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Property taxation as incentive for cost control: Empirical evidence for utility services in Norway

Lars-Erik Borge*, Jørn Rattsø

Department of Economics, Norwegian University of Science and Technology, Dragvoll Campus, N-7491 Trondheim, Norway

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Abstract

Recent theoretical research suggests that property taxation has incentive effects that can help control cost problems in the public sector. The institutional setting in Norway allows this first empirical investigation of the incentive effect of property taxation, since we can separate between local governments with and without property tax. The raw data of the variation in the unit cost level for utilities show that local governments with property tax have 20% lower unit cost. Using both linear regression and propensity score matching, we are not able to wash out the difference in unit costs. Our interpretation is that having a visible and controversial local tax related to property stimulates voter interest in local government activities and thereby may help cost control.

JEL classification: H71; H72

Keywords: Property tax; Incentive effects; Public sector costs; Matching

1. Introduction

The design of tax systems may influence the incentives for government behavior. The broad argument was developed by Brennan and Buchanan (1978, 1980) with the proposition that responsive tax bases may help limit the growth of the public sector in the case of Leviathan governments. Wallis et al. (1994) developed the argument further by

*Corresponding author. Tel.: +47 73591941; fax: +47 73596954.
E-mail addresses: larseb@svt.ntnu.no (L.-E. Borge), jorn.rattso@svt.ntnu.no (J. Rattsø).

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combining tax policy and regulation, and labeled it the fiscal interest approach. The basic idea is that public officials prefer policies that relax their budget constraint.

The incentive effects for public officials in particular have been important in the discussion of tax systems for decentralized government. The main policy reform observed to enhance incentives is the poll tax in the UK (see Cullis et al., 1991). The poll tax was introduced to create a direct link between local spending, local taxation and local voters. The motivation was to improve the accountability of local government. The poll tax was assumed to raise fiscal awareness. The poll tax certainly increased fiscal awareness, but also it was abolished when voters protested against a tax unrelated to income and wealth.

Recent research has addressed the incentive effects of the property tax. Oates (2001, p. 23) argues that the property tax is visible and transparent and therefore contributes to an awareness of the costs of local public programs. Already Hamilton (1975) emphasized the strength of the property tax as a benefit tax when combined with fiscal zoning. Glaeser (1996) and Hoxby (1999) are important contributions that explicitly model the relationship between property taxation and cost incentives. In both contributions the source of the cost problem is a Niskanen (1971, 1975) type service-producing agency with preferences for high budgetary slack or low effort. Voters cannot observe slack or effort, and consequently they face a moral hazard problem. Assuming that the agency considers the tax rates as fixed, taxation works as a disciplining device if lower costs (less slack or more effort) increase the tax base and thereby relaxes the budget constraint. Gordon and Wilson (1999) and Wilson and Gordon (2003) analyze the incentives for public officials in the context of tax competition.

Glaeser (1996) provides a comparison of property taxation and income taxation for local governments. Both property taxation and income taxation work as disciplining devices because of feedback effects through the local tax bases. Less slack improves local public services and makes the community more attractive. In Glaeser's model the effects of increased attractiveness are higher property values (increased property tax base through capitalization) and increased population size (increased income tax base). Whether property tax or income tax provides the strongest incentives depends on the response of the tax bases to less slack. Glaeser shows that the property tax provides the strongest incentives if housing demand is inelastic (small increase in population size, large increase in property values), and he argues that inelastic housing demand is in accordance with the empirical evidence.

Hoxby (1999) compares centralized financing (social planner) of school districts and decentralized financing with property taxation. She emphasizes how a local property tax helps to solve the underlying information problem. The effort of the school district is indirectly made verifiable because it is capitalized into property values and thereby affects the budget of the agency. She shows that decentralized property taxation can attain about the same level of cost efficiency as a social planner armed with implausibly much information.

While Glaeser (1996) and Hoxby (1999) assume tax base reaction, Fischel (2001a, b) introduces the concept of 'homevoters', homeowners whose voting is guided by their concern for home values. To protect property values, homevoters will put great pressure on local governments to provide services efficiently. In Fischel's view the homevoter hypothesis strengthens the case for viewing the local property tax as a benefit tax. Eom and Rubenstein (2006) find support for the homevoter hypothesis in a study of property tax exemption in the New York State. They document that tax exemptions are associated with lower government efficiency and argue that the effect is due to reduced incentives of local homeowners to monitor efficiency.

The broad argument is that property taxation raises the fiscal awareness and consequently stimulates the monitoring of local government service costs. Property taxation may work as a disciplining device for local government. The institutional setting in Norway allows for this first empirical investigation of the incentive effect of having property taxation, since we can separate between local governments with and without property tax. The property tax is visible and controversial, and it has been observed that local governments with property tax have a more engaged public debate. The variation in the use of the property tax reflects that it is a voluntary tax and that it is restricted to urban areas. We analyze how the property tax affects the unit cost of a particular utility service, sewage. It may be argued that the voluntary nature of the property tax and the focus on utility costs limit the applicability of the analysis. On the other hand it is the specific nature of the property tax that facilitates the test, and utilities are of direct importance for property values and may therefore be of particular relevance for the incentive effects of property taxation. Fiva and Rønning (2007) offer a similar investigation of the effect of having property tax for schools.

The paper proceeds by a first look at the data in Section 2. In a raw comparison of cost levels, local governments with property tax have 20% lower costs than those without. In Section 3 we discuss the empirical strategy. The two main challenges are that other characteristics may explain the cost difference and non-random selection into property taxation. To address these problems we use linear regression (Section 4) and propensity score matching (Section 5), but the cost difference in favor of local governments with property tax is still economically and statistically significant. In Section 6 we investigate whether the regression and matching results are biased due to selection on non-observables capturing that local governments with property tax have more fiscal stress than those without. We find little support for this objection when analyzing fiscal conditions, fiscal performance, and service standards in other sectors. Finally, concluding remarks are offered in Section 7.

2. Costs and property tax: A first look at the data

Comparing costs of public services is difficult because of lack of data about service output. We have access to unique data across local governments about the costs per standardized user of sewage, an important utility service. Utilities are of particular relevance for the incentive effects of property taxation because they influence property values directly. Local governments are politically responsible for the utility service supply and there has been a concern for their cost level in the public debate.

The cost analysis is based on a dataset prepared by Statistics Norway covering the years 1993–1998. The collection of the data started in 1993, and is described in several reports from Statistics Norway. Bersvendsen et al. (1999) document the 1997 survey. The cost measure is very comprehensive, as it includes capital costs, administrative costs, labor expenses, and maintenance. Conditional grants related to discharge of sewage are deducted. Capital costs are calculated in the same way for all local governments, based on historical investments and the interest rate of the Norwegian local government funding agency (*Kommunalbanken*). In the analysis we focus on the unit costs, which are total costs divided by the number of standard users. No measure of waste is available, and the standardization of users is an alternative way of scaling the costs. A standard user is defined as a household consisting of three people. Firms are converted into standard users according to their consumption of the service. The number of local governments that have reported sufficient and reliable information to calculate unit cost varies substantially from year to year, from a low of 295 in 1998 to a high of 388 in 1995.[1] The total number of observations is 2031. During the period under study, the unit cost has been quite stable in nominal terms on average.

The large variation in the cost level of utilities across local governments has raised discussion about the working of the local political system and control of public service production. The unit cost varies from NOK 500 to 10,000 (USD 80–1600) in 1998 (the latest year in the sample). About half of the local governments have costs per standardized household between NOK 2000 and 4000 (USD 320–640). The focus of the analysis is the importance of property taxation for the variation in unit costs. Based on the theoretical arguments briefly reviewed in the introduction, our working hypothesis is that property taxation will reduce costs.

The financing of Norwegian local governments is quite centralized, and the revenues are dominated by block grants and regulated income and wealth taxes (where all local governments apply the maximum rates). The property tax is an important source of marginal revenue under local control and is not included in the tax equalization system. Local governments without property tax are basically financed by revenue sources regulated by the central government. Local governments with property tax have local discretion to set their revenues, and this invites more active voter engagement.

The property tax is a voluntary tax for the local governments, and applies to both residential and commercial property. However, it is restricted to urban areas and certain facilities, notably hydroelectric power plants.[2] The power plants can be taxed without taxing residential and commercial property in urban areas. In 1998, nearly 50% of the local governments had revenue from property taxation. Around half of these levied property tax on power plants only, and did not tax residential and commercial property in urban areas. Hydroelectric power plants and other facilities that can be taxed without taxing property in urban areas are related to the use of natural resources within the community and are owned by interests outside the community. The taxation of these facilities is best understood as tax exporting that does not provide incentives to reduce costs. For the purpose of this study, only local governments that levy property tax on residential and commercial property in urban areas are defined as 'local governments with property tax', while local governments that levy property tax only on power plants are lumped together with the rest and labeled 'local governments without property tax'. Local governments that only tax power plants are similar to local governments without property tax in the sense that they have chosen not to tax residential property. However, since the classification implies that local governments with power plants are represented in both groups, we will investigate whether the results are robust to exclusion of local governments with high revenues from power plants.

Data on residential property taxation cannot be obtained from local government accounts since they do not separate revenues from different types of property. Our data are based on a survey on residential property taxation conducted by Norwegian Household

[1]The total number of local governments is 435.

[2]From 2007 property tax can also be levied in non-urban areas.

Finances (*Norsk Familieøkonomi*) in 1996. The data for the remaining years are constructed from the 1996 classification and local government accounts. First, some local governments with local property tax in 1996 did not have property tax revenue in the accounts in at least one of the other years. They are classified as not having property tax in the years with no property tax revenue. Second, from the accounts we can identify local governments that abolished property tax in the years 1993–1996 or that introduced property tax in 1997–1998. These local governments are classified as having property tax in the years with property tax revenue if further investigation could confirm that the tax applied to residential property. In the further investigation we have utilized local government web pages and a survey on residential property taxation conducted in 2001.

For the local governments who choose to levy property tax, the tax rate is restricted to a narrow band, between 0.2% and 0.7%. Most of the local governments with property tax apply the maximum rate. It can be argued that the incentive effects of property taxation (discussed in the introduction) are higher the higher the tax rate. However, we have chosen not to utilize information about the tax rate in the construction of the property tax variable. The reason is that the effective tax rate depends both on the formal tax rate (which we have information about) and the assessment rate (which we do not have information about). Since there is some evidence that there is far more variation in the assessment rate than in the formal tax rate (Borge, 2005), it may be misleading to take account of only the variation in the formal tax rate.

Table 1 offers a first look at the cost level when local governments are grouped according to residential property taxation and population size. The table uses data for 1998 comprising 97 local governments with property tax and 198 without. It appears that the raw cost difference is 20% and to the advantage of the municipalities with property tax. The average cost per standardized household is NOK 2363 (USD 380) in the 97 local governments with property tax and NOK 2976 (USD 475) in the 199 local governments without property tax.

The simple control for population size in Table 1 is important in two respects. First, there is some evidence of economies of scale as increased population size is associated with lower costs. Second, the use of the property tax increases with population size. More than 60% of local governments with population size above 25,000 have property tax, compared to only 10% of those with population size below 3000. As a consequence, the raw difference of 20% is likely to exaggerate the impact of property taxation. When the local

Table 1
Cost per standard user in discharge of sewage, local governments with and without residential property tax according to population size

Population size	Without property tax			With property tax		
	Cost	Population	No. of obs.	Cost	Population	No. of obs.
Less than 3000	3856	1823	70	3417	2300	8
3000–5000	3457	3977	36	3035	4070	24
5000–10,000	3422	7210	42	2629	7230	28
10,000–25,000	2904	15,316	39	2496	16,142	20
More than 25,000	2429	45,495	11	2187	60,988	17
All	2976	8441	198	2363	17301	97

The cost is measured in Norwegian kroner (NOK) and the data are from 1998. Weighted averages.

governments are divided into five groups by population size there is still a cost difference in favor of local governments with property tax, but the difference is (in all but one case) substantially reduced compared to the raw difference. For four of the five groups the cost difference is in the order of 10–15%. Although the figures in Table 1 are consistent with our working hypothesis, we need an econometric analysis to conclude whether having property tax reduces costs. The following section addresses important empirical challenges that must be considered in order to check the robustness of the cost-reducing effect.

3. Empirical challenge and strategies

The purpose of the analysis is to investigate the impact of property taxation on costs. In the terminology of the evaluation literature, the outcome studied is the measured cost level C_i for local government i. Having property tax is considered as a treatment. Local government i either has ($PRTAX_i = 1$) or has not ($PRTAX_i = 0$) property taxation. The cost level for local government i is denoted $C_i(1)$ with property tax and $C_i(0)$ without. Our primary interest is whether property taxation affects the cost level, i.e. the difference $C_i(1)-C_i(0)$. The fundamental problem is that we do not observe both $C_i(0)$ and $C_i(1)$ for the same local government.

The statistical challenge is the possible sample selection bias since local governments without property tax may not be representative of those with property tax in the counterfactual situation with no property tax. Decomposition of the raw comparison of average (or expected) costs levels between local governments with and without property tax, corresponding to the bottom row of Table 1, clarifies the selection bias:

$$\begin{aligned} \mathrm{E}[C_i(1)|PRTAX_i = 1] - \mathrm{E}[C_i(0)|PRTAX_i = 0] &= \mathrm{E}[C_i(1) - C_i(0)|PRTAX_i = 1] \\ &+ \{\mathrm{E}[C_i(0)|PRTAX_i = 1] - \mathrm{E}[C_i(0)|PRTAX_i = 0]\}. \qquad (1) \end{aligned}$$

The first term on the right-hand side shows what we are looking for, i.e. the average treatment effect of property tax on the cost level in local governments with property tax (average effect of treatment on the treated). The second term reflects the bias that occurs if the cost level of those without property taxation is not representative of the cost level of the local governments with property taxation if they had not had property tax.

If the assignment of local governments into property taxation is random we will have no bias. However, the economic, political and historical background of having property tax is not random, and there may be systematic differences between local governments with and without property tax. We need to control for observed differences between local governments with and without property tax, and this is done in two ways. First, we run linear regression analyses (Section 4) where we, in addition to the property tax dummy, include a set of other variables ($\mathbf{X}_i$) that are likely to affect the cost level and the selection into property tax. Linear regressions give an unbiased estimate of the average treatment effect if the true cost functions are identical and linear for both groups of local governments and if the selection into property tax depends only on the observable $\mathbf{X}_i$. Second, we use propensity score matching (Section 5) as suggested by Rosenbaum and Rubin (1983). The idea of matching is to approach the estimation of treatment effects as in a controlled experiment. The observations are explicitly split into a treatment group and a control group, and the treatment effect is estimated by comparing each treated observation with untreated observations that are similar in terms of the observed characteristics. As linear regression, matching assumes selection on observables, but is more general in the sense that it allows for non-linearities in the cost function. Our use of linear regression and matching follows the lines of Persson (2001) analyzing the effect of common currency unions on trade and Persson and Tabellini (2002) analyzing the effect of constitutions on the size of government.

Both linear regression and matching assume selection only on the observable $\mathbf{X}_i$. If there is selection on unobservables that affect both the choice of property tax and the cost level, we have an endogeneity problem. It is, however, not clear how this endogeneity problem will bias our results. If high cost local governments have chosen to introduce property taxation to control their cost problem or maintain service provision, linear regression and matching will underestimate the causal effect of the property tax. On the other hand it can be argued that local governments that choose to use the property tax have high spending needs relative to their revenue from other sources than the property tax, and that they levy property tax to supplement their revenues. They have low costs because they are under fiscal pressure and we may observe low sewage costs in local governments with property taxation even if the property tax does not cause local governments to be more efficient.

The test of our working hypothesis is vulnerable to the endogeneity of property taxation in the second story, which basically says that local governments with property tax systematically have more fiscal stress, and consequently a lower cost level, than those without. Unfortunately, we are not able to solve the endogeneity problem by finding an instrument that affects the selection into property tax, but not the cost level. What we can offer is a test of important implications of the claim that local governments with property tax have more fiscal stress than others. The implication is that we should expect local governments with property tax to have weaker fiscal performance and lower service standards in other areas. These implications are tested in Section 6.

4. Analysis I: Linear regression

The linear regression analysis is based on alternative specifications of the following general cost function:

$$\begin{aligned}\log C_{it} = {} & \beta_t + \beta_1\, PRTAX_i + \beta_2\, RURAL_i + \beta_3 \log POP_{it} + \beta_4\, COAST_i + \beta_5 \log(1+\tau_{it}) \\ & + \beta_6 \log G_{it} + \beta_7\, IP_{it} + \beta_8 \log CH_{it} + \beta_9 \log YO_{it} + \beta_{10} \log EL_{it} + \beta_{11} \log Y_{it} \\ & + \beta_{12}\, SOC_{it} + \beta_{13}\, HERF_{it} + u_{it}, \end{aligned} \tag{2}$$

where C_{it} is the unit cost in community i in year t, etc. The included control variables can be divided into three groups reflecting cost factors, demand factors and political factors. The two first cost factors, population size (*POP*) and the share of the population in rural areas (*RURAL*) are included to represent economies of scale and a decentralized settlement pattern. We also include a dummy variable (*COAST*) that captures whether the local government has a coastline or not. Local governments by the coast may have lower costs related to cleaning and transportation of sewage. The payroll tax (τ), which has substantial regional variation, is included to capture differences in labor costs across local governments. The demand variables include private income (*Y*) and per capita grants (*G*). Grants include block grants and regulated income and wealth taxes. Revenues from property tax are not included. Since the true budget constraint is intertemporal, we have included net interest payments as share of grants (*IP*) to take this into account. The final demand variables describe the age composition of the population and are shown to be important in local public finance in Norway (e.g. Borge and Rattsø, 1995). Welfare services like child care, education, and care for the elderly are oriented towards specific age groups of the population. This is captured by three variables describing the age composition of the population: The share of children 0–6 years of age (*CH*), youths 7–15 years (*YO*), and elderly 80 years and above (*EL*). Two variables describe the local political system, the share of socialist representatives in the local council (*SOC*) and a Herfindahl-index measuring the (inverse of the) party fragmentation of the local council. Common trends are captured by time-specific constant terms (β_t), and u is an error term. Summary statistics of the variables (for the year 1998) are reported in Table A1 in Appendix A.

Since the main variable of interest, the property tax dummy (*PRTAX*), has limited time series variation, we cannot rely on estimation methods that only make use of the time series variation in the data. For the most part we report results from pooled OLS regressions. It is well known that the ordinary standard errors may be biased because of correlation between the error terms from the same local government. The bias is in the direction of underestimating the standard errors and overestimating the (absolute) t-values. We deal with this problem by reporting t-values that are based on clustered standard errors where correlation between error terms from the same local government is taken into account.[3] We also report random effects (RE) estimates where correlation between error terms from the same local government is taken into account in the estimation of the parameters, and where the cross-section variation in the data is utilized to a lesser extent.

Table 2 reports the results from the linear regression analyses. Models A–F are pooled OLS regressions, while model G reports RE estimates. The starting point is model A, where we estimate an equation where the property tax dummy is the only explanatory variable (in addition to the time-specific constant terms). The property tax dummy comes out highly significant and with a negative sign. The point estimate indicates that local governments with property tax have a 17.8% lower unit cost than local governments without property tax. This estimate is of the same magnitude as the raw difference in the bottom row of Table 1.

In the next step, model B, we include the cost variables as additional controls. The estimates show the importance of accounting for structural cost conditions of the localities. A more decentralized settlement pattern clearly leads to higher costs. If the share of the population living in rural areas increases by 10 percentage points, the unit cost increases by 4.3%. No evidence of economies of scale for utilities is captured by the population size variable, but the settlement pattern may represent some economies of scale.[4] The coast dummy and the payroll tax both come out highly significant with the expected signs. The estimated elasticity with respect to the payroll tax is clearly above 1 and indicates that the variable represents broad regional effects beyond the direct effect through labor costs. Inclusion of the cost controls reduces the effect of property taxation to 9.2%, but the estimate is still statistically significant (although the t-value is substantially reduced compared to model A). Our interpretation is that unfavorable cost conditions in rural

[3]This correction is clearly important. The robust t-values turn out be about 50% lower than the standard t-values.

[4]The apparent sign of economies scale related to population size in Table 1 reflects that population size correlates with the other cost factors included in model B.

Table 2
Regression analysis with the log of the unit cost as dependent variable

	A	B	C	D	E	F	G
Property tax dummy (*PRTAX*)	−0.178 (−3.07)	−0.092 (−1.87)	−0.096 (−1.97)	−0.100 (−2.03)		−0.122 (−2.41)	−0.076 (−1.83)
Settlement pattern (*RURAL*)		0.435 (4.07)	0.394 (3.34)	0.414 (3.47)	0.456 (3.82)	0.387 (3.18)	0.482 (3.92)
Log of population size (log *POP*)		−0.012 (−0.35)	0.031 (0.81)	0.026 (0.64)	0.012 (0.30)	−0.006 (−0.14)	0.002 (0.04)
Dummy for coastline (*COAST*)		−0.509 (−10.46)	−0.470 (−8.61)	−0.465 (−8.23)	−0.457 (−7.95)	−0.414 (−7.37)	−0.538 (−10.10)
Payroll tax ($\log(1+\tau)$)		3.387 (4.49)	4.611 (4.78)	4.809 (4.99)	5.035 (5.19)	3.948 (3.81)	3.800 (4.72)
Log of grants (log *G*)			0.350 (1.82)	0.381 (2.04)	0.397 (2.13)	−0.015 (−0.07)	0.107 (1.16)
Interest payments (*IP*)			−0.969 (−1.66)	−0.982 (−1.64)	−0.950 (−1.59)	−0.443 (−0.97)	−0.160 (−1.23)
Share of children (*CH*)			−0.303 (−1.31)	−0.278 (−1.15)	−0.306 (−1.27)	−0.349 (−1.34)	0.148 (1.14)
Share of youths (*YO*)			−0.305 (−1.19)	−2.267 (−1.05)	−0.269 (−1.05)	−0.243 (−0.93)	−0.139 (−0.08)
Share of elderly (*EL*)			−0.168 (−1.59)	−0.155 (−1.42)	−0.199 (−1.84)	−0.060 (−0.55)	−0.006 (−0.08)
Log of private income (log *Y*)			−0.631 (−2.22)	−0.580 (−1.99)	−0.565 (−1.91)	−0.365 (−1.21)	−0.105 (−0.59)
Share of socialists (*SOC*)				0.184 (0.92)	0.143 (0.73)	0.349 (1.66)	0.184 (1.59)
Party fragmentation (*HERF*)				−0.238 (−0.57)	−0.228 (−0.57)	−0.516 (−1.11)	−0.397 (−2.13)
Method	OLS	OLS	OLS	OLS	OLS	OLS	RE
No. of obs.	2031	2031	2031	2031	2031	1851	2031
R^2_{adj}	0.029	0.333	0.349	0.350	0.345	0.333	

The estimation period is 1993–1998. Time dummies (not reported) included in all equations estimated. For models A–F the *t*-values in parentheses are based on clustered standard errors.

areas explain some of the cost differences between local governments with and without property tax.

In model C we also control for the six demand variables. We generally expect that good fiscal conditions increase costs. The results are quite supportive to this hypothesis. The main source of local government financing is grants (comprising block grants and regulated taxes). High grants allow for higher costs, and a 10% increase in grants is expected to increase the unit cost by 3.5%. Interest payments as a share of revenue represent the intertemporal fiscal condition and come out with the expected negative sign, but the effect is only borderline significant.

Demand pressure represents yet another aspect of the fiscal conditions. A comprehensive literature has addressed the economic consequences of demographic shifts (see Borge and Rattsø, 1995; Poterba, 1997). Welfare services directed towards specific age groups of the population (child care, schooling, care for the elderly) compete with local services like the utilities investigated here. A higher share of the population in the relevant age groups represents high demand for welfare services and fiscal pressure elsewhere. All the three age groups have the expected negative effect on the unit cost, but none of the coefficients are statistically significant. The inclusion of the demand variables has little impact on the effect of property taxation. The estimated cost difference is 9.6% in favor of local governments with property tax and statistically significant.

Political characteristics are included to account for background preference factors, possibly also influencing the choice of property taxation. The estimates reported for model D show that socialist orientation and party fragmentation (a low Herfindahl-index) are associated with higher costs, but the effects are not statistically significant. Other Norwegian studies like Kalseth and Rattsø (1998), Falch and Rattsø (1999), and Borge and Naper (2006) find stronger effects of political variables on costs and efficiency. The effect of the property tax dummy is significant also when the political controls are included. The effect of having property tax is still around 10% lower costs.

To investigate the robustness of this complete model, the dummy variable for property taxation is excluded in model E. A comparison of models E and D shows that the impacts of the cost, demand, and political variables are very robust to whether the property tax dummy is included or not. This indicates that the estimate of the property tax dummy does not capture the impact of (observed) background variables.

As discussed in Section 2, both the group with and the group without residential property tax include local governments with power plants. Among the large number of local governments that receive property tax from power plants, there is substantial variation in property tax revenue, from NOK 100 per capita to nearly NOK 30,000 per capita.[5] The local governments with the highest tax revenues from power plants are outliers in both groups, and in model F these are excluded from the sample. The cutoff points are defined in terms of property tax revenue per capita, and are in 1998 set to NOK 3000 for local governments with residential property tax and to NOK 2000 for those without (the cutoff points for the previous years are inflation adjusted). The purpose of allowing a higher cutoff for local governments with residential property tax is to achieve a roughly equal cutoff in terms of property tax revenues from power plants. The cutoff point of NOK 2000 per capita is slightly less than 10% of average per capita grant. By excluding local governments with high property tax revenue from power plants the sample is reduced

[5]The figures are from 1998.

by 9%, and the reduction is slightly larger for local governments with residential property tax (10%) than for those without (8%). The modification of the sample increases the magnitude and statistical significance of the property tax dummy. The estimated coefficient indicates that the effect of residential property tax is 12% lower costs.

In model G we re-estimate model D using the RE model instead of pooled OLS with clustered standard errors. It appears that the advantage of having residential property tax is reduced to 7.6% lower costs when the cross-section variation in the data is utilized to a lesser extent, but the effect is still statistically significant.

In a companion paper (Borge and Rattsø, 2005) we investigate the relationships between costs and user charges and find that a high degree of user charge financing contributes to lower costs. In a final robustness check (not reported) we include the degree of user charge financing as an additional explanatory variable. Consistent with the findings of the earlier paper the degree of user charge financing comes out highly significant and with a negative sign. The estimate indicates that an increase in the degree of user charge financing by 10 percentage points will reduce the unit cost by 8%. However, the impact of the property tax dummy is largely unaffected. The estimated cost difference is 11.2% in favor of local governments with property tax with a *t*-value of −2.82.

The basic message from the linear regressions is that the quantitative impact of the property tax on costs is substantially reduced compared to the raw difference, but it is still economically and statistically significant. To get a better understanding of what is going on it is necessary to detect which explanatory variables contribute to the reduction in the quantitative effect compared to the raw difference. Sample means for local governments with and without property tax are reported in Table A1, and a more thorough analysis of the data shows that local governments with property tax a have significantly higher population size, a significantly lower share of the population living in rural areas, a significantly lower level of grants, a significantly lower share of youths in the population, and a significantly higher share of socialists in the local council compared to local governments without property tax. Among these five variables, only the share of the population living in rural areas and the level of grants have significant effects on costs. They can therefore be considered as the most important contributors to the reduction in the quantitative impact of property taxation on costs compared to the raw difference.

5. Analysis II: Propensity score matching

As an alternative to the control variable method applied in the regression analysis, we here apply the matching method where the estimation of the treatment effect is approached as in a controlled experiment. Angrist (1998) provides a comparison of regression and matching. He shows that the two methods yield different results, even when controlling for the same characteristics, because the observations are weighted differently. While the estimated coefficients of a regression reflect variance-weighted averages, the matching estimator generates weights that are proportional to the probability of property taxation given the observed characteristics.

Matching is widely used in evaluations of policy programs, and is based on a comparison of treated observations (those who participate in the program) and non-treated observations (those who do not participate). In our case local governments with property tax constitute the treatment group and local governments without property tax the non-treatment group. Compared to analyses of particular policy programs we do not have a clear pre-treatment situation. The property tax has existed since the first half of the 19th century and has changed in form over time. The local governments we have today are basically the result of a reform in the early 1960s consolidating about 750 units into about 450, and with implications for property taxation. The assumptions behind matching based on selection on observables are not strictly satisfied, but we do think that the analysis provides new information and a check on the robustness of our regression results. Persson (2001) and Persson and Tabellini (2002) use matching in similar situations of no pre-treatment observations.

The key assumption for the matching analysis is that selection into property taxation depends only on the observable $\mathbf{X}_i$. Alternatively, selection into property taxation is random conditioned on the observables. If this assumption is fulfilled, we get

$$\mathrm{E}[C_i(0)|PRTAX_i = 0, \mathbf{X}_i] = \mathrm{E}[C_i(0)|PRTAX_i = 1, \mathbf{X}_i]. \quad (3)$$

Given (3), the effect of property taxation (the average effect of treatment on the treated, *ATT*) can be expressed as

$$ATT = \mathrm{E}\{\mathrm{E}[C_i(1)|PRTAX_i = 1, \mathbf{X}_i] - \mathrm{E}[C_i(0)|PRTAX_i = 0, \mathbf{X}_i]|PRTAX_i = 1\}. \quad (4)$$

The outer expectation in (4) is over the distribution of the characteristics of the local governments with property taxation. The content of Eq. (4) is that the counterfactual costs for a specific local government with property tax can be estimated from the outcome for local governments without property taxation with similar characteristics. The remaining problem is that $\mathbf{X}_i$ contains many (continuous) control variables and this dimensionality problem is likely to make the matching strategy infeasible in practice. However, a result obtained by Rosenbaum and Rubin (1983) helps us out. They show that if conditioning on $\mathbf{X}_i$ eliminates the selection bias, then conditioning on $p(\mathbf{X}_i)$, where p is the probability of having property tax, achieves the same:

$$ATT = \mathrm{E}\{\mathrm{E}[C_i(1)|PRTAX_i = 1, p(\mathbf{X}_i)] - \mathrm{E}[C_i(0)|PRTAX_i = 0, p(\mathbf{X}_i)]|PRTAX_i = 1\}. \quad (5)$$

Observations with the same probability of having property tax will have the same distribution of the full vector of control variables. This probability of having property tax is called the propensity score. It solves the multidimensionality problem and helps us sort out which local governments the treated units should be compared with.

The propensity scores can be estimated from the data using any standard probability model. We use the probit model and include the same set of explanatory variables as in the regression analysis in Table 2, as we should not omit any variable that affects costs and may correlate with the choice of property tax.[6] The estimation results using the 1998 data are reported in Table 3.[7] The choice of property tax is significantly affected by settlement pattern, grants, age composition and politics. Local governments with high grants, a rural settlement pattern, a low share of socialists, little party fragmentation, and a low share of elderly are less likely to have property tax. These effects reflect the restriction of the property tax to urban areas (*RURAL*), fiscal conditions (*G* and *EL*), socialist preferences for a larger public sector (*SOC*), and that strong governments (*HERF*) are able to keep

[6] Persson and Tabellini (2002) are, due to the sample size, forced to have fewer controls in the matching analysis than in the regression analysis.

[7] We have used the Stata program developed by Becker and Ichino (2002) to perform propensity score matching.

Table 3
The propensity score equation

Variable	Coefficient (t-value)
Settlement pattern (*RURAL*)	−1.912 (−3.58)
Population size (in 1000) (*POP*)	0.000960 (1.41)
Dummy for coastline (*COAST*)	−0.237 (−1.10)
Payroll tax $(1+\tau)$	−8.543 (−2.40)
Exog. local gov. revenue (in NOK 1000) (*G*)	−0.0843 (−2.54)
Interest payments (*IP*)	−2.792 (−1.09)
Share of children (*CH*)	12.196 (1.09)
Share of youths (*YO*)	−7.260 (−0.66)
Share of elderly (*EL*)	38.437 (3.51)
Private income (in NOK 1000) (*Y*)	−0.0224 (−1.29)
Share of socialists (*SOC*)	2.554 (2.83)
Party fragmentation (*HERF*)	−3.398 (−1.98)
No. of treated	97
No. of untreated	198
Final number of blocks	5
Common support	Yes
Balancing property satisfied (1%)	Yes

The dependent variable is the dummy variable for whether the local government has property tax or not (*PRTAX*). Probit estimates with t-values in parentheses using data for 1998. A constant term (not reported) is included.

taxes low. And they are in line with recent Norwegian analyses of the property tax (Borge and Rattsø, 2004; Fiva and Rattsø, 2007).

The balancing property of the probit specification is essential for the comparison of cost levels. The test of the balancing property tests for each explanatory variable whether the means for local governments with and without property tax are statistically different, given that they have roughly the same propensity score. The first step of the test is to stratify all local governments into blocks such that the estimated propensity score does not differ significantly between local governments with and without property tax within each block. In our case, five blocks were necessary to achieve this. The second step is to test whether the means of the explanatory variables differ significantly between local governments with and without property tax within each block. If they do not, the balancing property is satisfied. It can be seen from Table 3 that the balancing property is satisfied for our probit specification, and we can then proceed to the comparison of costs between local governments with and without property tax.[8]

There are different methods that can be used in order to test whether there are significant differences in costs between local governments with and without property tax. We apply the four different methods of comparison programmed by Becker and Ichino (2002): Nearest neighbor, radius, kernel, and stratification. They represent alternative approaches to the selection and weighing of the control units. The nearest neighbor method matches

[8]We have imposed the common support option, which implies that the test is performed only on the observations whose propensity score belongs to the intersection of the supports of the propensity score of local governments with and without property tax.

Table 4
Matching estimates with the unit cost (in logs) as dependent variable

	Nearest neighbor	Radius	Kernel	Stratification
Estimate	−0.173 (−1.82)	−0.176 (−2.71)	−0.166 (−2.44)	−0.169 (−2.48)
No. of treated	97	96	97	95
No. of controls	53	168	168	169
Common support	Yes	Yes	Yes	Yes

t-values in parentheses and analyses based on data for 1998. With kernel and stratification matching the *t*-values are based on bootstrapped standard errors with 1000 drawings.

each treated unit with the control unit that has the closest propensity score. With nearest neighbor all treated units find a match, but some of the matches may be poor because the difference in propensity score may be large. Radius and kernel matching can be regarded as solutions to this problem. The radius method matches each treated unit with control units with a propensity score within a predefined neighborhood of the treated unit, while the kernel method matches all treated observations with a weighted average of all controls, with weights that are inversely proportional to the propensity score distance to the treated unit. The point of departure for the stratification method is the five blocks identified in the estimation of the propensity score. The test statistic is then based on the cost difference between local governments with and without property tax within each block. The different methods represent different tradeoffs between quality and quantity of the matches and none of them is a priori superior to the others.

Table 4 reports the results using cost data for 1998. We have performed the test on the log of the unit cost to make the estimates comparable to those in Table 2. It appears that all four methods yield a significant cost difference in favor of local governments with property tax. Moreover, the cost difference is quite stable across the four alternative methods defining the control groups. The estimated cost difference varies from 16.6% using the kernel method to 17.6% using radius matching, and is larger than the difference using linear regression.

The number of comparison units varies according to method in Table 4. All or almost all 97 local governments with property tax are included and they are compared with 53 local governments without property tax with nearest neighbor[9] and nearly 170 local governments with the three other methods.[10] To further check for the robustness of the definition of the control group, we have performed radius matching with different assumptions about the size of the radius in Table 5. In this case, the number of local governments both with and without property tax is reduced as the radius decreases, from 96 and down to 25 with property tax, and from 169 down to 29 without. Even with this reduction in the number of treated and non-treated observations, the estimated cost effect is quite stable. In all but one case the cost-reducing effect is between 15.8% and 17.6%, but it becomes insignificant for the two smallest radiuses.

[9]The number of control units is lower than the number of treated units because the matching is done with replacement.

[10]The number of controls is lower than the number of local governments without property tax (198, see Table 1) because the common support option is imposed.

Table 5
Radius matching with different sizes of the radius

	$r = 0.1$	$r = 0.05$	$r = 0.01$	$r = 0.005$	$r = 0.001$
Estimate	−0.176 (−2.71)	−0.171 (−2.63)	−0.158 (−2.19)	−0.090 (−1.11)	−0.159 (−0.97)
No. of treated	96	96	86	71	25
No. of controls	168	168	140	96	29
Common support	Yes	Yes	Yes	Yes	Yes

Estimated cost difference. *t*-values in parentheses and analyses based on data for 1998.

A final robustness check is provided in Table A2 in Appendix A where we present matching estimates for each of the years 1993–1998. It appears that the stability of the results across years is less than the stability across methods. However, all 24 estimates point towards a cost difference in favor of local governments with property tax and nearly half of them are statistically significant at the 5% level. This is far more than one would expect if the true effect was zero.[11]

6. Analysis III: Fiscal conditions, fiscal performance, and service standards

As discussed in Section 3, both linear regression and matching assume selection on observables and do not solve the endogeneity problem related to possible selection on unobservables. It can be argued that local governments that choose property taxation have high spending needs relative to their revenue from other sources, and that they levy property tax to supplement their revenues. Compared to others they have more fiscal stress and are likely to have lower cost levels. Consequently, the estimated cost difference in favor of local governments with property tax reported in the previous sections may reflect the selection into property tax rather than a causal effect of having property tax. Unfortunately, we are not able to solve the endogeneity problem by finding an instrument that affects the selection into property tax, but not the cost level. What we can offer is an investigation of the selection hypothesis above (that local governments with property tax have more fiscal stress than those without) and a test of its implications.

Let us first look at the fiscal conditions of local governments. An immediate indicator is the level of per capita grants (including block grants and regulated income and wealth taxes, but not property tax revenue) that was used as a control in Sections 4 and 5. In the first row of Table 6 we present matching estimates of whether the level of grants differs between local governments with and without property tax.[12] The point estimates indicate that local governments with property tax have lower grant levels than comparable local governments without property tax. The estimated differences amount to 3–5% of the average grant level, but none of them are statistically significant.

As an indicator of fiscal stress, grants per capita has the weakness that it does not take account of differences in spending needs and the regional variation in the payroll tax. In the second row we report matching estimates for the per capita grant adjusted for

[11]The estimated cost reduction is particularly low in 1996. This may reflect that the balancing condition is not fulfilled that year.

[12]The propensity score equation and the matching methods are identical to those applied in Section 5.

Table 6
Matching estimates for fiscal conditions, fiscal performance and service standards

	Nearest neighbor	Radius	Kernel	Stratification
Fiscal conditions				
Per capita grant	−1116 (−1.21)	−782 (−1.49)	−664 (−1.19)	−643 (−1.12)
Adjusted per capita grant	6.79 (1.98)	5.63 (2.45)	6.64 (2.70)	6.81 (2.71)
Fiscal performance and service standards				
Net operating surplus	335 (1.05)	366 (1.59)	264 (0.85)	394 (1.39)
Child care coverage	0.006 (0.67)	0.012 (1.91)	0.009 (1.25)	0.008 (1.12)
Home-based care, coverage	−0.003 (−0.41)	0.002 (0.31)	−0.005 (−0.60)	−0.001 (−0.19)
Care in institution, coverage	−0.018 (−1.17)	−0.018 (−1.30)	−0.007 (−0.76)	−0.006 (−0.67)

t-values in parentheses and analyses based on data for 1998. With kernel and stratification matching the *t*-values are based on bootstrapped standard errors with 1000 drawings.

differences in spending needs and payroll tax.[13] The difference is now turned around, and local governments with property tax stand out with better economic conditions than those without. The main driving forces for turning the results around are that local governments with property tax have a higher population size and a more concentrated settlement pattern, and thereby lower per capita spending needs, than those without. The differences amount to 6–7% of average revenue and are statistically significantly for all four methods.

So far the results give little support to the hypothesis that local governments with property tax have more fiscal stress than those without. If there is a difference between the two groups, it rather goes in the opposite direction. Although this is an interesting observation, it does little to solve the endogeneity problem since no unobservables are brought into the analysis. We handle this by testing implications of the hypothesis that local governments with property tax have more fiscal stress than those without. A key implication is that we would expect local governments with property tax to have lower service standards and maybe also poorer fiscal performance.

The bottom panel of Table 6 shows the results of the matching analysis for fiscal performance and service standards. Fiscal performance is measured by per capita net operating surplus, which is defined as current revenues less current expenditures, net interest payment and net installment of debt. There is no sign of weaker fiscal performance in local governments with property tax. The point estimates rather go in the opposite direction, but none of them are statistically significant.

Three indicators of service standards are analyzed: Child care coverage (the number of children 1–5 years in child care institutions as fraction of the age group), coverage in home-based care for the elderly (the number users as fraction of the population 67 years and above), and coverage in institutionalized care for the elderly (the number of users as fraction of the population 80 years and above). Both child care and care for the elderly are important welfare services under local government responsibility. During the last decades both services have received much attention in the public debate, and there has been concerns that the coverage rates on average are too low and that there is large variation

[13]Spending needs are calculated using the formula for the needs equalization grant. The formula takes account of differences in population size, settlement pattern, age composition and social criteria like divorce rate and unemployment rate. Most variables in the formula are included in the vector of control variables.

across local governments reflecting differences in economic conditions. The point estimates reported in Table 6 indicate that local governments with property tax have somewhat lower coverage rates in the care for the elderly sector and somewhat higher coverage rates in child care. However, none of the estimates for care for the elderly are statistically significant.

The analyses reported in this section yield little support to the hypothesis that local governments with property tax have more fiscal stress than those without. On the contrary the analyses document that local governments with property tax have higher revenues from other sources than property tax, at least when differences in spending needs and payroll tax are taken into account. Furthermore, we are unable to document that they have poorer fiscal performance or lower service standards in important service sectors such as child care and care for the elderly. Although we cannot rule out that selection on unobservables is of some importance, the results presented here make it unlikely that such selection is sufficiently strong to wash out the impact of property taxation on costs documented in Sections 4 and 5.

7. Concluding remarks

The paper analyzes the incentive effects of property taxation with respect to control of costs. Property tax financing is assumed to serve as a disciplining device. Local governments in Norway allow for testing the proposition that property taxes contribute to cost control, since the property tax is a voluntary tax and not used by all local governments.

The raw data show that local governments with property tax have 20% lower sewage costs than local governments without property tax. Using linear regressions and propensity score matching we address the issues of non-random selection into property taxation. With both methods the estimated difference is reduced compared to the raw difference, but it is still economically and statistically significant. It is a possible objection that the regression and matching estimates reflect selection on unobservables, and in particular that they reflect that governments with property tax have more fiscal stress than those without. However, we are not able to provide any support for this hypothesis when analyzing fiscal conditions, fiscal performance, and service standards in other sectors.

We conclude that our data indicate that property taxes embody mechanisms of cost control. The incentive effect is of interest for the design of fiscal federalism. Our interpretation is that having a visible and controversial local tax related to property stimulates voter interest in local government activities and thereby may help control costs.

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Appendix A

Table A1
Data description and descriptive statistics, 1998

Variable	Description	All	With pr.tax	Without pr.tax
Unit cost (*C*)	Total costs per standard user for discharge of sewage, Norwegian kroner (NOK)	3222 (1721)	2752 (1381)	3452 (1825)
Property tax (*PRTAX*)	A dummy variable that equals 1 if residential property is subject to property tax	0.329 (0.471)	1 (0)	0 (0)
Settlement pattern (*RURAL*)	The share of the population living in rural areas (1990)	0.508 (0.281)	0.392 (0.219)	0.564 (0.291)
Population size (*POP*)	Total population, January 1	11,354 (20,027)	17,301 (30,193)	8441 (11,332)
Coastline (COAST)	A dummy variable that equals 1 if the local government has a coastline	0.617 (0.487)	0.608 (0.491)	0.621 (0.486)
Payroll tax $(1+\tau)$	Tax on wage expenditures paid by private and public employers	1.111 (0.037)	1.110 (0.035)	1.112 (0.038)
Grants (*G*)	The sum of block grants from the central government and regulated income and wealth taxes, NOK per capita	21,716 (5399)	20,259 (3590)	22,430 (5973)
Net interest payment (*IP*)	Net interest payment as fraction of grants	0.005 (0.033)	0.005 (0.038)	0.005 (0.030)
Share of children (*CH*)	The share of the population 0–6 years, January 1	0.094 (0.012)	0.092 (0.012)	0.094 (0.013)
Share of youths (*YO*)	The share of the population 7–15 years, January 1	0.118 (0.013)	0.114 (0.012)	0.120 (0.014)
Share of elderly (*EL*)	The share of the population 80 years and above, January 1	0.048 (0.015)	0.048 (0.013)	0.048 (0.016)
Private disposable income (*Y*)	Taxable income minus income and wealth taxes to local, county ad central government, NOK per capita	76912 (7760)	77186 (6407)	76778 (8355)
Share of socialists (*SOC*)	The share of socialist representatives in the local council	0.375 (0.143)	0.431 (0.131)	0.348 (0.141)
Party fragmentation (*HERF*)	Herfindahl-index measuring the inverse of the party fragmentation of the local council	0.273 (0.089)	0.266 (0.076)	0.276 (0.095)
Adjusted grant	Grants adjusted for differences in spending needs and payroll tax, index	92.7 (21.1)	93.7 (19.6)	92.2 (21.8)
Net operating surplus	Current revenues net of current expenditures, net interest payment and net installments on debt, NOK per capita	620 (1621)	879 (1859)	493 (1480)
Child care coverage	The number of children 1–5 year in child care institutions as fraction of the total number of children in the same age group	0.384 (0.046)	0.390 (0.047)	0.382 (0.045)
Home-based care coverage	The number of users receiving home-based care as fraction of the number of inhabitants 67 years and above	0.200 (0.046)	0.200 (0.050)	0.201 (0.044)
Institution based care, coverage	The number of user receiving institution based care as fraction of the number of inhabitants 80 years and above	0.245 (0.091)	0.229 (0.059)	0.253 (0.103)

The reported figures are means (unweighted) with standard errors in parentheses.

Table A2
Matching estimates for each year

	Nearest neighbor	Radius	Kernel	Stratification
1993	−0.224 (−1.45)	−0.181 (−2.34)	−0.180 (−2.29)	−0.165 (−1.83)
1994	−0.093 (−0.68)	−0.186 (−2.59)	−0.131 (−1.84)	−0.114 (−1.59)
1995	−0.114 (−0.96)	−0.107 (−1.56)	−0.124 (−1.70)	−0.091 (−1.22)
1996	−0.063 (−0.61)	−0.071 (−1.12)	−0.088 (−1.16)	−0.067 (−0.99)
1997	−0.004 (−0.39)	−0.156 (−2.38)	−0.101 (−1.16)	−0.106 (−1.25)
1998	−0.173 (−1.82)	−0.176 (−2.71)	−0.166 (−2.44)	−0.169 (−2.48)

Estimated cost difference with t-values in parentheses. With kernel and stratification matching the t-values are based on bootstrapped standard errors with 1000 drawings.

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