THE RELATIONSHIPS BETWEEN COSTS AND USER CHARGES: THE CASE OF A NORWEGIAN UTILITY SERVICE*

Lars-Erik Borge** & Jørn Rattsø
Department of Economics, Norwegian University of Science and Technology
N-7491 Trondheim, Norway

Abstract
Governments struggle with rising service spending and user charges represent a possible incentive mechanism to control costs. The paper investigates the relationships between costs and user charges in the sewage industry in Norwegian local governments. The analysis addresses the following questions: (i) To what extent is a higher unit cost passed on to consumers in terms of higher user charge? (ii) Does user charge financing lead to higher or lower unit cost? The econometric analysis indicates that 30-40% of a cost increase is passed on to consumers in terms of higher user charge. Moreover, user charge financing has a significant negative effect on the unit cost. An increase in user charge financing by 10 %-points is predicted to reduce the unit cost by up to 10%.

Keywords: Cost control; User charges; Incentive mechanisms; Principal-agent model; Utility services; JEL-codes: D73, H71, H72

*An earlier version of this paper has been presented at the Nordic Conference on Local Public Finance (Helsinki), the Annual Meeting of the Norwegian Economic Association (Bergen), the Norwegian-German Seminar on Public Economics (Münich), the Annual Meeting of the European Public Choice Society (Berlin), and at a seminar at the Norwegian University of Science and Technology (Trondheim). We are grateful for comments from the participants, in particular from Magnus Wikström, Lars Håkonsen, Jo Thori Lind, Ansgar Belke, and also from two referees. The Norwegian Research Council (Economic Research Programme on Taxation) has funded the research.

**Corresponding author: Phone +47-73591941; Fax +47-73596954; E-mail larseb@svt.ntnu.no

Date: September 2004

1. Introduction

Governments struggle with rising service spending and user charges represent a possible incentive mechanism to control costs. In this paper we investigate the incentive effects of user charges by analyzing the relationships between costs and user charges in the sewage industry in Norwegian local governments. The analysis is related to the recent literature on the consequences of fiscal institutions for fiscal performance, which includes the incentive effects of alternative government financing. The broad background of the political economy arguments are related to Wicksell (1896, 1967) and most vigorously promoted by Breton (1996) as the 'Wicksellian connection'. Brennan and Buchanan (1977) developed the view that government financing should be designed to control inefficient 'Leviathan' government.

More recent contributions focus explicitly on how the tax system shapes the incentives of government officials. Gordon and Wilson (1999) promote the view that tax design should take account of behavioral responses in both the public and private sectors, and they analyze the general implications of agency problems for optimal taxes. Glaeser (1996) shows how property taxes serve as such a disciplining device for decentralized government. In his analysis, property taxation creates incentives for local service provision, since the services raise housing values and thereby the property tax base. Hoxby (1999) similarly introduces property taxation as a link between school quality and school financing that helps control costs and efforts in schools. This theoretical literature is not matched by much empirical analysis, but in a companion paper (Borge and Rattsø, 2004) we find empirical support for the hypothesis that property taxation reduces costs.

A first and simple econometric investigation of user charges and government behavior is offered by Bierhanzl and Downing (1998). Their approach is motivated by Wicksell's benefit principle and the Niskanen model of bureau behavior. User charge financing provides information and motivation to control the slack of the bureau. The empirical analysis of a utility service (sewer services) in 751 US municipalities shows that user charges are associated with lower service spending. Bierhanzl (1999) extends the empirical analysis with a separation between spending and output supply of the service and finds that user charges reduce costs, since they are associated with lower spending, but not lower output supply.

The issue of user charges and cost control certainly has been raised in the public debate in Norway. User charges are controversial, first and for all because they but they may lead to a more uneven income distribution than traditional tax financing. The relationship between user charges and costs is discussed by a government commission that has reviewed the financing of local governments (NOU, 1997:8). In Wicksellian fashion it is argued that user charge financing may contribute to improved voter control because voters as consumers are more directly affected by costs. On the other hand, the commission is worried that user charge financing may lead to a softer budget constraint for the producers, since higher costs more easily can be passed on to the consumers. The national government has addressed the concern with a proposal to limit utility charges by introducing maximum prices. The government explicitly argues that maximum prices may give a harder budget constraint for the producers and thereby induce cost efficiency. In this paper we throw light on the control problem by simultaneously analyzing the impact of user charges on costs and the impact of costs on user charges.

The theoretical background is a model describing the interaction between a political authority and a service-producing bureau. The user charge is set by the politicians, and the reaction function is derived in a representative voter model. We show that the impact of user charges on costs depends on the form of strategic interaction. In a Nash game where the bureau treats the user charge as fixed, user charge financing leads to lower costs because it makes slack more costly for the bureau. In a Stackelberg game, the costs are independent of the degree of user charge financing, since the budget of the bureau is set to cover reported costs. The theoretical ambiguity motivates an empirical analysis.

The empirical part is based on large panel data set for the local sewer service and investigates to questions: i) To what extent is a higher unit cost passed on to consumers in terms of higher user charge? (ii) Does user charge financing lead to higher or lower unit cost?
The empirical analysis is based on a large panel data set of one utility service, the local sewer service. We find that 30-40% of a cost increase is passed on to consumers in terms of higher user charge. Moreover, user charge financing has a significant negative effect on the unit cost. An increase in user charge financing by 10 %-points is predicted to reduce the unit cost by up to 10%.

The rest of the paper is organized as follows. Section 2 clarifies the institutional and empirical background. The modeling of the relationships between costs and user charges is presented in Section 3. The data and the econometric model are discussed in Section 4. Section 5 presents the estimated relationships between costs and user charges, while the broader determinants are discussed in section 6. Section 7 summarizes the main findings of the paper.

2. Empirical and institutional background

Norwegian local governments are important providers of welfare services like kindergartens, primary and lower secondary education, primary health-care, and care for the elderly. Local public goods such as culture and infrastructure also are the responsibility of local governments. The main revenue sources are taxes (45% of current revenues), grants from the central government (33%) and user charges (16%). Interest and other revenue account for the rest.

Compared to most other countries, the Norwegian system of financing is quite centralized. In principle local governments can choose tax rates within an interval for taxes on income, wealth and property. However, since the late 1970s all local governments have used the maximum tax rates in income and wealth taxation. In the following these income and wealth taxes are denoted regulated taxes. The discretion to influence current revenues is limited to property tax and user charges.

User charges are applied for a wide range of services, but utilities, care for the elderly and kindergartens account for most of the revenues. This paper focuses on user charges and costs for a particular utility service, sewer services. The market for utilities can be characterized as a local government monopoly where it is compulsory to make use of the service. The user charges are regulated, and they cannot exceed total production costs, but local governments are free to subsidize the services. The user charge for sewer services consists of a connection fee and an annual fee, where the annual fee depends on the level of consumption. However, the typical pricing scheme specifies a minimum quantity to be invoiced, implying that the relationship between the annual fee and actual consumption may be weak.

The analysis focuses on costs and user charges per standard user. The cost measure includes operating and capital costs, and the user charge includes connection fees and annual fees paid by households and firms.[1] The unit cost and the user charge are both about Norwegian kroner NOK 2,000 (Euro 250) per standard user. The development of unit cost and user charge during the period under study (1993-1998) is displayed in Table 1. Until 1997 average unit cost was quite stable in nominal terms, whereas the average user charge increased steadily. As a consequence, the share of cost covered (or the degree of user charge financing) increased from 80% in 1993 to 100% in 1997. From 1997 to 1998 the average unit cost increased sharply (14%). The increase in the user charge was more modest (5%), and the share of costs covered dropped back to 92%.[2]

Table 1 about here

In addition to the time series variation shown in Table 1, there is substantial variation across local governments. In 1998 the unit cost varied from NOK 500 to 10,000. Around half of the local governments have a unit cost between NOK 2,000 and 4,000. There is a positive correlation between the unit cost and the user charge, and the user charge varies from NOK 120 to 20,000. In roughly half of the local governments a standard user is charged between NOK 1,500 and 3,000. The share of costs covered by user charges varies from 5% to more than 400%. In 1998 the user charge exceeded the unit cost in 25% of the local governments in the sample.

Although user charges are regulated so that they cannot exceed total production costs, the share of costs covered may exceed 100% in a single year as long as user charges do not exceed total production costs over a period of 3-5 years. More than 25% of the 224 local governments with reliable data for all years had an average degree of user charge financing above 100% for the six-year period. In 14 local governments user charges exceeded costs each and every year. These figures suggest that local governments, at least to some extent, are able to circumvent the national regulation.

[1] We refer the reader to Section 4 for more details about the data.
[2] The trends in Table 1 are not driven by the fact that the number of local governments with reliable data varies somewhat from year to year. If we instead use a balanced panel data set, the same pattern emerges.

3. Modeling the relationships between user charges and costs

We address the determination of costs and prices when a political institution is responsible for service provision delegated to a bureau. This is the standard design of government service production across the world. The political side consists of a local council elected to arrange financing and production of local services. User fees are determined at the local government level. The service production investigated is decentralized to a lower-level agency, which is given a budget by the local government. The bureau is assumed to have an information advantage and therefore can have budgetary slack. The costs financed by the local government are determined in a budget process involving the agency. The working of the local government and the relationship to the agency form the outcomes of this game.

User charges and agencies have been addressed in previous analyses of local government financing, notably Inman (1989). In his model, however, the agency charges the consumers and has preferences over its own supply and fee level, while agency costs are exogenous. We study a situation where the agency costs are endogenously determined under asymmetric information and the local government sets the fee level taking the cost-determination into account. This leads to a model of bureaucratic interaction in the post-Niskanen tradition as developed by Migue and Belanger (1974), Miller and Moe (1983) and Moene (1986).

The conventional way of analyzing local government decision-making is a demand model of local public services. Individual inhabitants of a community demand public services dependent of private income and tax-prices of the services. The individual demands enter a political process whereby the local council makes a collective decision about financing and provision. The median voter model is the most common representation of the political process; see the surveys by Inman (1979) and Rubinfeld (1987). Borge (1995, 2000) has analyzed user charges in a demand model. Control of administrative costs related to service demand has been analyzed by Kalseth and Rattsø (1998). The demand framework is extended below to capture the interaction with an agency.

The key decision concerns a local service produced by a bureau. Here this local utility service is private in character and is distributed to households in the community for a user charge. It follows that the use of the individual service can be restricted to paying customers. Services subject to user charges, typically related to infrastructure, compete with welfare services within the local government budget. The local government sets the priority between the utility service and the welfare service and applies the user charge to regulate the financing on the margin. To concentrate on costs and charges for the utility with production delegated to a bureau, we assume that user charge is the key instrument of financing and that other taxes are regulated. This formulation captures the centralized financing in Norway (see Section 2), but may be realistic under the widespread use of tax limits in other countries.

The decision making at the local government level is described by a representative voter model where three types of services are separated out; an all-purpose private good (*q*), utility services (*x*) and other local public services (*w*, hereafter denoted welfare services). The preference of the representative voter is given by the utility function

$$u = u(q, x, w; z) \tag{1}$$

which is assumed to have the regular properties, i.e. strictly quasi-concave with positive marginal utilities. The preferences are conditioned on the size of the client groups of the welfare services (*z*), and the coverage of the welfare services varies (i.e. the share of old offered care). We assume that an increase in the size of client groups raises the marginal utility of welfare services.

The resources available to the local government are grants and regulated taxes (*r*, hereafter denoted exogenous local government revenue) and user charge revenue (*fx*, where *f* is the user charge per unit). The production of the utilities is delegated to a bureau, and the bureau asks a unit cost *c*. The true costs are unknown to the local government and it must act according to the reported and therefore actual costs. When the unit cost of welfare services is normalized to unity, the local government budget constraint reads:

$$r + (f - c)x - w = 0 \tag{2}$$

We assume that the consumption of utility services is determined by the local government. This seems realistic for most utilities where discretion at the household level is limited, see Section 2. This setup implies that the user charge functions as a tax instrument. The consumption of the all-purpose private good is determined by the budget constraint of the representative voter

$$q = y - fx \qquad (3)$$

where y is exogenous private income.

The local government decides the provision of utilities, the user charge and the provision of welfare services so as to maximize the utility function of the representative voter subject to the private and the local government budget constraints. We have not imposed any restriction on the fee setting, like $f \leq c$, since the discussion in Section 2 suggests that local governments are able to circumvent the national regulation. The utility maximization results in the following equations for utility demand and fee setting:[3]

$$\underset{-\,+\,+\,-}{x = x(c, r, y, z)} \qquad (4)$$

$$\underset{?\;-\;?\;+}{f = f(c, r, y, z)} \qquad (5)$$

The demand for utilities and the fee level are dependent on the unit cost asked by the bureau, exogenous revenue, private income and the size of the client groups. The indicated signs of the partial effects are derived under the assumption of an additive separable utility function (see Appendix 1). If the bureau reports a higher unit cost, the response of the local government is to reduce the demand for utilities. The effect on the user charge will most likely be positive, but it might be negative if the user charge is lower than the unit cost at the outset. The possibility of reduced user charge with higher unit cost is somewhat surprising and can be explained as follows: Suppose that the user charge is kept unchanged as the demand for and therefore the provision of utilities decreases. If the user charge is lower than the unit cost and the cost elasticity of demand is 'large', more resources are available for provision of welfare services. If the demand effect for welfare services is less than the new resources available, there is room for the local government to reduce the user charge when the unit cost increases.

[3] The equations for private consumption and provision of welfare services are suppressed since they play no role in the interaction between the local government and the bureau.

Increases in private income or exogenous local government revenue have a positive income effect that increases the provision of utilities, as well as welfare services and private consumption. When local government revenue increases, the user charge must be reduced in order to facilitate an increase in private consumption. On the other hand, higher private income will most likely raise the user charge. A sufficient condition for this result to hold is that user charge is lower than or equal to the unit cost. If the user charge exceeds the unit cost, higher private income might lower the user charge. The intuition goes as follows: If the user charge is kept unchanged as the provision of utilities increases, more resources will be available for provision of welfare services. And if this 'automatic' increase in provision of welfare services is less than the desired increase, the user charge will be reduced. Finally, a demographic shift towards welfare clients will reduce the provision of utilities and drive up the user charge to finance the expansion of welfare services.

The actual cost and the allocation of resources are determined by strategic interaction between the local government and the bureau. We will study two forms of strategic interaction. The first is a Stackelberg game where the bureau acts as leader. The bureau reports a unit cost for the utility service and the local government consequently chooses service level, user fee and grants the bureau a lump-sum budget to cover costs in excess of user fees. The second is a Nash game where the local government has a stronger hand, and where the bureau faces a fixed user fee and fixed lump-sum budget.

In accordance with the conventional formulation as in Moene (1986), the bureau has preferences for service production (x) and slack per unit (s). Slack per unit is defined as actual or reported cost (c) in excess of minimum cost (c_0):

$$b = b(x, s), \quad s = c - c_0 \tag{6}$$

Both production and slack are assumed to be normal goods in the bureau's utility function. The bureau has two sources of revenue, user charges as well as a fixed budget to cover costs in excess of user charges. The expression for the fixed budget (l) is given by:

$$l = (c - f)x \tag{7}$$

Consider first the Nash game with simultaneous moves where the bureau determines the actual cost treating both *f* and *l* as fixed. The bureau's optimization problem is:

$$\underset{c}{Max}\, b(\frac{l}{c-f}, c-c_0) \tag{8}$$

The first order condition reads:

$$\frac{b_s}{b_x} = \frac{x}{c-f} \tag{9}$$

It appears that the user charge affects the relative 'price' between slack and output. From the bureau's point of view an increase in the user charge makes slack more costly (in terms of lower production), and this substitution effect leads to lower reported cost. But if the lump-sum grant is fixed, there will also be a positive income effect that works in the opposite direction.[4] In relation to the empirical analysis it is not the partial effect of higher user charge that is of main interest, but rather the combined effect of higher user charge and lower fixed budget. The impact of a revenue neutral combination of higher user charge and lower fixed budget is given by[5]

$$dc = \frac{1}{D_2}\frac{x}{(c-f)^2} b_x df < 0, \tag{10}$$

where the denominator D_2 is negative from the second order condition. A revenue neutral increase in user charge financing has no income effect, and thereby an unambiguously negative effect on reported cost.

In the Stackelberg game the bureau acts as leader and does not consider *l* as fixed. It takes the demand function (4) into account and foresees that the local government will grant a total budget sufficient to cover the reported costs. The bureau's optimization problem becomes:

[4] There is an additional effect due to the non-linear budget constraint. The effect is not emphasized here because it cancels out when we consider the combined effect of higher user charge and lower fixed budget.
[5] See Appendix 1 for details.

$$\underset{c}{Max}\, b(x(c,r,y,z), c - c_0) \tag{11}$$

The first order condition reads:

$$\frac{b_s}{b_x} = \varepsilon \frac{x}{c}, \quad \varepsilon = -\frac{\partial x}{\partial c}\frac{c}{x} \tag{12}$$

The user charge does not appear directly in the bureau's optimization problem, and the bureau is not directly affected by user charge financing. Consequently, the model predicts that the costs are independent of user charge financing in this case.

The conclusion from the analyses above is that the effect of user charge financing on costs depends on the form of strategic interaction between the bureau and the local government. The Nash game with simultaneous moves predicts that a high degree of user charge financing leads to lower costs, whereas the costs in the Stackelberg game are independent of the user charge financing. The theoretical ambiguity calls for an econometric analysis of the issue.

4. Data and empirical specification

The empirical analysis of user charges and unit costs of the sewage services is based on a data set prepared by Statistics Norway. The collection of these 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 government bank for local governments (*Kommunalbanken*). In the analysis we focus on the unit costs, which is 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 persons. Firms are converted into standard users based on their consumption of the service. The user charge per standard user is calculated as collected user charges (connection fee and annual fee) from households and firms per standard user.

The number of local governments that have reported sufficient and reliable information to calculate unit cost and user charge varies substantially from year to year, from a low of 295 in 1988 to a high of 388 in 1995.[6] We apply an unbalanced panel data set with a total of 2,031 observations.

The empirical analysis is based on the following econometric model

$$\begin{aligned}
\log f_{it} &= \alpha_t + \alpha_1 \log c_{it} + \alpha_2 \log y_{it} + \alpha_3 \log r_{it} + \alpha_4 INTR_{it} + \alpha_5 RURAL_i + \alpha_6 \log P_{it} \\
&\quad + \alpha_7 CH_{it} + \alpha_8 YO_{it} + \alpha_9 EL_{it} + \alpha_{10} SOC_{it} + \alpha_{11} HERF_{it} + \gamma_i + u_{it} \\
\log c_{it} &= \beta_t + \beta_1 \frac{f_{it}}{c_{it}} + \beta_2 \log y_{it} + \beta_3 \log r_{it} + \beta_4 INTR_{it} + \beta_5 RURAL_i + \beta_6 \log P_{it} \\
&\quad + \beta_7 CH_{it} + \beta_8 YO_{it} + \beta_9 EL_{it} + \beta_{10} SOC_{it} + \beta_{11} HERF_{it} + \eta_i + v_{it},
\end{aligned} \tag{13}$$

where f_{it} is the user charge in community *i* in year *t*, etc. The user charge and cost equations are the reaction functions of respectively the local government and the bureau. Compared to the theoretical model discussed in Section 2, the following modifications are made to take into account the institutional setting of local governments in Norway (and in accordance with standard empirical studies such as Borge and Rattsø, 1995). First, the vector *z* comprises three variables describing the age composition of the population and representing the key clients of local government services. These are the shares of children 0-6 years (*CH*), youths 7-15 years (*YO*) and elderly 80 years and above (*EL*). Second, net interest payment as share of revenue (*INTR*) is included as an additional variable describing the intertemporal budget constraint of local governments. It is expected to have the opposite effect of exogenous local government revenue (*r*). Third, the share of the population living in rural areas (*RURAL*) and the population size (*P*) are included in the cost equation to capture cost disadvantages in sparsely populated communities and possible economies of scale. Fourth, two variables capturing political institutions are included, again typical of standard empirical analyses of Norwegian local governments such as Kalseth and Rattsø (1998). The ideological orientation of the political system is represented by the share of socialists in the local council (*SOC)*. To represent 'strength' of the political leadership, we include a Herfindahl-index (*HERF*) measuring the (inverse of) the party fragmentation in the local council. Fifth, time specific

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

constant terms (α_t and β_t) are included in both equations. Finally, *u* and *v* are error terms. Summary statistics of the variables are reported in Appendix 2.

Different assumptions are made about the community specific terms (γ_i and η_i). Given the short panel, we start out by a applying a pooled regression without any community specific terms, but where 18 county dummies are included to capture regional effects. We proceed by including random and fixed community specific effects. Finally, we also take account of the simultaneity problem related to the fact that the unit cost is a possible endogenous variable in the user charge equation and that the degree of user charge financing is a possible endogenous variable in the cost equation. The simultaneity problem is handled by using instruments.

5. Analysis: The relationships between costs and user charges

The first estimates of the unit cost and user charge equations are reported in Table 2. The unit cost and the degree of user charge financing are treated as exogenous when they serve as determinants of each other. The community specific terms are handled in three different ways, to be discussed below. The first panel reports the pooled regressions. It is evident from the user charge equation that a cost increase is partly passed over to the consumers. The estimated elasticity is around 0.4 and highly significant. Given that the elasticity is below unity, the share of costs covered by user charges is reduced as the unit cost goes up. The degree of user charge financing comes out highly significant and with a negative sign in the cost equation, which is consistent with a Nash game between the local government and the bureau. User charge financing helps to keep costs low, and the effect also is of economic significance. The estimated coefficient implies that an increase in the degree of user charge financing by 10 %-points will reduce the unit cost by 7.5%.

Table 2 about here

In the Appendix Table A2 we report some sensitivity analysis with the pooled regression as benchmark. The first sensitivity analysis is to extend the equations with a dummy variable that equals 1 if the local government levies property tax on residential property. The motivation is that we in a companion paper (Borge and Rattsø 2004) find evidence that residential property tax contributes to lower costs, and the primary interest is to check whether the impact of the degree of user charge financing in the cost equation is robust to the inclusion of the property tax variable. As in Borge and Rattsø (2004) we find that property tax has a significantly negative effect on the unit cost, but the inclusion of the property tax variable does not change the significance and the quantitative effect of the degree of user charge financing.

The property tax dummy also comes out with a negative and significant effect in the user charge equation, which probably reflects that property tax and user charges are alternative means of financing. Taken together, the user charge equation and the cost equation imply that the existence of property tax has two effects on the user charge. A direct effect in the user charge equation and an indirect effect through the cost equation. The total effect of having residential property taxation is to reduce the user charge by 10%.

The second sensitivity analysis is to exclude extreme observations. As discussed in Section 2, there is large variation in unit cost and user charge across local governments. To a great extent this large variation reflects that Norwegian local governments are very different in terms of topography and population, varying from rural communities with a few hundred inhabitants to larger cities. In the third panel of Table A2 we excluded the 10% of the observations with the highest and lowest values for unit cost and user charge for each of the six years. This modification of the sample only has minor effect on the estimates. In particular, the estimate of the unit cost in the user charge equation and the estimate of the degree of user charge financing in the cost equation seem very robust.

Returning to Table 2, the second and third panels report random and fixed effects estimates respectively. The effect of costs on the user charge is very similar to the result from the pooled regression. The estimated elasticity is around 0.4 and highly significant. When it comes to the impact of user charge financing on costs, sign and significance is unaltered by the inclusion of community specific effects, but the quantitative effect is somewhat reduced compared to the pooled regression. The random and fixed effects estimates indicate that an increase in the degree of user charge financing by 10 %-points will reduce the unit cost by around 6 %.

The fixed effects specification is the most general of the three, and it is of interest to test whether the two more restrictive specifications can be rejected. The pooled regressions are clearly rejected by a regular F-test, which tests whether the community specific effects can be captured by county dummies. We still think the pooled regressions are of interest since local factors may be attributed to the community specific effects in the fixed effects regressions. The specifications with random community specific effects and county dummies are not rejected by a regular Hausman test.[7]

Table 3 deals with the simultaneity problem related to the fact that the unit cost is a possible endogenous variable in the user charge equation and that the degree of user charge financing is a possible endogenous variable in the cost equation. As instruments we apply one year lag of the exogenous variables (excluding private income and net interest payments) and one year lag of the possible endogenous variable. Private income and net interest payments were excluded based on Sargan tests.[8]

Table 3 about here

The first panel reports the pooled regressions. The elasticity of the user charge with respect to the unit cost is estimated to around 0.4 and the coefficient of the degree of user charge financing in the cost equation is around 0.8, and they are both highly significant. It should be noticed that the similarity with the pooled regressions in Table 2, where the unit cost and the degree of user charge financing are not instrumented, is not due to 'overfitting' in the first stage regression. The R^2-s in first stage regressions are in the range 0.5-0.8.

In the second panel of Table 3 we combine instruments and random effects. The unit cost comes out significantly positive in the user charge equation and the degree of user charge financing is significantly negative in the cost equation. The third panel shows that these results hold when instruments are combined with fixed effects. Although the estimates are less precise with fixed effects, they are still significant at conventional levels. The random and fixed effects specifications indicate that around 30% of a cost increase is passed on to consumers in terms of higher user charges, and that an increase in the degree of user charge financing by 10 %-points will reduce the unit cost by 8-10%.

---

[7] When county dummies are not included, the random effects specifications are rejected.

[8] We also performed F and Hausman tests to test the pooled and random effects specifications in the case where the unit cost and the degree of user charge financing are instrumented. The results were the same as for the basic regressions without instruments discussed above, i.e. the pooled regressions are rejected against the fixed effects specification, whereas the random effects specifications (with county dummies) are not rejected.

In the bottom row of Table 3 the validity of the instruments is tested by a Sargan test for the pooled and fixed effects specifications. The null hypothesis of valid instrument can not be rejected for the pooled regressions. On the other hand, the presence of first order autocorrelation questions this conclusion as one year lag of the possible endogenous variable is included in the instrument set. Autocorrelation seems to be a problem also in the random effects specification. However, the fixed effects specification performs well as the hypotheses of valid instruments and absence of first order autocorrelation can not be rejected.

6. Broader determinants of costs and user charges

The estimated equations reported in Tables 2 and 3 also provide information about the impact of other determinants of costs and user charges. Exogenous revenue (grants and regulated taxes) is expected to have a negative effect on the user charge and a positive effect on the unit cost. A negative and significant effect on the user charge is found in the pooled regressions in Tables 2 and 3, whereas a positive and significant effect on the unit cost is found in the pooled and random effects regressions in Table 2.

Fiscal pressure from high interest payments is expected to have the opposite effect of high revenue. A significantly positive impact on the user charge is found in the pooled and random effects regressions in Table 2. The variable comes out with the expected negative sign in all cost equations estimated, but is never statistically significant.

The population size and the share of the populations residing in rural areas are included to capture cost disadvantages in small and sparsely populated communities. The pooled regressions in Tables 2 and 3 and the random effects regression in Table 2 provide evidence that a sparse settlement pattern leads to high costs. Rather surprisingly, the settlement seems to have a stronger impact on the user charge than on the unit cost. Given that costs are directly controlled for, this must be interpreted as a broader effect of structural factors related to the settlement pattern. The population size is largely insignificant in both the user charge equation and the cost equation, except for a significantly negative effect on the user charge in the fixed effects regression in Table 2. Private income has a negative effect on the unit cost in the pooled regressions, but is otherwise insignificant.

A comprehensive literature has addressed the political response to demographic shift (see e.g. Borge and Rattsø 1995, Poterba 1997). An increase in the share of children, youth or elderly is expected to increase the provision of welfare services and thereby the user charge, and to represent fiscal pressure that contributes to lower costs. The support for these predictions is mixed. The shares of children and elderly have a positive and significant effect on the user charge in the cases with community specific effects and instruments (Table 3), and the share of children also in the random and fixed effects regressions in Table 2. The share of elderly has a significantly negative effect on the unit cost in the pooled regressions, but otherwise there is little evidence that the clients of welfare services contribute to lower costs.

Other studies of fee setting in Norwegian local governments (Borge 1995, 2000) have shown that socialist influence and a fragmented local council leads to higher user charges. The Herfindahl-index has a negative and significant impact on the user charge in most cases, which is consistent with the outcome of the earlier studies. The Herfindahl-index also has a significantly negative effect on costs when community specific effects are accounted for. This result is consistent with Kalseth and Rattsø (1998) who find that a low degree of party fragmentation contributes to lower administrative costs. Besides the variables of main interest discussed in Section 5, the Herfindahl-index is the variable that has the most consistent impact on costs and user charges. The other political variable, the share of socialists, has less impact, but in the pooled and random effects regressions in Table 3 there is some evidence that socialist influence contributes to higher costs.

7. Concluding remarks

The purpose of the paper is to investigate the relationships between costs and user charges in the sewage industry in Norwegian local governments. The main questions addressed are: (i) To what extent is higher unit cost passed on to consumers in terms of higher user charge? (ii) Does user charge financing lead to higher or lower unit cost?

Theoretical predictions are derived within a game theoretical model describing the interaction between a political authority and a service-producing bureau. The politicians set the user charge, and their reaction function is derived from a representative voter model. The impact of user charges on costs depends on the form of strategic interaction. In a Nash game where the bureau treats the user charge as fixed, user charge financing leads to lower costs because it makes slack more costly for the bureau. In a Stackelberg game, the unit costs are independent of user charge financing, as the budget is designed to cover reported costs.

The empirical analysis is based on a panel data set for a sample of Norwegian local governments over the years 1993-1998. The estimates indicate that 30-40% of a cost increase is passed on to consumers in terms of higher user charge. Moreover, user charge financing has a significant negative effect on the unit cost. An increase in user charge financing by 10 %-points is predicted to reduce the unit cost by up to 10%. The results are robust to the inclusion of community specific terms and use of instruments. The main policy implication of the analysis is that user charge financing can contribute to better cost control in the public sector, but at the possible cost of a more uneven income distribution compared to traditional tax financing.

References

Bersvendsen, T.W., J.L. Hass, K. Mork and B.H. Strand (1999): Ressursinnsats, utslipp og rensing i den kommunale avløpssektoren (Resource Use, Discharge and Cleaning in the Municipal Sewage Industry), Report 99/2, Statistics Norway.

Bierhanzl, E. (1999), Incentives for Efficiency: User Charges and Municipal Spending, Journal of Public Finance and Public Choice 17, 19-34.

Bierhanzl E. and P. Downing (1998), User Charges and Bureaucratic Inefficiency, Atlantic Economic Journal 26, 175-189.

Borge, L.-E. (1995), Economic and Political Determinants of Fee income in Norwegian Local Governments, Public Choice 83, 353-373.

Borge, L.-E. (2000), Charging for Public Services: The Case of Utilities in Norwegian Local Governments, Regional Science and Urban Economics 30, 703-718.

Borge, L.-E. and J. Rattsø (1995), Demographic Shift, Relative Costs and the Allocation of Local Public Consumption in Norway, Regional Science and Urban Economics 25, 705-726.

Borge, L.-E. and J. Rattsø (2004), Property Taxation as Incentive for Cost Control: Empirical Evidence for Utility Services in Norway, Mimeo, Department of Economics, Norwegian University of Science and Technology.

Brennan, G. and J. Buchanan (1977), Towards a Tax Constitution for Leviathan, Journal of Public Economics 8, 255-273.

Breton, A. (1996), Competitive Governments: An Economic Theory of Politics and Public Finance, New York.

Glaeser, E. (1996), The Incentive Effects of Property Taxes on Local Government, Public Choice 89, 93-111.

Gordon, R.H. and J.H. Wilson (1999), Tax Structure and Government Behavior: Implications for Tax Policy, Working Paper 7244, National Bureau of Economic Research.

Hoxby, C. (1999), The Productivity of Schools and other Local Public Goods Producers, Journal of Public Economics 74, 1-30.

Inman, R.P. (1979), The Fiscal Performance of Local Governments: An Interpretative Review, in: P. Mieszkowski and M. Straszheim (eds.), Current Issues in Urban Economics, Baltimore.

Inman, R.P. (1989), The Local Decision to Tax: Evidence from the Large US cities, Regional Science and Urban Economics 19, 455-491.

Kalseth, J. and J. Rattsø (1998), Political Control of Administrative Spending: The Case of Local Governments in Norway, Economics and Politics 10, 63-83.

Migue, J. and G. Belanger (1974), Towards a General Theory of Managerial Discretion, Public Choice 17, 27-43.

Miller, G. and T. Moe (1983), Bureaucrats, Legislators, and the Size of Government, American Political Science Review 77, 297-322.

Moene, K.O. (1986), Types of Bureaucratic Interaction, Journal of Public Economics 29, 37-53.

NOU (1997:8): Om finansiering av kommunesektoren (The financing of the local public sector), Report from a government commission, Oslo.

Poterba, J. (1997), Demographic Structure and the Political Economy of Public Education, Journal of Policy Analysis and Management 16, 48-66.

Rubinfeld, D.L. (1987), The economics of the local public sector, in: A.J. Auerbach and M. Feldstein (eds.), Handbook of Public Economics Volume 2, Amsterdam.

Wicksell, K. (1896, 1967): A New Principle of Just Taxation, reprinted in R. Musgrave and A. Peacock, Classics in the Theory of Public Finance, New York.

Appendix 1. Comparative statics

The first order conditions for the local government's decision-making problem can be found by inserting the budget constraints (2) and (3) into the utility function and maximizing with respect to *x* and *f*:

$$u_q = \frac{u_x}{c} = u_w \tag{A1}$$

By differentiating the first order conditions and assuming an additive separable utility function, we obtain the following results:

$$\begin{aligned} \frac{\partial x}{\partial c} &= -\frac{x}{D_1}\left[(u_{qq}+u_{ww})u_w - cxu_{qq}u_{ww}\right] < 0 \\ \frac{\partial f}{\partial c} &= \frac{x}{D_1}\left[(fu_{qq}-(c-f)u_{ww})u_w - x(cu_{qq}+u_{xx})u_{ww}\right] > 0 \text{ if } c \le f \end{aligned} \tag{A2}$$

$$\begin{aligned} \frac{\partial x}{\partial r} &= -\frac{cx}{D_1}u_{qq}u_{ww} > 0 \\ \frac{\partial f}{\partial r} &= \frac{1}{D_1}(cfu_{qq}+u_{xx})u_{ww} < 0 \end{aligned} \tag{A3}$$

$$\begin{aligned} \frac{\partial x}{\partial y} &= -\frac{cx}{D_1}u_{qq}u_{ww} > 0 \\ \frac{\partial f}{\partial y} &= -\frac{1}{D_1}(u_{xx}+c(c-f)u_{ww})u_{xx} > 0 \text{ if } c \ge f \end{aligned} \tag{A4}$$

$$\begin{aligned} \frac{\partial x}{\partial z} &= -\frac{cx}{D_1}u_{qq}u_{wz} < 0 \\ \frac{\partial f}{\partial z} &= \frac{1}{D_1}(cfu_{qq}+u_{xx})u_{wz} > 0 \end{aligned} \tag{A5}$$

The denominator D_1 is given by:

$$D_1 = -x(u_{qq}u_{xx} + c^2 u_{qq}u_{ww} + u_{xx}u_{ww}) < 0 \quad \text{(A6)}$$

By differentiating the bureau's first order condition, given by equation (9), and assuming an additive separable utility function, we obtain the following comparative static results:

$$\begin{aligned} \frac{\partial c}{\partial f} &= \frac{1}{D_2}\left[\frac{2x}{(c-f)^2}b_x + \frac{x^2}{(c-f)^2}b_{xx}\right] \\ \frac{\partial c}{\partial l} &= \frac{1}{D_2}\left[\frac{1}{(c-f)^2}b_x + \frac{x}{(c-f)^2}b_{xx}\right] \end{aligned} \quad \text{(A7)}$$

$D_2 = \frac{x^2}{(c-f)^2}b_{xx} + b_{ss} - \frac{x}{c-f}b_x$ is negative from the second order condition. The combined effect of increased user charge and lower fixed budget is revenue neutral if $dl = -xdf$. By utilizing equation (A7), we then arrive at equation (10) in the main text.

Appendix 2. Documentation of the variables

Table A1 about here

Appendix 3. Sensitivity analysis

Table A2 about here

Table 1: The development of unit cost, user charge and share of costs covered by user charges. 1993-1998.

Year	Number of local governments	Unit cost (NOK)	User charge (NOK)	Share of costs covered by user charges
1993	313	2 117	1 713	80.9
1994	354	2 107	1 812	86.0
1995	388	2 276	2 008	88.2
1996	384	2 211	2 057	93.0
1997	297	2 189	2 197	100.4
1998	295	2 490	2 300	92.4

Notes: Unit cost and user charge are measured in Norwegian kroner (NOK) per standard user. The figures are weighted averages.

Table 2: Basic estimation results

	Pooled regression		Random effects		Fixed effects	
	User ch.	Cost	User ch.	Cost	User ch.	Cost
log *c*	0.414		0.391		0.382	
	(17.91)		(19.24)		(12.69)	
$\frac{f}{c}$		-0.751		-0.611		-0.578
		(-19.35)		(-31.51)		(-20.11)
log *y*	-0.019	-0.416	-0.209	-0.044	-0.208	0.197
	(-0.12)	(-2.81)	(-1.26)	(-0.29)	(-0.74)	(0.97)
log *r*	-0.428	0.210	-0.058	0.155	0.166	0.123
	(-4.11)	(2.36)	(-0.71)	(2.09)	(1.08)	(0.98)
INTR	0.424	-0.202	0.267	-0.076	0.174	-0.051
	(2.19)	(-0.78)	(2.12)	(-0.71)	(1.16)	(-0.47)
RURAL	-0.458	0.135	-0.483	0.244		
	(-8.50)	(2.57)	(-5.54)	(2.62)		
log *P*	0.006	-0.004	0.047	-0.026	-1.124	-0.350
	(0.36)	(-0.25)	(1.79)	(-0.96)	(-2.60)	(-1.12)
CH	0.256	0.688	3.236	3.211	8.562	5.711
	(0.20)	(0.57)	(2.52)	(2.70)	(2.57)	(2.72)
YO	-0.689	-0.976	-0.807	-1.567	1.032	-0.865
	(-0.63)	(-0.92)	(-0.74)	(-1.55)	(0.48)	(-0.53)
EL	1.363	-2.029	0.606	-2.309	-2.368	-3.495
	(1.24)	(-1.71)	(0.42)	(-1.65)	(-0.64)	(-1.47)
SOC	-0.109	0.216	-0.075	0.126	-0.092	0.039
	(-1.41)	(1.64)	(-0.73)	(1.34)	(-0.57)	(0.34)
HERF	-0.395	-0.204	-0.331	-0.295	-0.263	-0.334
	(-2.34)	(-1.17)	(-2.03)	(-1.95)	(-1.02)	(-1.72)
R^2_{adj}	0.551	0.644			0.822	0.904

Note: Time dummies (included in all equations) and county dummies (included in the pooled and random effects equations) are not reported. The t-values in parentheses are based on heteroskedasticity-consistent standard errors. The number of observations is 2,031.

Table 3: Estimation results taking the simultaneity problem into account

	Pooled regression		Random effects		Fixed effects	
	User ch.	Unit cost	User ch.	Unit cost	User ch.	Unit cost
log *c*	0.417		0.346		0.272	
	(13.97)		(6.71)		(2.00)	
$\frac{f}{c}$		-0.820		-0.831		-1.030
		(-18.05)		(-8.16)		(-3.98)
log *y*	-0.037	-0.447	0.015	-0.082	0.045	0.102
	(-0.24)	(-2.78)	(0.09)	(-0.51)	(0.14)	(0.43)
log *r*	-0.504	0.147	-0.102	0.144	0.155	0.172
	(-4.25)	(1.47)	(-1.06)	(1.61)	(1.24)	(1.10)
INTR	0.182	-0.126	0.065	-0.117	0.022	-0.107
	(1.26)	(-0.50)	(0.57)	(-1.19)	(0.24)	(-1.12)
RURAL	-0.404	0.120	-0.443	0.095		
	(-7.31)	(2.04)	(-4.60)	(0.85)		
log *P*	0.005	-0.004	0.037	-0.016	-0.678	-0.666
	(0.29)	(-0.21)	(1.35)	(-0.56)	(-1.19)	(-1.47)
CH	0.581	0.527	4.142	2.179	8.846	3.793
	(0.52)	(0.44)	(2.96)	(1.65)	(2.92)	(1.72)
YO	-0.319	-1.438	1.062	-0.728	3.318	-1.000
	(-0.29)	(-1.29)	(0.87)	(-0.63)	(1.32)	(-0.43)
EL	1.389	-2.562	3.349	-0.267	6.114	1.648
	(1.15)	(-1.93)	(2.15)	(-0.18)	(1.75)	(0.51)
SOC	-0.122	0.170	0.050	0.177	0.129	0.148
	(-1.51)	(1.89)	(0.48)	(1.86)	(1.01)	(1.02)
HERF	-0.276	-0.149	-0.535	-0.436	-0.848	-0.659
	(-1.70)	(-0.79)	(-3.21)	(-2.81)	(-3.04)	(-2.51)
Sargan	16.13	14.33			7.51	10.93
(p-value)	(0.064)	(0.111)			(0.378)	(0.142)
AR(1)	9.47	10.63	6.62	6.52	-1.41	-1.25
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.158)	(0.211)
R^2_{adj}	0.552	0.644			0.845	0.893

Notes: As instruments we use one year lag of the exogenous variables, except log *y* and *INTR*, and one year lag of the possible endogenous variable. Time dummies (included in all equations) and county dummies (included in the pooled and random effects regressions) are not reported. The t-values in parentheses are based on heteroskedasticity-consistent standard errors. The number of observations is 1,560.

Table A1: Data description and descriptive statistics

Variable	Description	Mean (st. dev.)
User charge (*f*)	Collected user charges (connection fees and yearly fees) per standard users, NOK	1 876 (970)
Unit cost (*c*)	Total costs per standard user for discharge of sewage, NOK	2 874 (1 762)
Degree of user charge financing ($\frac{f}{c}$)	Collected user charges divided by total costs	0.779 (0.391)
Private disposable income (*y*)	Taxable income minus income and wealth taxes to local, county and central government, measured per capita and deflated by the consumer price index, NOK	64 468 (9 619)
Exogenous local government revenue (*r*)	The sum of lump-sum grants from the central government and regulated income and wealth taxes, measured per capita and deflated by a price index for local government purchases and adjusted for minor changes in the functional responsibility, NOK	19 125 (5 167)
Net interest payment (*INTR*)	Net interest payment as fraction of exogenous local government revenue	0.023 (0.052)
Settlement pattern (*RURAL*)	The share of the population living in rural areas (1990)	0.533 (0.286)
Population size (*P*)	Total population, January 1	10 145 (18 442)
The share of children (*CH*)	The share of the population 0-6 years, January 1	0.093 (0.012)
The share of youths (*YO*)	The share of the population 7-15 years, January 1	0.117 (0.015)
The share of elderly (*EL*)	The share of the population 80 years and above, January 1	0.047 (0.015)
The share of socialists (*SOC*)	The share of socialist representatives in the local council	0.397 (0.149)
Party fragmentation (*HERF*)	Herfindahl-index measuring the party fragmentation of the local council	0.268 (0.081)
Property tax dummy (*PRTAX*)	A dummy variable that is equal to unity if the local government levies property tax on residential property	0.305 (0.461)

Table A2: Sensitivity analysis with the pooled regressions as benchmark

	Basic OLS regression		Property tax dummy		Excluding extreme obs.	
	User charge	Unit cost	User charge	Unit cost	User charge	Unit cost
log *c*	0.414		0.412		0.349	
	(17.82)		(17.67)		(13.70)	
$\frac{f}{c}$		-0.751		-0.753		-0.703
		(-18.99)		(-18.95)		(-20.21)
log *y*	-0.019	-0.416	0.024	-0.418	-0.113	-0.270
	(-0.12)	(-2.79)	(0.15)	(-2.81)	(-0.70)	(-2.10)
log *r*	-0.428	0.210	-0.436	0.201	-0.255	0.068
	(-4.06)	(2.31)	(-4.13)	(2.20)	(-2.77)	(0.85)
INTR	0.424	-0.202	0.409	-0.214	0.128	0.102
	(1.94)	(-0.62)	(1.90)	(-0.65)	(0.52)	(0.63)
RURAL	-0.458	0.135	-0.480	0.110	-0.307	0.090
	(-8.47)	(2.56)	(-8.85)	(2.08)	(-6.18)	(2.07)
log *P*	0.006	-0.004	0.012	0.003	0.034	0.007
	(0.35)	(-0.25)	(0.77)	(0.17)	(2.13)	(0.52)
CH	0.256	0.688	0.233	0.663	0.606	2.551
	(0.20)	(0.57)	(0.18)	(0.55)	(0.60)	(2.71)
YO	-0.689	-0.976	-0.877	-1.160	-0.251	-0.801
	(-0.63)	(-0.92)	(-0.80)	(-1.08)	(-0.27)	(-0.96)
EL	1.363	-2.029	1.547	-1.832	0.575	1.185
	(1.23)	(-1.70)	(1.39)	(-1.54)	(0.54)	(1.20)
SOC	-0.109	0.216	-0.075	0.248	-0.076	0.092
	(-1.39)	(2.61)	(-0.96)	(2.95)	(-0.95)	(1.27)
HERF	-0.395	-0.204	-0.399	-0.208	-0.250	-0.290
	(-2.30)	(-1.15)	(-2.32)	(-1.15)	(-1.47)	(-1.79)
PRTAX			-0.070	-0.069		
			(-3.77)	(-3.47)		
# of obs.	2,031	2,031	2,031	2,031	1,371	1,371
R^2_{adj}	0.551	0.644	0.553	0.646	0.472	0.576

Note: Time and county dummies (not reported) are included in all equations. The t-values in parentheses are based on heteroskedasticity-consistent standard errors.