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PROPERTY TAXATION AS INCENTIVE FOR COST CONTROL: EMPIRICAL EVIDENCE FOR UTILITY SERVICES IN NORWAY

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Property taxation as incentive for cost control: Empirical evidence for utility services in 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 about 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. The incentive effect is of interest for the design of fiscal federalism.

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1. Introduction

The design of tax systems may influence the incentives for government service production. 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 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 in the real world 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 the poll tax 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 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 costs. 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 consider 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 feed back effect 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 is 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 how much the tax bases respond to less slack. It is shown that the property tax provides the strongest incentives if housing demand is inelastic (small increase in population size, large increase in property values). Glaeser 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. With local property taxation 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. It is shown 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, 2001b) 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 in the US. 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 the 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. Our observation is that the property tax is visible and controversial, and that local governments with property tax have more enganged 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. Utilities are of direct importance for property values and therefore of particular relevance for the incentive effects of property taxation. Related investigations of the Norwegian property tax are made by Fiva and Rattsø (2005) and Fiva and Rønning (2005).

The paper proceeds by a first look on the data in Section 2. In a raw comparison of cost levels, local governments with property tax have more than 20% lower costs than those without. In Section 3 we discuss the empirical challenges and strategies. 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 among municipalities 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 10000 (USD 80 to 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 to 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 Norwegian setting, where some local governments have and some have not residential property tax, enables us to analyze the cost effects of the tax.

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

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

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 that 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'.

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) is 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 (that we have information about) and the assessment rate (that 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 might be highly misleading to take account of only the variation in the formal tax rate.

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

Table 1 offers a first look at the cost level when local governments are separated according to residential property taxation and population size. The table uses the data for 1998 comprising 96 local governments with property tax and 199 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 2370 (USD 380) in the 96 local governments with property tax and NOK 2970 (USD 475) in the 199 local governments without property tax.

Table 1 about here

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 25000 have property tax, while 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 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 10-13%. 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 the empirical challenges that must be handled in order to conclude regarding a causal 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 property taxation ($PRTAX_i = 1$) or not ($PRTAX_i = 0$). 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 influences 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:

$$\begin{aligned} &E\left[C_i(1) \mid PRTAX_i = 1\right] - E\left[C_i(0) \mid PRTAX_i = 0\right] = \\ &\quad E\left[C_i(1) - C_i(0) \mid PRTAX_i = 1\right] + \left\{E\left[C_i(0) \mid PRTAX_i = 1\right] - E\left[C_i(0) \mid PRTAX_i = 0\right]\right\} \end{aligned} \tag{1}$$

The first term on the right hand side shows what we are looking for, the average causal 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 have 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 causal effects as in a controlled experiment. The observations are explicitly split into a treatment group and a control group, and the causal 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 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 lower 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:

$$\log C_{it} = \beta_t + \beta_1 PRTAX_i + \beta_2 RURAL_i + \beta_3 \log POP_{it} + \beta_4 COAST_i + \beta_5 \log(1+\tau_{it}) + \beta_6 \log G_{it} + \beta_7 IP_{it} + \beta_8 CH_{it} + \beta_9 YO_{it} + \beta_{10} EL_{it} + \beta_{11} \log Y_{it} + \beta_{12} SOC_{it} + \beta_{13} HERF_{it} + u_{it} \quad (3)$$

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 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 (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 trend is 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 the appendix Table A1.

Since the main variable of interest, the property tax dummy (*PRTAX*), is based on data for 1996 and has no time series variation at all, we cannot rely on estimation methods that only make use of the time series variation in the data. The equations are estimated by ordinary least squares. 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. To take account of this problem we report t-values that are based on standard errors that are robust to heteroskedasticity and to correlation between error terms from the same local government.[3]

Table 2 reports the results from the linear regression analyses. We start out by estimating 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 17.6% lower unit cost than local governments without property tax. This estimate is of the same magnitude as the raw difference in the bottom raw 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 9.9%, 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 municipalities explain some of the cost differences between local governments with and without property tax.

Table 2 about here

[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.

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 clearly allow for higher costs, and a 10% increase in grants is expected to increase the unit cost by 4%. Interest payments as 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 shift (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. 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 that are separated out have the expected negative effect on the unit cost, but only the share of elderly is statistically significant. A 1 percentage point increase in the share of elderly will reduce the unit cost by nearly 6%. The inclusion of the demand variables has little impact on the effect of property taxation. The estimated cost difference is 9.7% 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.

In model F we reestimate model D on a more homogeneous sample of local governments as we exclude the cities and the smallest local governments (population size below 1500). The cities have historically used the property tax to a greater extent than other local governments and may have favorable cost conditions. On the other hand, none of the local governments with population size below 1500 have property tax (as defined here) and they may have unfavorable cost conditions. Although the sample size is substantially reduced (by more than 20%), the sign and significance of the property tax dummy do not change much compared to model B.

In a companion paper (Borge and Rattsø, 2005) we investigate the relationships between costs and user charges and found 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 10.7% in favor of local governments with property tax with a t-value of -2.70.

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 that 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 have significantly lower population size, significantly lower share of the population living in rural areas, 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 causal effect is approached as in a controlled experiment. Angrist (1998) provides an interesting 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 1960's 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:

$$E\left[C_i(0) \mid PRTAX_i = 0, \mathbf{X_i}\right] = E\left[C_i(0) \mid PRTAX_i = 1, \mathbf{X_i}\right] \quad (4)$$

Given (4), the causal effect of property taxation (the average effect of treatment on the treated, *ATT*) can be expressed as:

$$ATT = E\left\{E\left[C_i(1) \mid PRTAX_i = 1, \mathbf{X_i}\right] - E\left[C_i(0) \mid PRTAX_i = 0, \mathbf{X_i}\right] \mid PRTAX_i = 1\right\} \quad (5)$$

The outer expectation in (5) is over the distribution of the characteristics of the local governments with property taxation. The content of equation (5) 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:

$$ATT = E\left\{E\left[C_i(1) \mid PRTAX_i = 1, p(\mathbf{X_i})\right] - E\left[C_i(0) \mid PRTAX_i = 0, p(\mathbf{X_i})\right] \mid PRTAX_i = 1\right\} \quad (6)$$

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 to compare the treated units 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.[5] The estimation results using the 1998 data are reported in

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

Table 3.[6] The choice of property tax is significantly affected by settlement pattern, grants, age composition and politics. Local governments with high grants, rural settlement pattern, a low share of socialists, little party fragmentation, and a low share of elderly is 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 taxes low. And they are in line with recent Norwegian analyses of the property tax (Borge and Rattsø, 2004; Fiva and Rattsø, 2005).

Table 3 about here

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 is 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 do not differ significantly between local governments with and without property tax within each block. In our case 5 blocks was 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 the Table 3 that the balancing property is satisfied for our probit specification, so we safely can proceed to comparison of costs between local governments with and without property tax.[7]

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 each treated unit with the control unit that has the closest propensity score. With nearest neighbor

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

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 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 superior to the others.

Table 4 about here

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 methods to define the control group. It varies from 15.9% using the kernel method to 17.4% using nearest neighbor. The estimated cost difference using propensity score matching is larger than the difference using linear regression.

The number of comparison units varies according to method in Table 4. Basically all 96 local governments with property tax are included, and they are compared with 59 local governments without property tax with nearest neighbor[8] and 169 local governments with the three other methods.[9] 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 28 with property tax, and from 169 down to 35 without. Even with this reduction in the number of treated and non-

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

treated observations, the estimated cost effect is quite stable. It is in the order of 15.5-18.5% and statistically significant in all cases expect the case where the radius is 0.001 (0.1 percentage point) and the number of treated units is as low as 28.

A final robustness check is provided in Table A2 where we present matching estimates for each of the years 1993-1998. It appears 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 half of them are statistically significant at the 5% level. This is far more than one would expect if the true effect was zero.

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 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. 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 firs 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.[10] The point estimates indicate that local

[9] The number of controls is lower than the number of local governments without property tax (199, see Table 1) because the common support option is imposed.
[10] The propensity score equation and the matching methods are identical to those applied in section 5.

governments with property tax have lower grant levels than comparable local governments without property tax. However, the difference is small (in no case more than 1.5% of the average grant level) and never 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 differences in spending needs and pay roll tax.[11] 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 higher population size and more concentrated settlement pattern, and thereby lower spending needs, than those without. The difference is sizeable (6-9% of average revenue) and 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. Unobservables can be brought into the analysis 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.

[11] 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.

Three indicators of service standards are analyzed. These are child care coverage (the number of children 1-5 year 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 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 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 documents that local governments with property tax have higher revenues from other sources than the property tax, at least when differences in spending needs and pay roll tax is taken into account. And we are not able 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. It is our understanding that the results presented here provide support for the view that the impact of property taxation on costs documented in Sections 4 and 5 may be interpreted as a causal effect.

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 not used by all local governments.

The raw data show that local governments with property tax have about 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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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	# obs	Cost	Population	# obs
Less than 3000	3856	1823	70	3416	2300	8
3000 - 5000	3438	3962	37	3049	4098	23
5000 - 10000	3384	7212	43	2660	7229	27
10000 - 25000	2904	15379	38	2511	15987	21
More than 25000	2429	45495	11	2187	60988	17
All	2970	8388	199	2 369	17504	96

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

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

	A	B	C	D	E	F
Property tax	-0.176	-0.099	-0.097	-0.101		-0.106
dummy (*PRTAX*)	(-3.01)	(-2.00)	(-1.99)	(-2.04)		(-1.91)
Settlement pattern		0.433	0.424	0.440	0.478	0.513
(*RURAL*)		(4.07)	(3.63)	(3.74)	(4.06)	(3.80)
Log of population		-0.011	0.027	0.022	0.009	-0.033
size (log *POP*)		(-0.32)	(0.70)	(0.56)	(0.22)	(-0.61)
Dummy for		-0.511	-0.465	-0.461	-0.454	-0.455
coastline (*COAST*)		(-10.52)	(-8.68)	(-8.33)	(-8.05)	(-7.96)
Payroll tax		3.364	4.807	4.967	5.182	5.038
($\log(1+\tau)$)		(4.48)	(5.08)	(5.24)	(5.43)	(4.87)
Log of grants			0.399	0.426	0.444	0.437
(log *G*)			(2.15)	(2.32)	(2.44)	(1.99)
Interest payments			-0.992	-1.003	-0.971	-0.675
(*IP*)			(-1.74)	(-1.71)	(-1.66)	(-1.22)
Share of children			-3.839	-3.625	-3.870	-1.822
(*CH*)			(-1.59)	(-1.45)	(-1.56)	(-0.70)
Share of youths			-3.047	-2.746	-2.729	-3.283
(*YO*)			(-1.38)	(-1.23)	(-1.23)	(-1.46)
Share of elderly			-5.851	-5.545	-6.453	-4.943
(*EL*)			(-2.22)	(-2.03)	(-2.40)	(-1.68)
Private income			-0.657	-0.613	-0.590	-0.206
(log *Y*)			(-2.38)	(-2.17)	(-2.06)	(-0.65)
The share of				0.159	0.111	0.309
socialists (*SOC*)				(0.82)	(0.58)	(1.32)
Party				-0.220	-0.208	-0.182
fragmentation				(0.57)	(0.56)	(-0.39)
(*HERF*)						
# obs	2031	2031	2031	2031	2031	1572
R^2_{adj}	0.029	0.334	0.354	0.355	0.350	0.363

The estimation period is 1993-1998. Time dummies (not reported) included in all equations estimated. The t-values in parentheses are based on standard errors that are robust to heteroskedasticity and correlation between error terms from the same local government. Cities and local governments with population size below 1 500 are excluded from model F.

Table 3
The propensity score equation

Variable	Coefficient (t-value)
Settlement pattern	-1.828
(*RURAL*)	(-3.44)
Population size (in 1000)	0.000925
(*POP*)	(1.36)
Dummy for coastline	-0.219
(*COAST*)	(-1.01)
Payroll tax	-7.700
($\log(1+\tau)$)	(-2.17)
Exog. local gov. revenue (in 1000 NOK)	-0.0791
($\log G$)	(-2.40)
Interest payments	-2.434
(*IP*)	(-0.95)
Share of children	10.719
(*CH*)	(0.96)
Share of youths	-11.004
(*YO*)	(-1.01)
Share of elderly	34.624
(*EL*)	(3.19)
Private income (in 1000 NOK)	-0.0208
($\log Y$)	(-1.21)
The share of socialists	2.367
(*SOC*)	(2.64)
Party fragmentation	-3.344
(*HERF*)	(-1.95)
# of treated	96
# of untreated	199
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.

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

	Nearest neighbor	Radius	Kernel	Stratification
Estimate	-0.174	-0.170	-0.159	-0.164
	(-1.86)	(-2.62)	(-2.76)	(-2.13)
# of treated	96	95	96	96
# of controls	59	169	169	169
Common support	Yes	Yes	Yes	Yes

T-values in parentheses and analyses based on data for 1998.

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	-0.170	-0.160	-0.155	-0.169	-0.185
	(-2.61)	(-2.45)	(-2.11)	(-2.01)	(-1.43)
# of treated	95	94	79	66	28
# of controls	169	169	150	117	35
Common support	Yes	Yes	Yes	Yes	Yes

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

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

	Nearest neighbor	Radius	Kernel	Stratifi-cation
Fiscal conditions				
Per capita grant	-263	-159	-154	-306
	(-0.41)	(-0.34)	(-0.25)	(-0.53)
Adjusted per capita grant	8.45	5.80	7.24	6.85
	(3.32)	(2.51)	(3.23)	(2.67)
Fiscal performance and service standards				
Net operating surplus	198	348	205	324
	(0.70)	(1.47)	(0.74)	(0.84)
Child care coverage	0.011	0.015	0.011	0.009
	(1.25)	(2.39)	(1.59)	(1.27)
Home based care, coverage	-0.007	0.002	-0.006	-0.004
	(-0.76)	(0.27)	(-0.74)	(-0.56)
Care in institution, coverage	-0.005	-0.001	-0.005	-0.003
	(-0.49)	(-1.26)	(-0.50)	(-0.36)

T-values in parentheses and analyses based on data for 1998.

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)	2765 (1384)	3442 (1824)
Property tax (*PRTAX*)	A dummy variable that equals 1 if residential property is subject to property tax (1996)	0.325 (0.469)	1 (0)	0 (0)
Settlement pattern (*RURAL*)	The share of the population living in rural areas (1990)	0.508 (0.281)	0.391 (0.220)	0.564 (0.290)
Population size (*POP*)	Total population, January 1	11354 (20027)	17504 (30303)	8388 (11305)
Coastline (*COAST*)	A dummy variable that equals 1 if the local government has a coastline	0.617 (0.487)	0.604 (0.492)	0.623 (0.486)
Payroll tax $(1+\tau)$	Tax on wage expenditures paid by private and public employers	1.111 (0.037)	1.110 (0.034)	1.112 (0.038)
Grants (*G*)	The sum of block grants from the central government and regulated income and wealth taxes, NOK per capita	21716 (5399)	20216 (3623)	22446 (5948)
Net interest payment (*IP*)	Net interest payment as fraction of exogenous local government revenue	0.005 (0.033)	0.005 (0.039)	0.005 (0.030)
The 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)
The 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)
The 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 (0.014)
Private disposable income (*Y*)	Taxable income minus income and wealth taxes to local, county ad central government, NOK per capita	76912 (7760)	77355 (6391)	76698 (8347)
The share of socialists (*SOC*)	The share of socialist representatives in the local council	0.375 (0.143)	0.430 (0.130)	0.349 (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 pay roll tax, index	0.927 (0.211)	.0938 (0.197)	0.922 (0.218)
Net operating surplus	Current revenues net of current expenditures, net interest payment and net installments on debt, NOK per capita	620 (1621)	874 (1873)	497 (1474)

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)	0.198 (0.049)	0.201 (0.050)
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)	0.228 (0.060)	0.253 (0.102)

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

Table A2
Matching estimates for each year

	Nearest neighbor	Radius	Kernel	Stratification
1993	-0.157	-0.166	-0.228	-0.188
	(-1.11)	(-2.13)	(-2.15)	(-2.25)
1994	-0.145	-0.181	-0.170	-0.151
	(-1.05)	(-2.49)	(-2.14)	(-1.92)
1995	-0.128	-0.104	-0.103	-0.122
	(-1.09)	(-1.50)	(-1.56)	(-1.79)
1996	-0.063	-0.071	-0.088	-0.067
	(-0.61)	(-1.12)	(-1.22)	(-0.99)
1997	-0.006	-0.160	-0.107	-0.096
	(-0.06)	(-2.40)	(-1.41)	(-0.92)
1998	-0.174	-0.170	-0.159	-0.164
	(-1.86)	(-2.62)	(-2.76)	(-2.13)

Estimated cost difference. T-values in parentheses.