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Demand for Local Public Schooling:

Another Brick in the Wall *

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Abstract

In this paper we investigate the demand for local public school expenditures in Sweden. By using survey data, a method previously never applied to Swedish data, the paper provides an additional piece of evidence on individual demand for publicly provided local services. Estimating a linear demand specification, we find that the demand is inelastic with respect to income and tax, much in line with previous Swedish findings in a median voter framework. Estimation of a log-linear demand specification indicates more elastic demand. Testing the hypothesis that municipal employees tend to have a higher demand for public spending than others, we conclude that income, as well as taxprice, enters the demand function differently for the two groups of employees. We find no evidence of Tiebout sorting.

Key words: Demand for local public school expenditure, survey data, public employees,
JEL Classification: C25, H40, H72

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1. Introduction

The provision of public schooling is an essential building stone in the Swedish welfare society. As for many other publicly provided services, the municipalities have been given the responsibility of supplying primary and upper secondary schooling[1]. Evaluating the efficiency of local public provision of schooling is an issue of central concern, not least since spending on schools constitutes the largest single item of Swedish local government expenditures. However, the task is problematic, since there is no market in which individuals' demand can be observed. Estimating individuals' preferences and their corresponding income and taxprice elasticities is a necessary first step towards such an evaluation. The purpose of this paper is to use survey data, a method never previously applied to Sweden, in order to investigate the demand for schooling. In particular, we will (i) estimate the income and taxprice elasticities and (ii) examine whether municipal employees, because of their high stake in municipal spending on schools, have significantly higher demand for local public school expenditures than others.

Using survey data is one way to estimate the demand for publicly provided local goods. Other alternatives are the median voter model, the hedonic approach and the random utility model. These methods have earlier been applied to Swedish data by, e.g., Aronsson & Wikström (1996), Dahlberg & Jakobsson (2000), Boije (1997), and Boije & Dahlberg (1997). All four methods have their weaknesses, but taken together they will hopefully give us a better understanding of the demand for publicly provided goods at the local level in Sweden. This paper gives an additional piece of evidence, and we will relate our findings to those of the earlier Swedish studies. In addition, we will discuss our results in relation to earlier US-studies that employ survey data to estimate demand for local public school expenditures, e.g. Bergstrom, Rubinfeld & Shapiro (1982), Gramlich & Rubinfeld (1982), Rubinfeld, Shapiro & Roberts (1987), Bergstrom, Roberts, Rubinfeld & Shapiro (1988) and Rubinfeld & Shapiro (1989).[2]

We use data from 1991, the year when the responsibility for providing primary and upper secondary education was decentralized to the local level. At this time, the share of pupils

[1] The primary education is compulsory, and covers the first to the ninth grade. In 1991, the upper secondary school comprised two to three years of theoretical or vocational education.

[2] Survey data has also been applied by Preston & Ridge (1995) on UK data, by Rongen (1995) on Norwegian data, by Shapiro & Papadakis (1993) on Australian data and by Schokkaert (1987) on Belgian data.

attending private schools was negligible. Despite decentralization, the provision of a minimum standard of education to all – irrespective of income or residence – remained a national policy objective. This was to be achieved through a grant system, with the aim of canceling out differences in per capita costs across municipalities due to such factors as geographic location or demographics. Despite this, the variation in local per capita spending on schools has been significant, warranting an investigation of the preferences for local public school expenditures.

The paper is organized as follows. In the next section we present the theoretical model. In section 3, we describe and discuss the data. Section 4 reports and interprets the results, while section 5 extends the analysis by testing for differences in demand between public and private employees. In section 6, finally, we briefly compare our results with those of earlier US- and Swedish studies. Section 7 concludes.

2. A Model of the Demand for Schooling

2.1 Theoretical model

Assume that the individual (i) receives utility from private consumption (C_i) and publicly provided education, measured by per capita spending on primary and upper secondary education (G_i) in i's home municipality. The individual maximizes the following utility function

$$U_i = U(C_i, G_i) \tag{1}$$

subject to her private budget constraint

$$C_i = (1 - t_i) y_i \tag{2}$$

as well as the municipal budget constraint

$$N_i G_i = t_i N_i \bar{y}_i + N_i S_i \qquad (3)$$

where t_i denotes the local tax rate, N_i the population in the municipality, $\bar{y}_i$ the municipality mean income and S_i the per capita central government grants targeted to schools in i's home municipality. Inserting (3) in (2) yields

$$C_i + t_i G_i = y_i + t_i S_i . \qquad (4)$$

From equation (4) we can see that the price for schooling will be given by the individual's taxprice $t_i = y_i / \bar{y}_i$ and that the individual's income will consist of two terms; personal income and the individual's share of public income, $t_i s_i$. Inserting (4) in (1) and assuming some specific functional form for the utility function, we can derive a demand equation. We will use two different specifications; a log-linear demand specification as well as a linear.

2.1.1 Log-linear demand specification[3]

Studies investigating the demand for schooling typically use a log-linear demand specification, and we will start by following these papers. The log-linear specification is globally consistent with maximizing a Cobb-Douglas utility function with unitary price- and income elasticities.[4] We will however not restrict the elasticities to one, but rather investigate if this is really the case.

In the log-linear case individual i's demand for local public school spending, G_i^*, is given by

$$\ln G_i^* = b_0 + b_1 \ln(y_i + t_i s_i) + b_2 \ln t_i + \sum_{j=3}^{J} b_j x_{ij} - \ln e_i , \qquad (5)$$

where the definition of the taxprice and the individual's income is defined as in (4). Furthermore, x_i is a $J \times 1$ vector of socio-economic variables, b a vector of parameters to be estimated, and $\ln e_i$ is an independently and identically distributed random variable. Using this

[3] This is the same approach as in, e.g., Bergstrom, Rubinfeld & Shapiro (1982).
[4] See Rubinfeld (1987) for a discussion of this.

demand specification the elasticities are represented by the coefficients b_j, which makes them easy to calculate.

2.1.2 Linear demand specification

As an alternative to the log-linear specification we also estimate a linear model. Assuming a specific form of the utility function[5] we reach the following, linear demand equation

$$G_i^* = b_0 + b_1(y_i + t_i s_i) + b_2 t_i + \sum_{j=3}^{J} b_j x_{ij} - e_i, \qquad (6)$$

with the same definitions of taxprice, income and socio-economic variables as in the log-linear specification. The income- and price elasticities are given by

$$h_y = b_1 \frac{y_i}{G_i} \qquad (7a)$$

$$h_t = (b_1 s_i + b_2)\frac{t_i}{G_i} \qquad (7b)$$

2.2 Estimation method[6]

In our data, we do not observe G_i^* directly. What we do observe is whether individuals are satisfied with the home municipality's efforts, or if they want the municipality to spend more or less than at present. Combined with information about the actual level of spending, we can estimate individuals' preferences using an ordered logit model. Next, we will describe how this is done.

Let us, for simplicity, assume that we have the following simple log-linear demand specification

[5] This type of utility function is the same as used in the labor supply literature by, e.g., Hausman (1980). See Dahlberg & Jakobsson (2000) for the formula.

[6] The estimation method used in this paper is the same method as was proposed and used by Bergstrom *et al*. (1982).

$$\ln G_i^* = b_0 + \sum_{k=1}^{K} b_k z_{ik} - \ln e_i \tag{8}$$

where z_i is a vector of regressors.

Let G_i denote actual spending in the municipality where i lives. Assume that individuals will express dissatisfaction with the level of public spending if G_i deviates from G_i^* with a sufficiently large fraction, which we denote d. Hence, individuals will answer "increase spending" if $G_i^* > dG_i$, "satisfied" if $G_i/d \le G_i^* \le dG_i$ and "decrease spending" if $G_i^* < G_i/d$.

Inserting this into (8) and rearranging gives:

"more" if $\ln e_i < b_0 + \sum_{k=1}^{K} b_k z_{ik} - \ln d - \ln G_i$ (9)

"less" if $\ln e_i > b_0 + \sum_{k=1}^{K} b_k z_{ik} + \ln d - \ln G_i$ (10)

"same" if $b_0 + \sum_{k=1}^{K} b_k z_{ik} - \ln d - \ln G_i \le \ln e_i \le b_0 + \sum_{k=1}^{K} b_k z_{ik} + \ln d - \ln G_i$ (11)

If we assume that $\ln e_i$ follows a logistic distribution with zero mean and variance s_e^2, lne_i/s will have a logistic distribution with zero mean and unit variance. Knowing this, we can rewrite (9) – (11) in terms of the likelihood for each outcome:

$$F\left(\frac{b_0}{s} + \sum_{k=1}^{K}\frac{b_k}{s} z_{ik} - \frac{1}{s}\ln d - \frac{1}{s}\ln G_i\right) \tag{9'}$$

$$1 - F\left(\frac{b_0}{s} + \sum_{k=1}^{K}\frac{b_k}{s} z_{ik} + \frac{1}{s}\ln d - \frac{1}{s}\ln G_i\right) \tag{10'}$$

$$F\left(\frac{b_0}{s} + \sum_{k=1}^{K}\frac{b_k}{s} z_{ik} + \frac{1}{s}\ln d - \frac{1}{s}\ln G_i\right) - F\left(\frac{b_0}{s} + \sum_{k=1}^{K}\frac{b_k}{s} z_{ik} - \frac{1}{s}\ln d - \frac{1}{s}\ln G_i\right) \tag{11'}$$

where $F(\cdot)$ denotes the cumulative distribution function.

The likelihood function to be maximized is then given by

$$\prod_{\in more} F\left(\frac{b_0}{s}+\sum_{k=1}^{K}\frac{b_k}{s}z_{ik}-\frac{1}{s}\ln d-\frac{1}{s}\ln G_i\right)\times$$
$$\times\prod_{\in less}\left(1-F\left(\frac{b_0}{s}+\sum_{k=1}^{K}\frac{b_k}{s}z_{ik}+\frac{1}{s}\ln d-\frac{1}{s}\ln G_i\right)\right)\times \qquad (12)$$
$$\times\prod_{\in same}\left(F\left(\frac{b_0}{s}+\sum_{k=1}^{K}\frac{b_k}{s}z_{ik}+\frac{1}{s}\ln d-\frac{1}{s}\ln G_i\right)-F\left(\frac{b_0}{s}+\sum_{k=1}^{K}\frac{b_k}{s}z_{ik}-\frac{1}{s}\ln d-\frac{1}{s}\ln G_i\right)\right)$$

Estimation of an ordered logit model yields the coefficients (b_k/s) and ($1/s$), from which the elasticities of interest, b_k, can be obtained. The estimation process also produces two "intercept terms", in which the threshold value is included; ($b_0/s + \ln d/s$) and ($b_0/s - \ln d/s$).

If we instead have a linear demand specification, we proceed in the same way; that is, we combine the actual spending level in the home municipality with the answers given in the survey to identify the individuals' demand and elasticities. More specifically, an individual is assumed to answer "urgent to do more" if $G_i^* > G_i + d$, "satisfied" if $G_i - d \geq G_i^* \geq G_i + d$, and "efforts should be diminished if $G_i^* < G_i - d$. [7]

3. Data

In this study we combine survey data from the Local Citizen Survey[8] with municipal data. The survey consists of data on 7550 individuals living in 28 Swedish municipalities.[9] It includes

[7] Note that the interpretation of d differs from above; there it was a proportion now it is a sum. In order to get a comparative expression summarize d and G_i and divide by G_i.

[8] The principal investigator was Folke Johansson at the Department of Political Science, Göteborg University. The data sets are handled and distributed by the Swedish Social Science Data Service (SSD) at Göteborg University. A detailed description of the sample procedure and construction of the survey is available in Johansson, Lorentzon & Strömberg (1993).

[9] The municipalities are the following: Upplands-Väsby, Nacka, Tierp, Uppsala, Enköping, Katrineholm, Eksjö, Kalmar, Staffanstorp, Kävlinge, Sjöbo, Trelleborg, Munkedal, Göteborg, Lysekil, Ale, Tranemo, Grästorp, Töreboda, Lidköping, Kil, Surahammar, Västerås, Härjedalen, Sorsele, Kalix, Gällivare, Luleå.

information on individual specific characteristics such as the respondents' age, sex, income[10], type of employment and presence of children in the family. After deleting observations where we have missing values on at least one of the variables of interest, we are left with 2298 observations[11]. The respondents are asked about their preferences for publicly provided local services. More specifically, they are asked the following question:

(Q1) On this card are shown certain things for which the municipalities are responsible. Please indicate for each and every one of them whether you feel that it is urgent that your municipality does more than it is doing at present, that generally speaking things are satisfactory at present, that the municipality's efforts should be diminished, or that you have no opinion about it.

a. School
b. Child care
c. Elderly care
d. Culture
e. Roads
f. Social assistance

The question above has one important shortcoming, it does not link an increased level of services to a corresponding tax increase. In order to control for the individual's willingness to pay for announced preferences, we need to use more information from the survey. The question stated below serves our purposes;

(Q2) Consider the following claim: It is more urgent to lower the local taxes than to raise the level of local services. Do you

a. agree completely
b. agree on the whole
c. disagree on the whole
d. disagree strongly
e. have no opinion

[10] The survey data provides observations from a single year. If the individuals' income significantly deviates from the permanent income during the year of observation, the income elasticity can be expected to be understated (See Gramlich and Rubinfeld, 1982, for a discussion).

If an individual considers it ”urgent the municipality does more than at present” with respect to schools, but at the same time agrees (completely or on the whole) with the claim in Q2, one would suspect that this person would have expressed a different opinion in Q1, had this question been linked to increased taxes. In order to capture individuals' preferences for schooling, we therefore combine the answer in Q1 to the one in Q2.[12]

In doing this, we need to consider that question Q2 is not specifically linked to schooling, but to local services in general. Consequently, a respondent considering it ”more urgent to lower local taxes than to raise the level of local services”, may refer to the level of all local services but schooling. We take this possibility into account by relating the answer given with respect to schooling (alternative Q1a) to the individual's average preference for local public spending, which we calculate by using the answers to Q1a-f. [13] Thus, we control for the individual's willingness to pay in the following way:

A. If the individual

I) answers Q1a with ”more” or ”same”,

II) answers Q2 with ”agree completely”, and

III) expresses lower or the same preferences for schooling than for the average public service,

we interpret this as a preference for *less* spending on schools

B. If the individual

I) answers Q1a with ”more”,

II) answers Q2 with ”agree on the whole”, and

[11] The individuals left out of the sample due to missing values are equally distributed across municipalities and with respect to socio-economic characteristics.

[12] It could also be argued that the individuals answering Q1a with ”urgent the municipality does more” expresses an opinion for organizational change - which does not require an increase in the tax rate - rather than more spending. In particular, this could be the case if they also agree with the claim in Q2. Using the answers to an additional survey question, relating to school quality, we could conclude the following; only a very small fraction – 4.6 percent – of the respondents in this “critical group” expressed dissatisfaction with the school quality. This might be an indication that interpreting ”urgent to do more” as a preference for increased spending is not too problematic.

[13] The preferences for the average public service is calculated by coding each answer as 1 if the individual expresses a preference for less spending, as 2 if the individual is satisfied and as 3 in case of a preference for more spending. Having done this, the mean is calculated, yielding a value ranging from 1 to 3, to be compared with the answer given on question Q1a (also ranging from 1 to 3).

III) expresses lower or the same preferences for schooling than for the average public service

we interpret this as if the individual is satisfied and has a preference for the *same* level of spending on schools

C. If the individual

I) answers Q1a with ”same”,

II) answers Q2 with ”agree on the whole”, and

III) expresses lower or the same preferences for schooling than for the average public service,

we interpret this as a preference for *less* spending on schools

D. Otherwise we assume that the answer given in Q1a directly expresses the individual's preferences.

In Table 1 we present the resulting frequencies of ”less”, ”more” and ”same” –answers, divided according to employment status, sex, voting behavior, taxprice and income.

The figures in Table 1 indicate that public employees in general want more spending on schools than private employees, women want more than men and left-wing voters want slightly more spending than right-wing voters. The higher income people have, the more public spending on schools is preferred. The same is, somewhat surprisingly, true for the taxprice; the larger proportion of higher public spending that the individual has to pay, the more spending is preferred. These figures do however not control for the actual level of spending in the municipalities, and must be interpreted with care.

The municipal data set includes local school expenditures per capita, mean income, per capita grants targeted to education, and population (see Table A.1 in the appendix for a complete list of variables and Table A.2 for summary statistics).[14] Using school expenditures instead of output, which is hard to measure, will give biased estimates if variations in actual spending are influenced by cost differences across communities rather than purely quantitative differences. Teachers' wages constitute a significant part of the production cost and it could be a problem if

[14] Source: Kommunförbundet and Statistics Sweden (1992).

wages differ much across municipalities for teachers of the same ”quality” (education and experience). In 1991 there was however a centralized system of wage bargaining for teachers and any observed differences in wage costs are more likely to represent differences in the number of teachers and their experience rather than differing geographical wage setting strategies. In addition, any structural cost differences that the municipalities cannot influence, such as demographic and geographical factors, are to be compensated for through the grant system. In 1991, the municipalities received grants targeted to the school sector on the basis of structural factors such as the density of school-aged children in the community, the share of immigrant children in the population and the number and costs of programs run in upper secondary school. As these grants are included in our analysis, in a way that was specified in section 2, we should not expect the estimations to be biased due to structural cost differences.

Table 1. Distribution of Preferences for School Expenditures

	less	*same*	*more*
Full sample	0.171	0.347	0.482
Type of employee			
Public employees	0.132	0.328	0.540
Private employees	0.203	0.344	0.453
Sex			
Women	0.132	0.342	0.526
Men	0.209	0.352	0.439
Political preferences			
Left-wing voters	0.120	0.386	0.494
Right-wing voters	0.212	0.313	0.475
Income			
Income < 95000	0.171	0.401	0.427
95000 > Income > 140000	0.150	0.350	0.500
Income >140000	0.191	0.288	0.521
Taxprice			
Taxprice < 0.68	0.168	0.395	0.438
0.68 < Taxprice < 1.04	0.148	0.360	0.491
Taxprice > 1.04	0.194	0.293	0.513

4. Empirical Results

Let us now turn to the estimations. We have used two different specifications of the demand equation; a log-linear and a linear one. For both the log-linear and the linear specification we estimate a parsimonious model (*Model 1*) as well as an extended model (*Model 2*). The former includes only the variables needed for estimating the elasticities, i.e. spending per capita, income and taxprice. *Model 2* also includes socio-economic individual specific variables. Some of these variables, e.g. age, are likely to be correlated with income. As a result, we should expect the income elasticity of demand to be less elastic in *Model 2*, reflecting a 'pure' effect of a marginal change in the individual's income on demand in contrast to the composite effect implied by *Model 1*.

While the ordered logit estimates treat individual location as exogenous, the central argument in Tiebout (1956) is that those who are dissatisfied with the level of public spending in their home municipality will move to the municipality providing the mix of public spending and taxes most in accordance with their tastes. In fact, the endogeneity of location is the mechanism ensuring efficient provision of public services. If this 'vote-with-your-feet'-mechanism worked perfectly, we would only observe 'satisfied'-answers in our survey, which is not the case. Nevertheless, as long as there is some truth in the Tiebout model, we risk getting biased estimates if we do not control for potential Tiebout sorting.[15] In order to get consistent estimates, we applied the two-step procedure outlined in Rubinfeld *et al.* (1987) to both models in the log-linear and the linear setup, respectively. In doing so, we could not reject the null of no Tiebout bias in any of the setups. Therefore we present the results from the estimations where we do not control for Tiebout sorting. A thorough description of the methodology used to test and control for Tiebout bias, the ensuing results and a discussion of these are given in the appendix.

[15] Controlling for the so called Tiebout bias when estimating the demand for local school expenditures in Michigan, Rubinfeld *et al.* (1987) and Bergstrom *et al.* (1988) find that the results change dramatically taking this mechanism into account. Rubinfeld & Shapiro (1989), on the other hand, cannot reject the null that there is no Tiebout bias in school demand estimates for Massachusetts. Neither can Preston & Ridge (1994) when investigating the demand for local public spending in the UK.

The results from the estimations are presented in Table 2 and Table 3.[16] Let us begin our study of these by looking at the elasticities, presented in Table 2. In all four specifications, the elasticities have their expected signs. It turns out that it matters how we specify our model. The parsimonious models give higher elasticities both in the log-linear and the linear specification. As mentioned above, this is to be expected when socio-economic variables correlated with income is excluded in the parsimonious model. We can also note that the elasticities are lower when we choose a linear, instead of a log-linear, specification of the demand equation. For example, in the extended model, the income elasticity is 0.73 in the linear specification, to be compared with 1.13 in the log-linear one. The corresponding figures for the taxprice elasticities are -0.74 and -1.07 respectively. Any precise statements about the magnitude of the elasticities are, however, prevented by the relatively wide confidence intervals. Of the two specifications, the linear one is associated with somewhat smaller standard errors. Finally, it can be noted that in the case of the log-linear specification of *Model 1*, neither the point estimate of the income elasticity, nor the corresponding tax price estimate, is significantly different from one (in absolute terms). Thus, the log-linear specification is consistent with a maximized Cobb-Douglas utility function.

Turning to the socio-economic variables in Table 3 we find that, irrespective of whether the log-linear or the linear specification is used, being female, municipally employed, of working age and having children – in particular if these are of school age – increases the probability of demanding more school spending. In all setups, the coefficients have the expected signs and are statistically significant but in one case (the dummy indicating whether the individual is 60-70 years of age). The three coefficients used for deriving the elasticities are throughout significant on a one-percent level, as are the elasticities. The negative sign preceding the spending coefficient tells us that a positive change in school expenditures decreases the probability of demanding more spending. Correspondingly, an increase in the taxprice decreases the

[16] Bergström, Dahlberg & Johansson (1998) found different parameters on own income and grants when investigating Swedish municipal labor demand. Having this in mind, as well as the flypaper effect, we also estimated the following model :

$$\ln G_i^* \approx b \ln t_i + b_2 \ln y_i + b_3 \frac{t_i s_i}{y_i} + \sum_{j=4}^{J} b_j x_{ij} - \ln e_i$$

Testing the hypothesis that $b_2 = b_3$, we could not reject the null of equal parameters. Neither could we find evidence of a flypaper effect in the linear specification, in which case the corresponding test is whether $a_1 = a_2$ in the following equation:

$$G_i^* = b_0 + a_1 y_i + a_2 t_i s_i + \sum_{j=3}^{J} b_j X_{ij} - e_i$$

probability of demanding more spending, while the opposite interpretation is valid when individual income increases.

Table 2. Elasticities for local school expenditures

	Log-linear		Linear	
Elasticity	Model 1	Model 2	Model 1	Model 2
Income	1.636***	1.131***	1.200***	0.734***
	(0.399)	(0.308)	(0.283)	(0.236)
Taxprice	-1.596***	-1.073***	-1.219***	-0.744***
	(0.382)	(0.296)	(0.288)	(0.244)

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) Standard error in parentheses

Table 3. Estimated demand for local school expenditures

	Log-linear		Linear	
	Model 1	Model 2	Model 1	Model 2
Ordered logit coefficients				
Spending	-1.588***	-1.685***	-1.98e-04***	-2.14e-04***
	(0.264)	(0.300)	(3.610e-5)	(4.10e-05)
Income	2.598***	1.907***	1.39e-05***	9.16e-06***
	(0.370)	(0.423)	(2.49e-06)	(2.65e-06)
Taxprice	-2.535***	-1.808***	-1.931***	-1.269***
	(0.370)	(0.423)	(0.349)	(0.379)
Female		0.327***		0.278***
		(0.088)		(0.088)
Age_30		0.809***		0.791***
		(0.189)		(0.186)
Age_40		0.800***		0.842***
		(0.207)		(0.207)
Age_50		0.717***		0.787***
		(0.192)		(0.191)
Age_60		0.371*		0.417**
		(0.198)		(0.198)
Age_70		0.129		0.167
		(0.201)		(0.200)
Municipal		0.335***		0.358***
		(0.108)		(0.108)
Child		0.208*		0.226*
		(0.120)		(0.119)
School child		0.345***		0.341***
		(0.110)		(0.110)
b_0	-9.944	-4.554	11357.01	6606.555
d	1.700	1.665	1.577	1.548
N	2835	2298	2835	2298
Log L	-2856	-2243	-2866	-2249
LR chi2 (df)	75.69 (3)	192.52 (12)	55.93 (3)	180.68 (12)

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) Standard error in parentheses
iii) The LR-test tests the joint significance of all coefficients.

Does it matter how we specify the dependent variable? Running the ordered logit estimations on the basis of three alternative definitions of the dependent variable, the qualitative results do not change.[17] The estimated coefficients, elasticities and the associated standard errors are similar in magnitude, and the statistical significance remains the same. We therefore conclude that the results are not particularly sensitive to the definition of the dependent variable.

5. Public and Private Employees

Do public employees tend to have a higher demand for public spending than private employees have? Some support for this hypothesis was given by the above analysis, where the dummy reflecting whether an individual is municipally employed was statistically significant (on a one percent level), hence indicating that the constant in the demand equation differs for municipal employees and others.[18] Considering also the relatively high ratio of municipal employees to total employment in Sweden, amounting to more than 20 percent at the time of the survey, this issue seems relevant to investigate further. We will therefore devote this section to tests for differences in demand between public and private employees.

There are several reasons to expect demand to differ between these two types of employees, one being that cutbacks in public spending might be associated with decreasing job security in the public sector. Another hypothesis is that public employees in general might be more prone towards public services because of, e.g., their political identification. In both these cases, this will be reflected by a differing constant in the demand equation for the two groups of employees. Just assuming public employees to have higher demand for public services because of some underlying taste parameter seems a bit unsatisfactory however. Courant, Gramlich and Rubinfeld (1979b) put forth a theoretical model where the reasons for differences in the demand equations are modeled more thoroughly.[19] In the model, differences in demand are due to differences in the budget constraints. The main mechanism is that the suppliers of the public goods are in part their own demanders, with the private sector having little to do but pay. Consider, for example, public sector wages. For a private employee, higher public sector

[17] These alternative ways of adjusting for the individual's willingness to pay are summarized in Table A.3 in the appendix. The coefficient estimates and elasticities are available from the authors on request.
[18] We have chosen to use municipal employees rather than public employees (which also contains state and county employed) since they supply of education is a municipal matter.
[19] The same topic is discussed in Courant, Gramlich and Rubinfeld (1979a) and in and Gramlich and Rubinfeld (1982).

wages mean that the public services have become more expensive and she will hence demand less public service. For a public employee, this is only one side of the coin, since higher public wages also imply higher income. As a consequence, the price elasticity will be less negative for public employees than for private employees and the income elasticity will be higher.

Below we will test whether the hypothesis that demand differs for public and private employees is true in Sweden. More precisely, we will test if the intercept as well as the slope coefficients differ for people employed by the municipalities.

Consider the following model:

$$\begin{aligned}\ln G_i^* = {} & b_0 + b_1 \ln(y_i + t_i s_i) + b_2 \ln t_i + \sum_{j=3}^{J} b_j x_{ij} + g D_i + D_i l_1 \ln t_i + \\ & + D_i l_2 \ln(y_i + t_i s_i) + D_i \sum_{j=3}^{J} j_j x_{ij} - \ln e_i\end{aligned} \tag{13}$$

where D_i takes the value 1 if the respondent is municipally employed, 0 otherwise. From equation (13), we see that there are least three potential hypotheses that we could be interested in testing:

H1: $g = 0$

H2: $l = 0$

H3: $j = 0$

As always, when there are a number of different hypotheses one likes to test, there is the question of which order to test the hypotheses in. In Table 4 we describe the procedure we have chosen. We use the traditional LR-test given by

$$LR = -2(\ln L^R - \ln L^U), \tag{14}$$

which under the null is distributed as c^2 with as many degrees of freedom as there are restrictions imposed.

Table 4. Tests of model specification

	df	Log-linear model		Linear model	
		LR-test	P-value	LR-test	P-value
i. $g = 0$, given that $l = j = 0$	1	352.25	1.00	357.88	1.00
ii. $l = 0$, given that $g = j = 0$	2	355.32	1.00	367.67	1.00
iii. $j = 0$, given that $g = l = 0$	8	361.74	1.00	368.32	1.00
iv. $l = 0$, given that $j = 0$, $g \neq 0$	2	3.74	0.698	11.43	0.999
v. $g = 0$, given that $j = 0$, $l \neq 0$	1	0.67	0.209	1.65	0.515
vi. $j = 0$, given that, $l = 0$, $g \neq 0$	8	10.11	0.736	11.103	0.804
vii. $j = 0$, given that, $l \neq 0$, $g = 0$	8	11.47	0.749	14.40	0.904

Starting out with a model with no differences between municipal employees and the rest of the population, and testing whether the intercepts differ, we see from line *i* of Table 4 that we reject the null of equal intercepts. If we instead test whether the slope coefficients on income and taxprice differ (line *ii*) we reject the null in this case as well. In line *iii* we test the hypothesis that the socioeconomic variables have the same impact for the two different employee types. We reject this hypothesis as well. [20]

Is it the case that both the intercept and the two slope coefficients are different for the two groups of employees? Assuming that the intercept differs and testing whether the slope-coefficients for income and taxprice differ as well, we can reject the hypotheses that they do not differ (line *iv*) for the linear model but not for the log-linear one. On the other hand, assuming that that the slope coefficients differ and testing the null of equal intercepts, we cannot reject the null (line *v*) for neither of the models. For the linear model the conclusions from these tests are clear-cut; a model with differing coefficient on income and taxprice for municipal and non-municipal employees seems to work best. For the log-linear case, things are not so obvious. Either we need differing intercept, in which case we cannot reject the hypothesis of equal coefficients for taxprice and income (see line *iv*). On the other hand, when allowing these two to differ, we cannot reject the null of equal intercepts (see line *v*). In order to choose which specification to work with, we have used the p-values as a guideline. Having a higher p-value for the test conducted in line *iv* than for the test conducted in line *v*, we are closer to reject the hypothesis tested in line *iv*. Hence, we conclude that the model with equal intercepts but

[20] In addition to the presented tests, we have also tested the hypotheses that all parameters differ, that only taxprice differ and, finally, that only the parameter estimate on income differs. The results from these tests are in line with the results presented in Table 4 and are available upon request.

differing parameter coefficients for income and taxprice is the ”best” specification for the log-linear model as well.

Let us finally test for different slope coefficients on the socioeconomic variables. From lines *vi* and *vii*, we see that we cannot reject the null that they do not differ, neither when we allow for different intercepts for the two types of employees, nor when differing coefficients are allowed. Thus, we can conclude that income and taxprice enter differently for municipal employees, while the constant term seems to be the same across groups, as is the effect of the socio-demographic variables. So in what way do the income and price elasticities differ? In Table 5 we present the results from ordered logit estimations where we allow for different impact of income and taxprice for the two groups of employees.

Table 5. Estimated demand for local public school expenditures – municipal vs non-municipal employees

	Log-linear		Linear	
	Estimate	Standard Error	Estimate	Standard Error
Coefficient				
Spending	-1.691 ***	0.300	-0.00021 ***	0.000041
Income	1.939 ***	0.424	8.58E-06 ***	2.78E-06
Taxprice	-1.867 ***	0.425	-1.203 ***	0.400
Income * Munic	1.974 ***	0.424	2.14E-05 ***	8.21E-06
Taxprice * Munic	-1.673 ***	0.433	-2.442 ***	1.100
Female	0.328 ***	0.088	0.281 ***	0.086
Age_30	0.818 ***	0.189	0.800 ***	0.186
Age_40	0.801 ***	0.207	0.832 ***	0.207
Age_50	0.712 ***	0.192	0.761 ***	0.191
Age_60	0.364 *	0.198	0.385 **	0.198
Age_70	0.128	0.201	0.156	0.201
Children	0.207 *	0.120	0.227 **	0.119
Sch_child	0.349 ***	0.110	0.346 ***	0.110
b_0	-4.739	--	6660.441	--
d	1.663	--	1.550	--
N	2298	--	2298	--
Log L	-2241.09	--	-2243.65	--
LR chi2 (df)	195.59 (13)	--	190.47 (13)	--

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) The LR-test tests the joint significance of all coefficients.

Table 6. Elasticities for local public school expenditures – municipal vs non-municipal employees

	Log-linear		Linear	
Elasticity	Estimate	Standard Error	Estimate	Standard Error
Income	1.147 ***	0.294	0.723 ***	0.253
Price	-1.104 ***	0.291	-0.739 ***	0.264
Income, munic employed	1.167 ***	0.296	1.515 ***	0.642
Price, munic. employed	-0.989 ***	0.286	-1.266 **	0.614

Note: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.

From Table 6, we see that whereas the income elasticity is higher for municipal employees than for others, the price elasticity is lower, even though the differences are very small for the log-linear model. This is as we would expect from economic theory. Looking at the linear model, we see that the income elasticity for municipal employees is 1.52, to be compared with 0.72 for the rest of the population. The corresponding figures for the price-elasticities are -1.27 and -0.74. These elasticities are however not significantly (in a statistical sense) different for municipal and non-municipal employees, because of the rather large standard errors. It is also worth noting that the elasticities for the non-municipal employees are very similar to the ones presented in Table 2.

6. A comparative perspective

A number of American studies estimate taxprice and income elasticities of local school expenditures using the same method as we do[21]. Needless to mention, the US system differs considerably from the Swedish one, with respect to the school setting as well as other aspects. A comparison between studies applying the same method of estimation is nevertheless of interest. It is also of value to know whether our survey data estimates correspond to those found in earlier Swedish work, where other methods have been employed.

[21] See Bergstrom *et al* (1982) for a comparison between macro and micro estimates and Inman (1979) for a review of demand estimates for public education as well as other local public services.

6.1. A comparison with American Studies

In Table 7 we list American studies estimating a log-linear demand equation, using survey data. All of them examine the demand for schooling.

In contrast to our findings, Rubinfeld *et al*. (1987) and Bergstrom *et al*. (1988) find evidence of Tiebout sorting, using Michigan survey data. Since our data contains a set of randomly chosen municipalities across the country, and only a few municipalities in the vicinity of the larger Swedish cities, it is likely that the mobility costs are considerably higher than in the Michigan data set. This might explain the divergent results.

Table 7. Estimated income/taxprice elasticities of demand for local school expenditures in studies applying US survey data on a log-linear demand specification

Study	**Income/taxprice elasticity**
Models that do no control for Tiebout sorting [22]	*Log-linear demand specification*
Bergstrom *et al* (1982)	Parsimonious model 0.83 / -0.57 Extended model 1 0.49 / -0.41 Extended model 2 0.38 / -0.43
Gramlich & Rubinfeld (1982)	Macro data using median income 0.53/ 0.01 Survey data, different models 0.29—0. 409 / -0.011—0.014
Rubinfeld & Shapiro (1989)	Parsimonous models 0.83—0.93 / -0.57— -0.72 Extended models 0.38—0.72 / -0.43— -0.70
Rubinfeld *et al.* (1987)	Extended model 0.32 /-0.32
Models controlling for Tiebout sorting	
Bergstrom *et al*. (1988)	Extended model 0.23 / -0.87
Rubinfeld *et al.* (1987)	Extended model 0.10 / -0.11

[22] As the results from estimating a Tiebout corrected model are sensitive to the instrumental variables used, we believe that it is relevant to look at the estimates that do not control for potential Tiebout sorting as well.

How do the elasticities of the US-studies compare to ours? Bergstrom *et al.* (1982) and Rubinfeld & Shapiro (1989) estimate a model similar to our parsimonious one (*Model 1* in Table 3). As the resulting income elasticities (price elasticities) ranges from 0.83 to 0.93 (from -0.57 to -0.72), demand seems much less elastic than according to our findings where, in the log-linear case, the point estimates centers around 1.5, in absolute terms.

Comparing the results of the extended models, it can be noted that the US estimations tend to control for a larger set of socio-economic variables than we do in *Model 2*.[23] Not taking potential Tiebout sorting into account, the point estimates of the income elasticity (taxprice elasticity) run from 0.29 to 0.72 (from -0.01 to -0.72), while the Tiebout corrected estimates vary from 0.10 to 0.23 (from -0.11 to -0.87). Evidently, these results suggests considerably less elastic demand compared to our log-linear case, while the "uncorrected" results are not out of line with those of our linear demand specification.

6.2 A Comparison with Swedish studies

As mentioned above, there are four different methods available when estimating the demand for publicly provided goods, for which there is no market; the survey data method, used in this paper, the median voter model, the hedonic approach and the random utility model. Each of these methods has their strengths and weaknesses. With the results pointing in the same direction, however, we will have a more comprehensive picture of individual demand for local public goods in Sweden.

In Table 8, we compare the results from this paper with the findings of earlier Swedish studies using other methods. One fundamental difference to our study is that these are based on macro or household data rather than micro data. Also, they focus on demand for local public services in general, and not on a specific sector such as education. This latter difference is to be kept in mind when interpreting the results.

The models in the Swedish studies typically include variables reflecting household or municipal characteristics (see Table 8). Thus, a comparison of results should primarily focus

on those of our extended model (*Model 2*). Consistent with our findings, attributes such as municipal age structure, presence of children in the household and a woman head of the household are statistically significant and positive, irrespective of the methodology employed.

Table 8. Estimated income/taxprice elasticities of demand for local public services in Sweden

Study	**Method**	**Year**	**Variables in demand function**	**Income/taxprice elasticity**
Boije (1997)	Hedonic	1990	(i) Household attributes: INC, AGE, CHILD, SEX, MARITAL, SINGLE Dep. var: MARG PRICE OF LOCAL PUB SERVICES	0.09 / -0.89
Aronsson & Wikström (1996)	Median voter	1990	(ii) Municipal attributes: PRICE, INC, POL, AGE, DEM, REGIONAL Dep. var: LOCAL PUB. EXP.	0.82/-0.53 Median voter model 0.87/-0.53 General model
Dahlberg & Jakobsson (2000)	Median voter	1981-1987	(iii) Municipal attributes: INC, TAXPRICE, AGE, DEN. Dep. var: LOCAL PUB. EXP.	Log-linear demand 1.30 / -1.48 Fixed effect 0.45/ -0.67 GMM, static 0.47/ -0.74 GMM, dynamic Linear demand 0.57/-0.91 Short run, dynamic 0.83/-1.32 Long run, dynamic
Ahlin & Johansson (2000)	Survey data	1991	(iv) Individual attributes: INC, TAXPRICE, AGE, SEX, MUNIC EMPL, CHILD, SCHOOL CHILD. Dep. var: LOCAL PUB. SCHOOL EXP.	Log-linear demand: 1.13/ -1.07 Linear demand: 0.73/-0.74

(i) INC – disposable household income, AGE – age of the head of household, CHILD – no of children in household, SEX – dummy for female head of household, MARITAL – dummy for married head of household, SINGLE – dummy for one member household.
(ii) PRICE – per capita tax base, INC – median income, POL – share of members in local council repr socialist parties, AGE – municipal age structure, DEM – size and density of municipal population, respectively, REGIONAL – dummy indicating geographic location, LOCAL EXP – total operating cost net of user fees.
(iii) INC – median household income before tax + taxprice*grants, TAXPRICE – household median income/household mean income, AGE – young and old population, respectively, DEN – density of municipal population.

[23] In the survey used in this study, the questions relating to, e.g., the educational level, occupational status (employed/unemployed/welfare receipent) and citizenship of the respondent contained too many missing observations for them to be included in the estimations.

Boije (1997) and Aronsson & Wikström (1996) both use the same municipal data set from 1990. Relying on hedonic price functions, Boije's results indicate substantially lower income elasticity than the median voter framework of Aronsson & Wikström, or in any of the other studies, while the price elasticity is higher. Relating these results to our point estimates, the price elasticity given by the hedonic approach is of a similar magnitude as that of the linear demand model. However, the income elasticity resulting from the linear specification, corresponds more closely to those of the median voter model.

Dahlberg & Jakobsson (2000) take dynamics and endogeneity into account in a panel for the years 1981-1987. Like we do, they find that the log-linear demand specification is consistent with maximizing a Cobb-Douglas utility function with unitary income and price elasticities. The point estimates of Dahlberg & Jakobsson for the log-linear model are lower than ours. Their estimates of a linear demand specification on the other hand, are slightly higher, at least in the long run. Finally, when estimating a fixed effect log-linear model, they find somewhat more elastic demand than we do in our log-linear version of the extended model.

7. Conclusions

In this paper, we have used survey data from 1991 to estimate individual demand for local public school expenditures. In particular, we have estimated income and taxprice elasticities. We have also tested the hypothesis that the preferences of municipal employees differ from those of other types of employees. When examining these two topics, we did not find any evidence of Tiebout sorting.

In a log-linear setting, a model including individual specific socio-economic variables indicates rather elastic demand, both with respect to income and taxprice (1.13 and –1.07, respectively). We cannot reject the hypothesis that the elasticities differ from unity, which indicates that the log-linear demand specification is consistent with maximizing a Cobb-Douglas utility function. Furthermore, demand is found to be considerably more elastic than in US-studies using survey data to estimate demand for local public school expenditures. In addition, our elasticities are higher than the ones typically found in earlier Swedish studies. Estimations of a linear demand specification indicate considerably less elastic demand (0.73 and –0.74, respectively), which to a large degree is consistent with previous findings for

Sweden based on a median voter framework, in particular in a setting where dynamics is controlled for. Remember, however, that the earlier Swedish studies investigate total local public spending rather than school spending alone.

From our analysis of whether there are significant differences in demand between municipally employed and others, we conclude that income as well as taxprice enter differently in the demand function for municipal employees. On the other hand, we cannot find evidence of differences with respect to the constant term, or the socio-economic variables. As predicted by theory, the income elasticity is higher for municipal employees than for others. The price elasticity associated to municipal employees is lower than for the other group of employees only in the log-linear specification. However, the latter differences are not significant, in a statistical sense.

Besides employment status, being female, of working age and having children increases the probability of demanding more spending on schools. Not controlling for these individual characteristics yields considerably higher income and taxprice elasticities (in absolute terms).

Evaluating the efficiency of local public provision of schooling cannot be accomplished by demand elasticities alone. An important task for future research is therefore to investigate the supply side more thoroughly. Also, from a comparative perspective it would be interesting to estimate the demand for *total* local public spending using survey data. Finally, a theoretical model explaining differences between private and public employees' demand for public spending, adapted to the Swedish setting, would be a useful contribution to local public finance.

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Appendix

A.1. Variable definitions and summary statistics

Table A.1 Definitions of variables

TAXPRICE	respondent's taxprice (respondent's gross income/municipal mean income)
INCOME	(respondent's gross income + taxprice*grants per cap)
FEMALE	1 if female, 0 otherwise
AGE_30	1 if the respondent is 20-29 years; 0 otherwise
AGE_40	1 if the respondent is 30-39 years; 0 otherwise
AGE_50	1 if the respondent is 40-49 years; 0 otherwise
AGE_60	1 if the respondent is 50-59 years; 0 otherwise
AGE_70	1 if the respondent is 60-69 years; 0 otherwise
MUNIC	1 if employed by municipality; 0 otherwise
CHILDREN	1 if children 0-6 years of age; 0 otherwise
SCH_CHILD	1 if children under the age of 16; 0 otherwise
SPENDING	municipal spending per capita on primary and secondary schools
Instruments in "Tiebout regressions"	
EDU_8990	percentage change in municipal spending on schools 1989-1990
EDU_9091	percentage change in municipal spending on schools 1990-1991
LOCAM	number of municipalities in the labor market area
TRANSP	the number of kilometers of local public transportation per square kilometer in the county
ST_DEV	standard deviation of personal income in the municipality

Table A.2 Summary statistics

Variable	Mean	Std. Dev.	Min	Max
DEP VAR	2.311464	.7457188	1	3
TAXPRICE	.9402138	.8090001	.0062972	25.2766
INCOME	128641.4	116956.7	1022.029	3651313
FEMALE	.4941799	.5000543	0	1
AGE	43.2769	15.70113	18	80
MUNIC	.2032737	.4025111	0	1
CHILDREN	.2233918	.4166	0	1
SCH_CHILD	.3109594	.462974	0	1
SPENDING	7321.705	1019.107	5666	9618

A.2. Alternative definitions of the dependent variable

Table A.3 Alternative ways of controlling for willingness to pay when the individual expresses lower or the same preferences for schooling than for the average public service

	Original definition*		Alt. 1		Alt. 2		Alt. 3	
Q1 \ Q2	Agree completely	Agree on the whole	Agree completely	Agree on the whole	Agree completely	Agree on the hole	Agree completely	Agree on the whole
”More”	Less	Same	Less	Less	Less	Same	Less	More
”Same”	Less	Less	Less	Less	Less	Same	Less	Same

Note: * See description on page 8.

A.3. The Tiebout bias

One potential problem with the ordered logit estimates is that they treat individual location as exogenous. If, however, people are dissatisfied with the level of spending (i.e. if $G_i^* \neq G_i$) they could simply move to a municipality where the level of services at the given taxprice is more in accordance with their tastes, as suggested in Tiebout (1956). Obviously, this ”vote-with-your-feet”-mechanism is not likely to work perfectly, considering the costs associated with moving. However, even if this mechanism works only imperfectly, the ordered logit estimates may be subject to bias if Tiebout sorting is not controlled for.

The problem with endogenous individual location can be illustrated in the following way. Let the individual’s optimal level of spending be given by the following demand equation

$$G_i^* = b_0 + x_i' b + e_i . \qquad \text{(A1)}$$

The mismatch between the demanded level and the actual level (denoted by G_i) is given by

$$G_i - G_i^* = g_0 + x_i' g + u_i \equiv v_i . \qquad \text{(A2)}$$

Note that some b_j and/or g_j might be zero. The problem arises if G_i and e_i are correlated, in which case v_i and e_i will be correlated. In this case, the likelihood function will be much more complex than the one given in equation (12). Intuitively, if individuals' choice of community is influenced by the preferences for school spending, the change in the probability that we will register a "less"- or a "more"-answer will be smaller for a given change in actual spending since people move if they are dissatisfied. Instead, we will tend to get "same"-answers, i.e. the estimated coefficients tend to be underestimated. It is, however, not possible to predict *a priori* in which direction the elasticities will be biased, as these are calculated by dividing the (under)estimated income and taxprice coefficients by the (under)estimated spending coefficient.

Testing and controlling for the existence of Tiebout bias involves a two-step procedure, which yields consistent estimates.[24] In a first step, per capita school spending is regressed on the explaining variables of the demand function, x_i, and on a vector of variables explaining the individuals' decisions on where to live but not their demand for schooling, z_i:

$$G_i = (b_0 + g_0) + x_i'b + z_i'g + w_i \qquad \text{(A3)}$$

In a second step, the residuals (w_i) resulting from this regression are included as an additional explaining variable in the original model. If this regressor enters positively and significantly we have evidence of sorting.

For identification to be possible, we need at least one z-variable, i.e. at least one regressor explaining the mismatch but not the demand for schooling. Unfortunately, the results in earlier studies have turned out to be quite sensitive to the choice of instrumental variables. The instrumental variables we use include the degree of labor market opportunities (measured as the number of municipalities within the labor market area) and the availability of public transportation (defined as the number of kilometers of local public transportation per square kilometer in the county) as these are factors which are likely to influence residential choice, but not school demand. In addition, we use the degree of heterogeneity in the population (defined as the standard deviation of personal income in the municipality) as, in the presence of moving

[24] See Rubinfeld *et al*. (1987) for the exact likelihood function and a description of the two-stage procedure used to estimate this.

costs preventing perfect sorting, the level of public services is more likely to deviate from an individual's preferred level if the community is of a heterogeneous composition than if it is homogenous. By the same token, the percent of change in per capita local school expenditures over the previous years is suitable as instrument. Since moving is costly, people might chose not to move even if the actual level of spending changes and thereby deviates from the individual's most preferred level. In a municipality where the spending level has changed a lot, there are more likely to be many inhabitants who are dissatisfied. The results from these regressions are given in Table A.4.

In Table A.5 and Table A.6 the results from the ordered logit estimations are reported. We see the same result occurring in all of the setups; the "Tiebout residual" is positive, but not statistically significant. Thus, we cannot reject the hypothesis of no Tiebout bias.

Table A.4 First-step regression testing for Tiebout bias

	Log-linear		Linear	
	Model 1	Model 2	Model 1	Model 2
Income	1.514***	1.575***	0.010***	0.011***
	(0.085)	(0.094)	(0.001)	(0.002)
Taxprice	-1.511***	-1.577***	-1502***	-1588.89***
	(0.085)	(0.094)	(212.081)	(231.069)
Female		-0.002		-56.082
		(0.005)		(38.418)
Age_30		-0.026**		-117.784
		(0.011)		(86.828)
Age_40		1.172e-04		95.865
		(0.012)		(94.495)
Age_50		-0.003		67.738
		(0.011)		(88.752)
Age_60		-0.003		33.048
		(0.012)		(92.618)
Age_70		-0.007		17.378
		(0.012)		(94.282)
Munic		-0.008		-18.898
		(0.006)		(46.186)
Child		0.004		-22.125
		(0.007)		(50.333)
Sch_child		-0.004		-33.012
		(0.006)		(46.950)
Edu_8990	0.072**	0.071*	47.499	107.390
	(0.034)	(0.038)	(258.552)	(291.354)
Edu_9091	1.152***	1.117***	7021.372***	6802.124**
	(0.034)	(0.037)	(252.669) *	
				(281.699)
Locam	-0.002***	-0.002***	-25.026***	-28.238***
	(4.86e-04)	(5.468e-04)	(3.646)	(4.101)
Transp	-0.005***	-0.004***	-19.072***	-16.9128***
	(4.47e-04)	(5.0e-05)	(3.399)	(3.816)
St_dev	1.37e05***	-1.4e-05***	0.032***	0.0314***
	(1.19e-06)	(1.32e-06)	(0.004)	(0.004)
Constant	-8.726***	-9.419***	6480.901***	6581.414**
	(0.973)	(1.079)	(110.885) *	
				(144.953)

N	2835	2298	2835	2298
F-value	280.72	100.61	191.21	67.77
R2adj	0.409	0.410	0.320	0.317

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) Standard error in parentheses

Table A.5 Estimated demand for local public school expenditure, Second-step regression testing for Tiebout bias

	Log-linear		Linear	
	Model 1	Model 2	Model 1	Model 2
Coefficient estimates				
Spending	-1.888***	-1.902***	-2.75e-04***	-2.5e-04***
	(0.415)	(0.472)	(6.52e-05)	(7.50e-05)
Income	2.681***	1.967***	1.46e-05***	9.56e-06***
	(0.381)	(0.436)	(2.54e-06)	(2.73e-06)
Taxprice	-2.617***	-1.869***	-2.039***	-1.329***
	(0.381)	(0.436)	(0.358)	(0.391)
Female		0.327***		0.276***
		(0.088)		(0.088)
Age_30		0.804***		0.786***
		(0.189)		(0.186)
Age_40		0.802***		0.848***
		(0.207)		(0.207)
Age_50		0.719***		0.793***
		(0.192)		(0.192)
Age_60		0.372*		0.422**
		(0.198)		(0.198)
Age_70		0.130		0.171
		(0.201)		(0.201)
Munic		0.332***		0.356***
		(0.108)		(0.108)
Child		0.209*		0.226*
		(0.120)		(0.119)
Sch_child		0.344***		0.340***
		(0.110)		(0.110)
Tiebout	0.486	0.351	1.08e-04	5.45e-05
Residual	(0.518)	(0.590)	(7.64e-05)	(8.76e-05)
b_0	-7.472	-3.400	10259.63	6737.55
d	1.563	1.571	1.417	1.463
N	2835	2298	2835	2298
Log L	-2855.653	-2242.439	-2864.976	-2248.344
LR chi2 (df)	76.56	192.88	57.92	181.07

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) Standard error in parentheses

iii) The LR-test tests the joint significance of all coefficients.

Table A.6 Estimated demand for local public school expenditure, Second-step regression testing for Tiebout bias

	Log-linear		Linear	
Elasticity	Model 1	Model 2	Model 1	Model 2
Income	1.420***	1.034***	0.909***	0.648***
	(0.308)	(0.290)	(0.234)	(0.227)
Taxprice	-1.386***	-0.983***	-0.929***	-0.658***
	(0.304)	(0.283)	(0.237)	(0.231)

Notes: i) ***, **, * denotes significance at the 1-, 5- and 10-percent level respectively.
ii) Standard errors in parentheses