after factoring out θ can be written as $\Delta \ln E_{it} \approx \Delta \ln R_{it} + (\alpha_{it} - \alpha_{i,t-1})\theta$. The 'true' form of this equation (the form with the correct θ) is $\Delta \ln E_{it}^{*} \approx \Delta \ln R_{it} + (\alpha_{it} - \alpha_{i,t-1})\theta^{*}$, so that the measurement error in the first differenced equation can be written as $\Delta \ln E_{it}^{*} - \Delta \ln E_{it} = (\alpha_{it} - \alpha_{i,t-1})(\theta^{*} - \theta)$.

plans on collecting mileage data in the coming years, and an important follow up to this study once sufficient data become available would be to confirm that the main result holds when using a mileage based measure of privatization.

Beyond the robustness of the general result to using an alternative measure of Percent in House, it is important to keep in mind that classical measurement error tends to bias coefficients of mis-measured variables towards zero. Therefore, even if measurement error is present, the conclusion that privatization has had a positive impact on student transportation expenditures still holds and is in fact strengthened.

5.3 Endogeneity issues

To understand why selection bias may be a problem, consider in general terms the question of why a school district would decide to privatize some or all of their transportation services. There are undoubtedly many reasons, some of which may be ideological rather than strictly rational in the economic sense, but the answer relevant to this section is that districts may privatize after observing what they deem to be unusually high costs of in-house transportation operations. If this is the case, then the pool of privatized districts may have higher costs than in-house districts due to factors other than privatization itself. In other words, this paper has discussed how privatization may affect transportation costs, but it is plausible that transportation costs meaningfully effect privatization as well.

L&M addressed the endogeneity issue by using the population of the county where each school district's office was located as an instrument for their privatization variable and conducting a Hausman test. Since privatization is more common in populous, urban areas, their instrument was correlated with the privatization variable but was unlikely to be correlated with the original reason for higher costs, which L&M assumed to be managerial competence. The results of their test uniformly indicated "minimal endogeneity" in their data. Since they were using data in the same state and time period as this study, their conclusion probably applies in large part to my results as well.

In addition to this previous result, I can once again use the fact that I am working with panel data to gain some insight into the potential selection bias problem. This is because districts that have pre-determined features which make their transportation operations more expensive, whether due to the nature of the student body or the physical terrain of the district or the competence of managers, may be more likely to privatize. But, once they have privatized to what they perceive to be the optimal level, we would generally expect them to stay there. The selection issue occurs because the districts that have settled on high privatization as their optimal strategies may have higher costs for predetermined reasons.

However, the possibility of such self-sorting is less likely among districts that have not settled on a particular level of privatization. Since these districts are still adjusting their levels of privatization, it is unlikely that predetermined cost factors are driving their current decisions. Put somewhat differently, the selection bias will tend to be a much stronger force in determining the 'stocks' of privatized and in-house districts than in determining the 'flows' from one status to the other.

This line of reasoning suggests that we could rid the first differenced specification of most of its potential endogeneity by restricting the sample to the 497 observations that reported year over year changes in Percent in House. The first-differenced equation was re-estimated with this restricted sample, and the results are reported in the third column of Table 4. The coefficient on Percent in House is almost identical to the coefficient reported in column one that used the entire sample, suggesting that the results are robust to possible selection biases.

A further test of whether endogeneity is a major issue is to restrict the sample to districts that *increased* the portion of their operations that were conducted in-house. Among these

districts there is clearly no potential that privatization reflects higher costs due to predetermined factors, because there is no privatization occurring. There are 256 such observations in my sample, with the average year over year change in Percent in House of 10.1 percentage points. An estimate of the first-differenced equation with this subsample is reported in column four of Table 4 and shows that the coefficient on Percent in House not only remains significant, but increases substantially in magnitude as well.

This evidence is not fully conclusive, and it is possible that ongoing changes in the privatization rate are being driven by either existing forces that are associated with privatization or with changes in those forces. However, taken cumulatively the evidence from L&M and the results of the regressions using restricted samples presented here suggest that endogeneity is very unlikely to be a serious problem in estimating privatization's cost impact.

6 Discussion and policy implications

The results reported here run counter to standard economic theory, which predicts that the increased competition and decrease in bureaucratic inefficiencies associated with privatization will reduce costs. So how are we to explain the large, negative, statistically significant and highly robust coefficient on Percent in House in the analysis above? The production technology of student transportation is quite simple, and other than minimal front office operations and bus repairs, consists primarily of a single driver operating a single bus. If the production is indeed approximated by a Leontief fixed-proportion inputs technology, there are only two potential areas for substantial efficiency improvements or cost savings: drivers and busses.

Given the nature of the production technology, the counter-intuitiveness of the result is compounded by the fact that drivers for in-house operations tend to be unionized and receive higher wages and benefits than drivers from private firms. A one-time survey of school districts conducted by the Minnesota Department of Education (Jax 2008) found that drivers for in-house districts had an hourly wage a full dollar higher than their counterparts at private firms, and it is well known that they often receive better benefits as well. With regard to busses, all school districts in the state have the option of purchasing school busses through a state program that solicited competitive bids from school bus manufacturers for the right to supply all districts in the state. This program ensures that any bulk purchasing discount achieved by large contractors can essentially be matched by in-house districts as well.

Since, if anything, contractors appear to have a price *advantage* over in-house districts in terms of the basic production inputs, we must look elsewhere to explain the increased transportation expenditures of districts that utilize them. One reasonable explanation for the results of this study is that the market for student transportation services may be oligopolistic or monopolistic. School bus contractors tend to be either very large or very small firms. The largest firms, First Student and Laidlaw, are national or multinational companies with operations in hundreds or thousands of districts across the country, while smaller contractors may own only a handful of busses and operate in two or three districts.

There are obvious reasons to suspect a lack of competition among major contractors who have achieved large market shares. This is particularly true given the recent merger of First Student and Laidlaw, which went forward only after the settlement of an anti-trust suit filed by the attorneys general of eleven states, including Minnesota.[11] There may be legitimate

[11] See Consent Decree and Final Judgment. The COMMONWEALTH of MASSACHUSETTS, and the STATES of ALASKA, CALIFORNIA, CONNECTICUT, ILLINOIS, MAINE, MINNESOTA, MISSOURI,

concerns about competition among small contractors as well, since the owners of some small firms are often also partial owners of other small firms operating in nearby districts. For example, one medium sized Minnesota contractor, Vision Transportation, operates in the Elk River and Big Lake school districts. Vision is owned in equal shares by three individuals who own three additional small private firms (Hoglund Transportation, Spanier Transportation and Hicks Transportation) with contracts in the nearby school districts of Monticello, St. Cloud and Litchfield.[12] This type of ownership structure clearly discourages competitive bidding, and demonstrates that even when the major contractors do not dominate a market, there is no guarantee that competitive conditions prevail.

As noted in footnote 8 above, the fact that the coefficient on Percent In House is a larger negative number for the non-metro portion of the sample than for the metro portion also supports the hypothesis that limited competition is at least partially to blame for the higher costs associated with privatization. Since it is safe to assume that the contracting environment is less competitive in rural districts than in urban and suburban districts, the 5.22 log-point difference in the Percent In House coefficients for the relevant samples (see columns 2 and 3 of Table 3) suggests that less competitive contracting environments do indeed drive up the cost increase that is associated with contracting.

The difference between the rural and non-rural coefficients also suggests that the impact of privatization is not the same for all districts or all types of districts, but rather varies from one to the next. This fact is made clear in Table 5, which presents a cross tabulation of the first differenced Percent In House variable and the percent change in the Expenditures variable for districts that had discrete annual changes in their level of privatization of 10% or more.

Table 5 shows that districts which had discrete shifts away from in-house operations of over 50% almost always (seven of eight cases) had an associated increase in costs, but that for four districts that increase in costs was more than 20% while for three others it was less than 10%. Similarly, in three of five cases districts with discrete shifts towards in house operations of greater than 50% experienced large cost savings, but in two of five cases such districts actually experienced small increases in their expenditures. The trends are even less clear for districts with discrete changes in their level of privatization of between 10% and 50%, where the cost advantage of taking operations in-house and the cost disadvantage of privatization is barely discernable.

The large range of values in each grouping of districts, as well as the lack of controls for other cost determinants, make Table 5 unsuitable for drawing general conclusions about the cost impact of privatization. This is why regression methods were utilized in the preceding sections. What Table 5 does make quite clear though, is that rather than either private operations or in house operations *always* being more cost-effective than the other, there is a distribution of the changes in expenditures associated with changes in Percent In House. The evidence suggests that this distribution is centered on a mean of approximately 15%–20% higher costs for privatizing districts, but there still could be, and indeed are, privatizing districts that experience cost savings and vice-versa.

This observation about school bus operations reflects the findings of a broader economic literature on the cost impacts of privatization. This literature is vast, with a 2001 survey in the Journal of Economic Literature (Megginson and Netter 2001) reviewing dozens of

NEW JERSEY, RHODE ISLAND, and WASHINGTON, Plaintiffs, v. FIRST STUDENT plc and LAIDLAW INC, Defendants. Civil Action no 07-11816. Filed 09/26/2007.

[12] Vision's ownership structure was revealed in sworn testimony before the National LaborRelations Board, Region 18 on May 31, 2007 by Vision Transportation General Manager MarkOstwald.

Table 5 Cross tabulation of changes in Percent in House and Expenditures for all districts with a discrete annual change in Percent in House of 10% or more

		Annual Percent Change in Transportation Expenditures						
		Decrease of more than 20%	Decrease of between 10% and 20%	Decrease of less than 10%	Increase of less than 10%	Increase of between 10% and 20%	Increase of more than 20%	Totals
Annual Percent Change in Proportion of Busses Owned by School District	Decrease of more than 50%	0 0.0%	0 0.0%	1 12.5%	4 50.0%	0 0.0%	3 37.5%	8 100.0%
	Decrease of between 10% and 50%	6 7.4%	5 6.2%	21 25.9%	23 28.4%	17 21.0%	9 11.1%	81 100.0%
	Increase of more than 50%	5 5.7%	20 23.0%	17 19.5%	35 40.2%	7 8.0%	3 3.4%	87 100.0%
	Increase of between 10% and 50%	3 60.0%	0 0.0%	0 0.0%	2 40.0%	0 0.0%	0 0.0%	5 100.0%

studies from a wide range of countries and in areas as diverse as airport operations, child care, highway maintenance, prison work, fire protection, postal routes and the provision of utilities.[13] The conclusions of studies in these other areas tend to mirror those found in the literature on student transportation reviewed earlier in this paper, with some studies finding cost savings from privatization and others finding increased expenditures.

For example, in his book *You Don't Always Get What You Pay For*: *The Economics of Privatization*, Elliot Sclar (2000) reviewed two large scale and methodologically sound studies on the cost of municipal services such as street maintenance and repaving. Both studies compared the costs from two groups of otherwise comparable municipalities or work sites, one run publicly and the other by contractors. One of the studies, conducted by the Department of Housing and Urban Development in Los Angeles, found substantial cost savings from the use of contractors while the other, conducted by the comptroller of the City of New York, found no difference or perhaps slight savings from in-house repaving operations. Sclar (2000, p. 59) argues that the different findings can only be reconciled by considering the particular characteristics of the work being performed and the contracting environment in each of the two cases, concluding that "no easy generalizations are possible about the inherent efficiency of private contracting versus public provision per se in these more complex areas of public service … general conclusions about specific characteristics are not easily drawn, even with a seemingly highly specific service."

Applied to the case of student transportation, this argument says that the specifics of the transportation operation and of how the privatization is conducted will determine the degree of cost savings for a given school district, leading to a range of outcomes associated with

[13] Hilke (1993) also provides a survey of over 100 US based cost studies on privatization and contracting. Other influential works in this literature include McGuire et al. (1990), Hodge (2000), and Domberger and Jensen (1997), among many others.

changes in the degree of privatization, as was found in the data of this study. The obvious next question then, is what specific factors determine where on the distribution of outcomes any particular school district will be located. This is a critical question worthy of dedicated future research, but what I have argued informally above is that the level of competition in the bidding procedure for private school bus contracts may be among the most important of those specific circumstances which determine a given school district's location in the distribution.

District level heterogeneity may also help to explain another apparent anomaly: if privatization generally raises average per-student expenditures, why do highly cost-conscious district administrators continue to pursue it as a cost saving measure? While ideological motivations or simple incompetence are plausible explanations in some cases, they seem unlikely to account for all or even most of the decisions to privatize. A more reasonable explanation is that administrators know that privatization *sometimes* produces cost savings, but misjudge the specific circumstances in their districts which will determine whether any given case of privatization reduces average expenditures. If my conjecture that competitive environment is one of the critical factors which determines the cost impact of privatization is accurate, then continued privatization may be partially the result of administrators misjudging the degree of competition among private contractors. Such a misjudgment seems especially likely given that the level of competition for the first contract may be different, and in most cases higher, than that for subsequent contracts.

If the limited amount of evidence available about the competitive conditions in the student transportation industry presented above is correct, it would suggest some basic directions for district administrators who wish to increase the efficiency and lower the cost of transporting students to and from school. Specifically, they should pursue policies that will increase the degree of competition among private contractors and write contracts that encourage the efficient delivery of services.

The extent to which districts do so varies greatly across the state, and this may explain in part why we see so many exceptions to the general relationship of privatization increasing costs. There is no reliable data source on the number of viable bids received by school districts each bidding cycle, but surveys completed by the Minnesota Legislative Auditor in 2008 found that many outstate districts have contracting practices that do not even approach competitive. For example, the surveys found two districts that had never even opened their contract to bidding at all, and ten more districts where the current staff could not recall the last time the district's contract had been open to bidding. Staff members in another district indicated that a contractor was chosen solely on the basis of being recommended by a neighboring district (Office of the Legislative Auditor 2008). Even among districts that regularly open their contracts to competitive bidding, anecdotal evidence indicates that many smaller and mid-sized districts routinely receive a bid from only one company, usually their current contractor.[14]

A novel policy being attempted in some Minnesota school districts with the potential to increase competition among contractors involves the school districts themselves purchasing or leasing a bus yard and then allowing any winning bidder, or multiple winning bidders, to operate out of the facility. There seems to be agreement among district administrators and contractors that acquiring suitable land to operate a bus yard is one of the largest barriers to entry faced by private firms. The land must be properly zoned, have fueling facilities, be in

[14] The Legislative Auditor's report states that it surveyed 95% of school districts and that it conducted more in depth site visits at 34 districts. It is not clear whether the practices reported above came from the surveys or site visits, making it difficult to know how widespread the reported practices are.

proximity to the district's schools and the homes of the district's students, and often must overcome considerable opposition from local residents concerned about noise, air pollution and diesel runoff. If the only suitable bus yard for a given district is owned or leased long-term by a single private contractor, as is often the case, then that firm would have an effective monopoly within the district and we would expect prices to rise accordingly.

The importance of access to a bus yard for encouraging competition and the viability of district ownership as a solution were acknowledged in a critical provision of the anti-trust settlement agreed upon by eleven states and First Student/Laidlaw. That provision required First Student/Laidlaw to allow school districts the option of taking over the company's leases on school bus yards within six months of the September 2007 settlement. If districts decided to not take over the leases, First Student/Laidlaw were required to make the depots available to any winning bidder for a particular school district's transportation contract for a period of six years. These provisions were added to the settlement in explicit recognition of the importance of bus yard access for encouraging competition among contractors.[15]

Data are not yet available regarding the cost impact of district ownership of bus yards, or even on how many districts exercised their right to take over the leases of their contractors. The investigation of the effects of these policies as well as other policies designed to increase competition among private school bus contractors would be important topics for future research, and could potentially serve as the primary explanation for the results found in this study.

Another possible explanation for this study's results, which is not mutually exclusive with the imperfect competition explanation, relates to differences between in-house operations and private contractors in the retention and training of drivers. As was outlined above, drivers for in-house operations tend to be unionized and to receive more generous wages and benefits than their counterparts who work for private-contractors. This may lead to higher average levels of tenure among in-house drivers, which could in turn lead to lower training costs, more highly skilled drivers, and lower accident rates.

The data necessary to test this explanation are not collected on a statewide basis, making it impossible to draw general conclusions about its validity. However, Minnesota's largest school district, Minneapolis Public Schools, uses an approximately equal mix of contractors and in-house operations and collected some basic data on tenure and accidents for the 2004–05 and 2005–06 school years. These data show that the average tenure of in-house drivers was 10.5 years, compared to only 3.7 years for contract drivers. As one might expect, the less experienced contract drivers had substantially more accidents, averaging 2.49 accidents per 100,000 trip miles in 2004–05 compared to 1.86 accidents per 100,000 trip miles for in-house drivers, and 3.62 accidents per 100,000 trip miles in 2005–06 compared to 2.35 accidents per 100,000 trip miles for in-house drivers (SEIU 2007).

This preliminary evidence that contractor drivers may experience higher accident rates than in-house drivers offers a potential explanation for this study's results, but it also serves as a reminder that cost is only one consideration for district administrators when deciding whether to outsource student transportation, and is presumably less important than student safety. From a policy perspective, an important next step is to collect detailed experience and performance data for both in-house and contractor operations at a statewide level. This information would be valuable both for assessing whether better driver retention among in-house operations can help to explain the results of this study, as well as for making contracting decisions in general.

[15] See Press Release: Office of Minnesota Attorney General Lori Swanson. September 26 2007. As of 01/04/10 available at http://www.ag.state.mn.us/consumer/pressrelease/070927busmerger.asp.

7 Conclusion

The primary contribution of this study is to take advantage of the availability of multiple years of data to estimate the effect of privatization on student transportation costs in more reliable ways than previously possible. Estimated cost equations using a wide variety of specifications and data sets showed with a great deal of consistency that privatization increases costs by a substantial amount. Most importantly, first differenced estimates, which were not possible in previous studies, estimated that going from fully privatized to fully in house decreased costs by over 20% for the average school district. Possible explanations for this counter-intuitive result are that the student transportation industry suffers from low levels of competition between contractors and that in-house operations experience lower driver turnover and lower accident rates because they tend to pay higher wages than private contractors.

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