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Abstract:
A cooperative bargaining model is adapted to the setting of local government in Norway. Aggregate consumption, the capital stock and net financial wealth in the local public sector are endogenized. The origin of intertia in the model is ascribed to incrementalism or adjustment costs in the disagreement points of the Nash solution. Using the method of ordinary least squares, the model is estimated on sample data for the period 1973-1991. Different hypotheses regarding the disagreement point formation are tested, and the pure incrementalist model is encompassed by a more general partial adjustment model, implying that some other mechanism than just preservation of the status quo is operative. It is found that local government consumption, the capital stock and the net debt in the long run are stabilized relative to disposable income. Finally, results form model simulations are reported.

Keywords: Local government, consumption, investment, dynamic specification.

JEL classification: C32, H72, H74.

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1. Introduction

The local public sector in Norway has experienced a relatively high rate of growth during most of the post-war era. The sector, which contains about 450 municipalities at the local level and 19 counties at the intermediate level of government, accounted for 15 percent of the mainland gross domestic product and 17 percent of total employment in 1991. The growing portion of economic activities under the management of local public authorities, means that the behaviour of these authorities has become more important to the macroeconomic performance of the Norwegian economy.

The main concern of this paper is how to explain local government spending behaviour in Norway at the aggregate level. In chapter 2, a theoretical model of local government spending behaviour is developed. In chapter 3, the model is estimated on annual time series data from the National Accounts of Norway for the period 1973 - 1991. The data are aggregated over all Norwegian municipalities and counties. The variables and data definitions in the model are summarized in Appendix A. Chapter 4 contains simulation results for the empirical model.

In the model analysis, local government disposable income is treated as exogenous. It is shown that disposable income is an important determinant for the dynamic spending pattern of local governments. When income increases, there is considerable sluggishness in the adjustment of consumption and real investment, leading to a decrease in the debt ratio in the short and medium term. The incrementalist hypothesis that the budget in the present year closely resembles the budget allocation in the previous year is found too simple to provide an accurate description of spending behaviour. It is found that local goverment consumption, the capital stock and the net debt in the long run are stabilized relative to disposable income.

Some of the benchmark models in public finance represent the economic behaviour of public authorities as that of preference maximization for a single individual agent. However, the models take various views on who's preferences are guiding the policy outcome.[1] Either the decision-maker is assumed to be a benevolent social planner, or it is the median voter who controls the outcome, or the power rests with the agenda setter in the guise of an influential chief politician or bureaucrat.

On the other hand, there are theories which introduce pluralism, conflict and bargaining in the budgetary process. In Niskanen (1975), the relation between bureaucrats and politicians is represented as that of a bilateral monopoly. They are mutually involved in the exchange of some output for a budget. Van Winden (1983) develops an interest function approach which emphasizes the influence of pressure groups and social classes on government behaviour.

Fischer and Kamlet (1984) propose a model of trade-offs among defense, non-defense, and fiscal policy concerns as they are reflected in the US presidential budgetary process. Their model conforms to the asymmetric Nash-solution to a tripartite game among advocates of defense and non-defense expenditures, and guardians of fiscal restraint.

In section 2.1, cooperative bargaining theory is applied to the Norwegian institutional setting. The model is based on a pluralist view of politics, in which conflicting interests and demands are reconciled by means of bargaining. However, the Nash-product could also be interpreted as the Stone-Geary utility function of a single agent. Thus, the model may represent several views as regarding power distribution and who's preferences are guiding the policy outcome.

Even if the political process is pluralist, the extent of conflict and antagonism in budget-making may be exaggerated. In the model presented below, considerable emphasis is laid on the cooperative aspect of bargaining. The bulk of local government spending may actually be undisputed. The presence of consensus, legal norms, shared social values and long range commitments may substantially delimit the area of contention in the bargaining process. This is assumed to affect the formation of disagreement points, which is discussed in section 2.2.

[1] Inman (1989), Rubinfeld (1987).

2. A bargaining model of local government spending behaviour

2.1 The asymmetric Nash bargaining model

This section develops a model of consumption, investment and budget surplus in a representative local government. The model presented is inspired by Fisher and Kamlet (1984) and Hagen and Sørensen (1993). However, the formulation adopted here differs especially in two respects:

- Total spending is split into consumption and investment expenditures
- Local government debt is explicitly incorporated in the model

The axioms of the original Nash (1950) model are essentially normative. Harsanyi (1977) and Binmore et al (1986) provide arguments in support of it's relevance in positive modelling. It has become customary to disregard the symmetry axiom in order to allow for unequal distribution of power among agents.[2] Although the outcome is Pareto optimal to the agents involved, it is not necessarily socially optimal.

The budgetary discretion of local governments in Norway is severely restricted. The national government determines the grants, and the local income tax rates are constrained by an upper limit. All authorities adopt the upper limit tax rate. Property taxes are hardly important, and what remains is about 10 percent of local revenues made up by charges that are regulated by law. Before 1981, prices charged for local services were subject to central regulation. In 1981, the price regulation regime was replaced by a provision that the fee income cannot exceed the costs of providing the service. Thus, the opportunities of local governments to increase revenues by imposing a higher tax rate on the residents, are limited. As a reasonable approximation, we assume that revenues are exogenous.

[2] Roth (1979).

Like in numerous other countries, local governments in Norway face a balanced budget law. The Local Government Act requires current expenditures to be covered by revenues. Borrowing is only allowed when issued to finance physical capital investment projects. Due to the widespread application of balanced budget laws, it is customary in empirical analysis to assume that the budget must balance in every period. Contrary to this, Leonard (1986) has emphasized that these laws require only that a balanced budget be submitted prior to the fiscal year, not that spending actually adhere to the budget. Because most balance rules require equating an estimate of revenues with an estimate of expenditures, there is considerable slack in the budget balance requirement. In short, local governments can and do circumvent balanced budget rules.[3]

The budget constraint relevant to a local authority in period t is

$$\sum_{i=1}^{n} P_{it} G_{it} + \sum_{i=1}^{n} Q_{it} \Delta K_{it} + \Delta W_t = Y_t \tag{2.1}$$

Y_t Local government nominal disposable income

G_{it} Real consumption item i

ΔK_{it} Net real investment item i

ΔW_t Local government budget surplus

P_{it} Price per unit of consumption item i

Q_{it} Price per unit of net real investment item i

K_{it} is the real capital stock on item i, so ΔK_{it} is net real investment. Depreciation is included in consumption G_{it}, in accordance with the definition in the National Accounts.

Equation (2.1) divides the budget by item and by spending for consumption and investment purposes. One can conceive of the items as n specific departments, agencies or programmes

[3] Holtz-Eakin et al (1993).

that constitute a complete partition of the budget. The difference between revenues and expenditures is reflected in the budget surplus.

Since revenues and prices will be regarded as exogenous, what is left to the discretion of the budget-makers is real consumption and capital spending partitioned by item - and the budget surplus. Each of these $2n+1$ terms is politically or economically significant in its own right. All of the consumption and investment items are advocated by at least one influencial politician, bureaucrat or interest group. Otherwise it would not be on the budget. However, the distinction between consumption and investment agents should not be taken too literally. A single agent may fancy both high consumption *and* investment spending for a particular sector. But given a sector budget, there are conflicts over appropriations for current expenditures as opposed to capital outlays.

On the other hand, there must be some guardian of the budget deficit, to keep checks on the public debt. As discussed above, local governments are legally committed to balance the budget. But this may not suffice to prevent the debt from exploding. For that, the budget-makers have to carry the intention of some degree of compliance with the law. The Chief Administrative Manager is liable to be such a proponent of budgetary discipline and restraint. Yet, the model does not preclude that all agents have a common interest in keeping the public debt under control.

Now consider the bargain between advocates of grants for various purposes, and guardians of budgetary restraint. The asymmetric Nash-product pertaining to this bargaining problem at time t is given by

$$N_t = \prod_{i=1}^{n} (P_{it}(G_{it} - G_{it}^d))^{\gamma_i} \prod_{i=1}^{n} (Q_{it}(\Delta K_{it} - \Delta K_{it}^d))^{\kappa_i} (\Delta W_t - \Delta W_t^d)^{\omega} \qquad (2.2)$$

The symbols with top-mark d signify the respective disagreement points or minimum requirement levels of the advocates and guardians. For the moment, it is sufficient to assume that the disagreement points are exogenous. The γ_i, κ_i, and ω coefficients are to be interpreted as measures of the relative power supporting the conflicting claims on behalf of the budget. The Nash-product (2.2) is maximized with respect to the endogenous variables, and subject to the budget constraint (2.1). The derived first-order conditions are

$$\gamma_i = \frac{P_{it}(G_{it} - G_{it}^d)}{\Delta W_t - \Delta W_t^d}\omega \qquad i = (1,2,\ldots n) \tag{2.3}$$

$$\kappa_i = \frac{Q_{it}(\Delta K_{it} - \Delta K_{it}^d)}{\Delta W_t - \Delta W_t^d}\omega \qquad i = (1,2,\ldots n) \tag{2.4}$$

Together with the budget constraint, this yields $2n+1$ equations to determine the endogenous variables G_{it}, ΔK_{it} and ΔW_t. The division into n budgetary items is redundant for our purpose, which is to explain consumption and capital spending at the aggregate level. Therefore, consider the following definitions:

$$\sum_{i=1}^{n} P_{it}G_{it} = P_t G_t \tag{2.5}$$

$$\sum_{i=1}^{n} P_{it}G_{it}^d = P_t G_t^d \tag{2.6}$$

$$\sum_{i=1}^{n} Q_{it}\Delta K_{it} = Q_t \Delta K_t \tag{2.7}$$

$$\sum_{i=1}^{n} Q_{it}\Delta K_{it}^d = Q_t \Delta K_t^d \tag{2.8}$$

$$\sum_{i=1}^{n} \gamma_i = \gamma \tag{2.9}$$

$$\sum_{i=1}^{n} \kappa_i = \kappa \tag{2.10}$$

G_t Total local government consumption

ΔK_t Total local government net real investment

P_t Local government consumption price index

Q_t Local government net real investment price index

Total consumption and investment is derived by summation over the n items that constitute the budget. The aggregate disagreement points are correspondingly defined by summing up the itemized disagreement points. The aggregate power coefficients for consumption and investment purposes are the sum of itemized power coefficients.

Summing equations (2.3), (2.4) and (2.1) over i, and utilizing (2.5) - (2.10), yields the aggregate first-order conditions

$$\gamma = \frac{P_t(G_t - G_t^d)}{\Delta W_t - \Delta W_t^d}\omega \tag{2.11}$$

$$\kappa = \frac{Q_t(\Delta K_t - \Delta K_t^d)}{\Delta W_t - \Delta W_t^d}\omega \tag{2.12}$$

$$P_t G_t + Q_t \Delta K_t + \Delta W_t = Y_t \tag{2.13}$$

(2.11) - (2.13) give 3 equations to determine the endogenous variables G_t, ΔK_t and ΔW_t. It is obvious that only the proportional magnitudes of the power coefficients are of significance, so that the following restriction can be imposed without loss of generality:

$$\gamma + \kappa + \omega = 1 \tag{2.14}$$

(2.14) contains the appealing property that total power in the budgetary process equals unity. Combined with the first-order conditions, this renders the reduced form equations

$$\gamma = \frac{P_t(G_t - G_t^d)}{BS_t} \tag{2.15}$$

$$\kappa = \frac{Q_t(\Delta K_t - \Delta K_t^d)}{BS_t} \tag{2.16}$$

$$\omega = \frac{\Delta W_t - \Delta W_t^d}{BS_t} \tag{2.17}$$

$$BS_t = Y_t - P_t G_t^d - Q_t \Delta K_t^d - \Delta W_t^d \tag{2.18}$$

BS_t is the budget slack, or what is left over when the minimum requirements are satisfied. The budget slack constitutes the disputed amount of funds, or the area of contention in the local government budget allocation.

The powerfulness of a specific demand for funds, as measured by the power coefficients, determines the proportion of the budget slack which is appropriated for that purpose.

The reduced form model (2.15) - (2.18) is assumed to be valid even in the case when the budget slack is negative. Then, there is a shortfall which is divided among purposes in proportions determined by the power coefficients.

2.2 The disagreement points

In section 2.1, it was assumed that the disagreement points are given, or exogenous. As the disagreement points are unobservables, some additional assumptions are needed to make the model operational. In this section, the disagreement points are endogenized. When the disagreement points are endogenous, one will have to substitute for the disagreement points in equation (2.15) - (2.18) in order to derive the reduced form model.

The minimum requirement levels should be thought of as critical values which become focal points in bargaining for some strategic or normative reason. A commonly held view is that the disagreement points coincide with the non-cooperative Nash equilibrium. Yet, in our model it is not so clear what the non-cooperative solution would be. And so, it is reasonable to draw more attention to the role played by legal norms and social values shared among the agents. The minimum requirements could in this perspective be called points of *agreement*, rather than *dis*agreement, but we will stick to the conventional terminology.

One possible norm which can impinge upon the disagreement points, is that of incrementalism, or preservation of the status quo. Davis, Dempster and Wildavsky (1966) point out that

> budgets are almost never actively reviewed as a whole in the sense of considering at once the value of all existing programs as compared to all possible alternatives. Instead, this year's budget is based on last year's budget, with special attention given to a narrow range of increases or decreases.

Under pure incrementalism, the instructive function of a would-be ideal state of the budget is displaced by the gravitational force of the present state of the budget. Preservation of the status quo tends to be elevated into a normative principle, almost like a property right. In the case of pure incrementalism, budget-makers follow simple decision-rules, like keeping constant the expected real expenditures of an agency.

This method of action could derive from bounded rationality among decision-makers, but may also be consistent with rational behaviour. First, high transaction and adjustment costs may make it too costly to scrutinize the whole budget allocation in every year. Second, preservation of the status quo may be in the interests of powerful interest groups.

An objection to the pure incrementalist model is that in the long run, straightforward preservation of the status quo may give rise to vast inefficiencies, unjustness or sub-optimal allocations as the environment is changing. In the short run, incrementalism may be quite decisive to the budget allocation, but in the long run, we expect that adaptations are made to a changing economic environment.

There are other hypotheses at hand than the incrementalist one. With zero-base threatpoints, the budget slack comprises the whole budget, so that the whole allocation is reconsidered in every bargain. It is shown below that the zero-base model does not explain inertia in the spending behaviour. Furthermore, the model does not take into account all the constraints which delimit the local government decision set.

Centrally imposed minimum standards, received selective grants, mandatory programmes and long-range commitments easily become focal points when deciding upon local spending. However, these constraints are not expected to be temporary stable either in real terms or as budget shares. In 1980 and 1986, there were reforms in the grant system of the central government, going from selective grants to more general grants. Minimum standards and other commitments may change. Even though minimum standards may be important constraints in quite a few local public service producing sectors; like day care centres, education, health care and care for the elderly, it is hard to measure in monetary terms the use of recources required to fullfil the standards. We have no access to time-series data which can quantify minimum requirements for consumption and real investment at the aggregate level on the basis of observed selective grants and minimum standards in specific local public services. The central authorities lay down minimum standards in order to regulate local priorities across service producing sectors. The standards may be less relevant to an explanation of consumption and capital spending at the aggregate level.

We will now formalize some of the possible assumptions concerning the disagreement points, and substitute for the alternative formulations in the bargaining model (2.15) - (2.18).

Model A: Pure incrementalism

The incremental hypothesis asserts that the status quo is by far the most important alternative to which reallocations are compared. To preserve the status quo, the requirement for consumption is

$$G_t^d = G_{t-1} \quad (2.19.A)$$

Real and financial investments are equal to changes in stock variables. Preservation of the status quo may be interpreted as zero change in the stock variable. Then, for investment expenditures and the budget surplus we have

$$\Delta K_t^d = 0 \quad (2.20.A)$$

$$\Delta W_t^d = 0 \quad (2.21.A)$$

(2.21.A) may also be derived from the quest for balanced budgets in the Local Government Act. After substituting the disagreement points (2.19.A) - (2.21.A) in equations (2.15) - (2.18), we get

$$\frac{P_t \Delta G_t}{Y_t} = \gamma\left(1 - \frac{P_t G_{t-1}}{Y_t}\right) \quad (2.22.A)$$

$$\frac{Q_t \Delta K_t}{Y_t} = \kappa\left(1 - \frac{P_t G_{t-1}}{Y_t}\right) \quad (2.23.A)$$

$$\frac{\Delta W_t}{Y_t} = \omega\left(1 - \frac{P_t G_{t-1}}{Y_t}\right) \quad (2.24.A)$$

The incrementalist budget slack comprises current income minus the consumption of the last period measured in current prices.

Model B: Zero-base threatpoints

The zero-base hypothesis accentuate that grants can become no less than zero, and that the corner solution naturally form a focal point in bargaining. Hagen and Sørensen (1993) conclude that a zero-base empirical model is preferable to a model with incrementalist disagreement points. However, in our setting the zero-base notion should be interpreted carefully. In the National Accounts, consumption is defined as non-charged current expenditures plus depreciation. The depreciation component is largely predetermined, and is obviously positive. Thus, the zero-base consumption threatpoint becomes

$$P_t G_t^d = V_t D_t \tag{2.19.B}$$

D_t Depreciation in real terms

V_t Price per unit of depreciation

The zero-base real investment threatpoint is accordingly defined as zero gross investment

$$Q_t \Delta K_t^d = -V_t D_t \tag{2.20.B}$$

As borrowing for current expenditures is illegal, the budget deficit has to be smaller than gross real investment. Letting this provision determine the zero-base minimum required budget surplus, we get

$$\Delta W_t^d = -Q_t \Delta K_t - V_t D_t \tag{2.21.B}$$

The solution to the model (2.15) - (2.18) combined with (2.19.B) - (2.21.B) is

$$\frac{P_t G_t - V_t D_t}{Y_t} = \gamma + \frac{\kappa}{1-\kappa} \tag{2.22.B}$$

$$\frac{Q_t \Delta K_t + V_t D_t}{Y_t} = \frac{\kappa}{1-\kappa} \tag{2.23.B}$$

$$\frac{\Delta W_t}{Y_t} = \omega - (1-\omega)\frac{\kappa}{1-\kappa} \tag{2.24.B}$$

The zero-base budget slack comprises disposable income plus gross investment. When the power coefficients are constant, the zero-base model implies that the budget shares of current expenditures, gross investment and the budget surplus are kept constant. The fact that local governments have significant aggregated net debt may indicate a relatively small value of ω.

Constant budget shares may result from optimising or satisficing behaviour in the face of technological constraints which limit the scope for factor substitution in the production of public services. Resources are allocated in fixed proportions to the factors of production in order to maintain a satisfying factor input mix. When agents worry about efficiency, this may be reflected in the power coefficients γ and κ. On the other hand, ω measures the influence of the debt aversion motive.

Model C: Social optimizing with adjustment costs

An objection to model B is that all real magnitudes are adjusted instantaneously to changes in income and prices. There is no scope for inertia and adjustment costs. This is in conflict with the serious sluggishness of adjustment documented in a study of local government behaviour in Norway by Borge and Rattsø (1993). One may also suspect that the dynamic specification of the pure incrementalist model is too simple and restrictive. Model C is designed to encompass several types of dynamic responses to changes in the economic environment.

Assume that local government decision-makers hold some common beliefs on the relationship between budget shares which is considered to be efficient or fair. To define the ideal propensity to consume in period t, they use the rule

$$g((\frac{P_t G_t}{Y_t})^*) = h(\frac{V_{t-1}D_{t-1}}{Y_{t-1}}, \frac{W_{t-1}}{Y_{t-1}}, (\frac{Q_t}{P_t})^e, (\frac{V_t}{P_t})^e, r_t^e) \tag{2.25}$$

Equation (2.25) is specified to include non-linear functional forms. The ideal rate of consumption is a function of lagged depreciation and net financial wealth in proportion to disposable income. The ideal rate also depends on expected relative prices. We use the term social optimizing even though the ideal consumption budget share need not be efficient or fair by a certain set of objective criteria.

Inclusion of lagged budget shares may derive from incomplete information and adaptive behaviour. When the lagged depreciation budget share is high, the ideal consumption budget share is high, ceteris paribus. When the expected depreciation is relatively high, a high rate of consumption is required to attain a normal budget share for current expenditures. Moreover, a high depreciation budget share implies that the capital stock is higher than intended, so that net real investment and saving should be low relative to income. When the lagged debt budget share is low, the ideal consumption budget share is high, ceteris paribus. Saving is low, since the debt-share is allowed to increase. Relative prices are included to capture substitution effects in budget shares.

In (2.25) there are some inertia due to adaptively formed expectations. Incrementalism and costs of adjustment are additional sources of sluggish adjustment towards the ideal budget share. Taking account of this, the optimal consumption budget share is

$$(\frac{P_t G_t}{Y_t})^{**} = \mu \frac{P_t G_{t-1}}{Y_t} + (1-\mu)\frac{P_{t-1}G_{t-1}}{Y_{t-1}} - \theta \left[g(\frac{P_{t-1}G_{t-1}}{Y_{t-1}}) - g((\frac{P_t G_t}{Y_t})^*) \right] \tag{2.26}$$

It is assumed that the first derivative of $g(\cdot)$ is positive. We consider two main cases covered by equation (2.26): $\theta = 0$, which is interpreted as the incrementalist case. And $\theta > 0$, which is interpreted as the partial adjustment case.

When $\theta = 0$, pure incrementalism follows as the special case where $\mu = 1$. On the other extreme, $\mu = 0$ can be labelled incrementalism with respect to budget share, as it is the consumption budget share, and not real consumption, which is kept konstant. For $0 < \mu < 1$ the optimal budget share is a compromise between pure incrementalism and budget share incrementalism.

$\theta > 0$ covers the case with partial adjustment towards the efficient or fair consumption budget share. If $\mu = 0$, (2.25) and (2.26) constitute an error correction model for the consumption budget share. If $0 < \mu \leq 1$, the optimal budget share can be regarded as a compromise between the status quo for real consumption and the efficient or fair budget share.

The consumption disagreement point is assumed to be determined by the optimal consumption budet share.

$$\frac{P_t G_t^d}{Y_t} = (\frac{P_t G_t}{Y_t})^{**} \tag{2.19.C}$$

Dynamic mechanisms analogous to (2.26) can be specified for real and financial investments. To illustrate our main points, it is not necessary to elaborate any further on this. Substituting from (2.25), (2.26) and (2.19.C) in (2.15) - (2.18) gives

$$\begin{aligned} \frac{P_t \Delta G_t}{Y_t} &= \gamma - (1-(1-\gamma)\mu)\frac{P_t G_{t-1}}{Y_t} + (1-\gamma)(1-\mu)\frac{P_{t-1} G_{t-1}}{Y_{t-1}} \\ &\quad - (1-\gamma)\theta\left[g(\frac{P_{t-1} G_{t-1}}{Y_{t-1}}) - h(\cdot)\right] - \gamma\left[\frac{Q_t \Delta K_t^d}{Y_t} + \frac{\Delta W_t^d}{Y_t}\right] \end{aligned} \tag{2.22.C}$$

$$\begin{aligned} \frac{Q_t \Delta K_t}{Y_t} &= \kappa - \kappa\left[\mu\frac{P_t G_{t-1}}{Y_t} + (1-\mu)\frac{P_{t-1} G_{t-1}}{Y_{t-1}}\right] + (1-\kappa)\frac{Q_t \Delta K_t^d}{Y_t} \\ &\quad - \kappa\theta\left[g(\frac{P_{t-1} G_{t-1}}{Y_{t-1}}) - h(\cdot)\right] - \kappa\frac{\Delta W_t^d}{Y_t} \end{aligned} \tag{2.23.C}$$

$$\frac{\Delta W_t}{Y_t} = \omega - \omega\left[\mu\frac{P_t G_{t-1}}{Y_t} + (1-\mu)\frac{P_{t-1}G_{t-1}}{Y_{t-1}}\right] + (1-\omega)\frac{\Delta W_t^d}{Y_t}$$
$$- \omega\theta\left[g(\frac{P_{t-1}G_{t-1}}{Y_{t-1}}) - h(\cdot)\right] - \omega\frac{Q_t \Delta K_t^d}{Y_t}) \qquad (2.24.C)$$

In order to arrive at the full-fledged reduced form model, one will also have to substitute for the real and financial investment disagreement points.

For $\theta = 0$, the consumption disagreement point is determined by incrementalism. For $\theta > 0$, the model postulates an optimal budget share allocation which is agreed upon as the best long-run solution, and this is reflected in the consumption disagreement point. In this case, the optimal allocation is derived on the basis of incomplete information, so the disagreement point is formed ex ante. Inertia stem from adaptive expectations and adjustment costs. Given the disagreement points, and given realizations of stochastic exogenous variables like disposable income and prices, the final allocation is determined ex post by appropriating the budget slack for competing purposes according to the power parameters. The budgetary process is modelled in two steps. In the first step, appropriations are determined by local government long range commitments and norms of optimal management. In the second step, the remaining slack resources are made subject to a political bargain.

3. Estimation procedure and results

In this chapter, stochastic counterparts of the three models derived in chapter 2 are estimated. The estimation method is ordinary least squares on the suggested reduced form equations for consumption and real investment. For the system to fulfil the budget constraint (2.13), the budget surplus is assigned to be a residual variable. By taking ordinary least squares, we obtain consistent estimators of the suggested reduced form equations, provided that all relevant explanatory factors are included in the model, the functional and dynamic specification is correct, and current income and prices are exogenous.

The exogeneity assumption for disposable income may be violated if the policy rule of the central government aims at stabilizing the local public economy or the aggregate activity level. But the presence of a policy rule for central government grants, will not necessarily bring about simultaneity bias. If the central government policy rule is backward-looking, or adaptive, and the error term in the policy rule equation is uncorrelated with the stochastic error terms of the estimated equations, there is no simultaneous equation bias resulting from having current disposable income as regressor. For instance, the central government policy rule could be formulated to stabilize the aggregate local government debt share. A relatively high debt share will trigger high increases in central grants. But the central government observes the local government debt share with a time lag. To the degree that the debt share is autocorrelated, it might be reasonable to formulate an adaptive policy rule. Similar adaptive rules could be employed if the goal is to stabilize local government real disposable income or aggregated employment. If so, a recession in the private sector economy producing low local tax income in the last period, brings about high central grants in the present period.

Another possible source of simultaneity bias, occurs if increases in the local public activity level affect the private sector activity level positively, and thereby induce higher local tax income. As before, if the effect is delayed, no bias will occur. However, if there is a positive simultaneous feedback mechanism in income, the income impact multipliers in the econometric equations for local government consumption and investment expenditures, will be biased upwards. In general then, when inertia is high, as reported in Borge and Rattsø (1993), simultaneity bias in the income impact multipliers is probably not a serious problem, unless the central government pursue a forward-looking policy rule. A simultaneous counter-cyclical policy will contribute to a downward bias in the impact multiplier estimates, implying that the sluggishness is overrated. As there is some obscurity in the exogeneity assumption for disposable income, it will be tested using the Hausman test.

In order to make the models stochastic, the structural equations (2.11) and (2.12) are augmented with error terms. The structural equations are transformed so that the random disturbances are denominated as budget shares.

$$\omega\frac{P_t(G_t-G_t^d)}{Y_t}-\gamma\frac{\Delta W_t-\Delta W_t^d}{Y_t}=\varepsilon_{1t} \tag{3.1}$$

$$\omega\frac{Q_t(\Delta K_t-\Delta K_t^d)}{Y_t}-\kappa\frac{\Delta W_t-\Delta W_t^d}{Y_t}=\varepsilon_{2t} \tag{3.2}$$

If the error terms ε_{1t} and ε_{2t} are zero, (3.1) and (3.2) are equivalent to the deterministic equations (2.11) and (2.12). Solving the stochastic system of equations (3.1), (3.2) and (2.13), we arrive at the model

$$\frac{P_t(G_t-G_t^d)}{Y_t}=\gamma\frac{BS_t}{Y_t}+u_{1t} \tag{3.3}$$

$$\frac{Q_t(\Delta K_t-\Delta K_t^d)}{Y_t}=\kappa\frac{BS_t}{Y_t}+u_{2t} \tag{3.4}$$

$$\frac{\Delta W_t-\Delta W_t^d}{Y_t}=\omega\frac{BS_t}{Y_t}+u_{3t} \tag{3.5}$$

One may substitute any set of suggested disagreement point equations in (2.18) and (3.3) - (3.5), and derive the corresponding reduced form model. The reduced form stochastic disturbances are

$$u_{1t}=\frac{(1-\gamma)\varepsilon_{1t}-\gamma\varepsilon_{2t}}{\omega} \tag{3.6}$$

$$u_{2t}=\frac{-\kappa\varepsilon_{1t}+(1-\kappa)\varepsilon_{2t}}{\omega} \tag{3.7}$$

$$u_{3t} = -\varepsilon_{1t} - \varepsilon_{2t} \tag{3.8}$$

Due to the budget constraint, the reduced form error terms satisfy $\sum_i u_{it} = 0$.

In addition, or as an alternative, stochastic error terms can be introduced in the disagreement point equations. Provided that all the error terms are specified in the scale of budget shares, it follows that the error terms in the reduced form equations are white noise, if we assume that all the error terms in the structural model are white noise.

Instability in the parameters of the model may result from institutional and political shocks altering the distribution of power or the mechanisms guiding minimum aspiration levels formation. Possible relief is gained from inclusion of dummy variables accounting for perceived institutional shifts. In 1981, the central regulation of prices charged for local services was lifted, and there has been a subsequent increase in charges. This development might have had a crowding out effect on local government consumption, as consumption by definition does not comprise the part of current expenditures for which clients pay charges. In 1985, there was a deregulation of credit markets which could have affected the behaviour of local governments. The effect from deregulation, if any, is expected to be increased borrowing, especially for real investment purposes, since borrowing for current expenditures is prohibited in the Local Government Act.

3.1 Data considerations

The data needed for empirical modelling are mainly available in the National Accounts of Norway. There, nominal disposable income equals tax income plus net transfers from the central government plus net interest income minus subsidies and transfers to the private sector minus dividend payments in local government enterprices. We assume that all the components are exogenous. The tax income, transfers, subsidies and dividends are partly determined by the central government, and partly by the state of the private sector economy.

Net interest income is affected by the interest rate, and local government assets and liabilities which are largely predetermined.

Fee income is not included in disposable income. Correspondingly, charges are substracted from current expenditures on the left hand side of equation (2.13). Consumption equals current expenditures plus depreciation minus fees and charges. By excluding charges from the income definition, there is one less source of simultaneity bias when income is used as regressor. On the other hand, if charges are endogenous, the suggested reduced form model may be incomplete, as ommited variable biases may occur. The increase in fees and charges during the 1980s was probably occasioned by the deregulation of fee tax rates in 1981. The potential crowding out effect on consumption as defined in the National Accounts, will in our model be captured only crudely by dummy variables. The same holds true for the other institutional shifts in the sample period.

There are some shortcomings in the assets and capital stock data in the National Accounts. For real capital, primary statistics is only available for the real investment flow, and the stock data are derived on the basis of economic life projections and some other special assumptions. For net financial wealth, the accounting time series show an irregular pattern before 1980, possibly because of changes in statistical definitions.[4] Therefore, the wealth data before 1980 are derived from accounting data for net financial investments. Starting with the level of financial debt in 1980, the debt is projected backwards by adding the budget surplus to the debt of the subsequent year. The method assumes no valuation changes, and zero net purchases of real estate.

Local governments possess a third type of wealth objects - real estate - which was bypassed in the model of chapter 2. Unfortunately, real property values are missing in the National Accounts. With an exception for Oslo from 1986 onwards, data are also missing for net purchases of real estate, and the change in real property assets. These transactions are

[4] NOS: Public sector finances 1972-1985.

included in the residual of the circular flow relationship for local governments in the National Accounts. On the assumption that the net purchases of real estate in the 1970s were zero, the residual equals net financial investments, and our method of backward projection of the net debt is valid.

Ideally, the model should endogenize real estate together with consumption, financial wealth and the capital stock. A generalization along these lines suggests that the lagged real estate to income ratio may enter into partial adjustment relationships in the reduced form equations for consumption and net real investment. The lack of data may involve estimation biases due to omission of the real estate variable. However, real property effects need not at all be significant in the equations for consumption and net real investment. For instance, this may be the case if there is a strong element of incrementalism in the disagreement point for net purchases of real estate, and the power coefficient for such purchases is close to zero.

The accounting relationship for which we have data is

$$P_t G_t + Q_t \Delta K_t + F_t + S_t = Y_t \tag{3.9}$$

F_t Net purchases of real estate in Oslo. Assumed to be zero before 1986.

S_t Residual in the equation. Equals net financial investment plus net purchases of real estate, except for property purchases in Oslo from 1986 onwards.

Equation (2.13) is replaced by (3.9) in the empirical model.[5]

[5] F_t is approximately zero in all years, except in 1986, when it was negative and amounted to almost 1 percent of disposable income in absolute value. Ascribing this to special circumstances, the property purchases in Oslo will be treated as exogenous in the model, while the residual S_t is endogenous.

To measure the real value of disposable income, wealth, interest expenses et cetera, an overall price index for local government expenditures is constructed. The index is a weighed average of consumption and investment prices.

$$\overline{P}_t = \Gamma_t P_t + (1-\Gamma_t) Q_t \qquad ,\Gamma_t = \frac{G_t}{G_t + \Delta K_t} \tag{3.10}$$

3.3 Econometric modelling

Estimation of equations (2.22.B) and (2.23.B) augmented with stochastic error terms shows that the zero-base model is misspecified. The Durbin-Watson statistics in the equations are 0.42 and 0.18, respectively, and the multiple correlation coefficients are low. The static zero-base model leaves no scope for sluggish adjustment in response of exogenous shocks. The poor empirical performance of the model may indicate that some inertia are present, either because of incrementalism or adjustment costs.

The incrementalist model is a special case of model C in section 2.2. To avoid misspecification, we will adopt the methodology of David F. Hendry,[6] which prescribes that one should start with a general model specification, and then simplify the model by means of empirical testing.

The point of departure is generalized, stochastic versions of equations (2.22.C) and (2.23.C). Lagged change in the capital stock is included in the disagreement point for net real investment. The disagreement points may also depend on the change in real disposable income. Finally, changes in relative prices are included to capture substitution effects in the short and medium run.

[6] Introductions to the methodology are provided by Gilbert (1986), Hendry et al (1984) and Pagan (1987).

When the model is augmented with differenced variables, the functional form for these variables is designed to obtain an elasticity interpretation of the related parameters. To achieve this, define

$$A_t = \frac{P_t G_{t-1}}{Y_t} \tag{3.11}$$

$$B_t = \frac{Q_t K_{t-1}}{Y_t} \tag{3.12}$$

For a variable Z_t, the differentiation takes the form $A_t \Delta \log Z_t$ in the consumption equation, and the related parameter is interpreted as an elasticity of G_t with respect to Z_t. In the real investment equation, the differentiation form is $B_t \Delta \log Z_t$, and the related parameter is interpreted as an elasticity of K_t with respect to Z_t. To simplify notation, we write $z_t = \log Z_t$. In general, let the log of a variable with upper-case letters be denoted with lower-case letters.

We first turn to the econometric modelling of local government consumption. Referring to equation (2.25), estimations of the consumption equation show that the parameters for the lagged depreciation budget share and the lagged debt ratio are significant. In the long run, the consumption budget share is not affected by changes in relative prices. Nevertheless, when relative prices change, the derived model indicate that some substitution occurs in the medium run.

The presence of significant depreciation and wealth effects imply that another mechanism than straightforward preservation of the status quo is operative in the formation of disagreement points. This is the partial adjustment mechanism which is introduced by the specification in (2.22.C) for $\theta > 0$ and $\gamma < 1$.

The estimate of the parameter for A_t is significantly greater than zero and less than one in absolute value. This implies that $\gamma < 1$, $\mu > 0$, and $\gamma > 0$ or $\mu < 1$. The lagged consumption budget share has a significant negative effect, and the preferred functional form is log-linear. The linear term is consequently omitted, and we proceed on the assumption that $\mu = 1$ and $\gamma > 0$.

To test for a possible crowding out effect on consumption from the rapid growth in fees and charges in the 1980s, the lagged ratio between fees and disposable income was included in the model. The parameter estimate was insignificant, indicating that there is no crowding out effect in the long run.

The parameter estimate for the the first difference of real disposable income in period t is insignificant. A lagged effect from change in real disposable income is included in the model, although it is barely significant.

After simplification, the preferred consumption equation takes the form

$$\frac{P_t \Delta G_t}{Y_t} = \alpha_1 + \alpha_2 A_t (\Delta q_{t-1} - \Delta p_{t-1}) - \alpha_3 A_t (\Delta v_{t-1} - \Delta p_{t-1}) - \alpha_4 A_t (\Delta y_{t-1} - \Delta \bar{p}_{t-1})$$
$$- \alpha_5 A_t - \alpha_6 \left[(p_{t-1} + g_{t-1} - y_{t-1}) - (v_{t-1} + d_{t-1} - y_{t-1}) - f\left(\frac{W_{t-1}}{Y_{t-1}}\right) \right] \tag{3.13}$$

where

$$f\left(\frac{W_{t-1}}{Y_{t-1}}\right) \equiv \log \left[\frac{e^{\frac{W_{t-1}}{Y_{t-1}}}}{1 + e^{\frac{W_{t-1}}{Y_{t-1}}}} \right] = \frac{W_{t-1}}{Y_{t-1}} - \log\left(1 + e^{\frac{W_{t-1}}{Y_{t-1}}}\right) \tag{3.14}$$

The chosen functional form is found to outperform a linear specification. The long run relationship is log-linear in the consumption and depreciation budget shares. The log-form is not tenable for the debt ratio, since the net debt in principle can become both positive and negative. The functional form in (3.14) gives a lower regression standard error and a more well-behaved equation than the linear form. The log transformation is applied to a logistic function of the debt ratio, which is strictly positive with 1 and 0 as upper and lower asymptotes. $f(\cdot)$ is increasing and concave in the net wealth to disposable income ratio, and is defined over all real-valued numbers. Neihter the long-run elasticity of the depreciation budget share nor the long-run quasi-elasticity of the net wealth to income ratio on the rate of consumption, differ significantly from 1, so these restrictions are imposed on the model.

Table 3.1 Preferred estimated consumption equation (3.13)

	Estimation method: OLS	Period: 1973 - 1991	
Parameter	Estimate	Standard-error	T-statistic
α_1	1.31	0.14	9.17
α_2	0.75	0.11	6.64
α_3	0.38	0.08	4.60
α_4	0.06	0.04	1.53
α_5	0.26	0.02	11.82
α_6	0.27	0.04	7.34
$\hat{\sigma}$=0.0044	DW=2.30	NORM $\chi(2)$=0.85	RESET F(1,12)=0.56
LM F(1,12)=0.55	LM F(2,11)=0.58	LM F(4,9)=1.77	ARCH F(1,11)=0.06

All parameters in equation (3.13) are positively signed. Conditional on the assumption $\mu = 1$, the power parameter is identified as $\gamma = \alpha_5$. And the adjustment speed parameter is identified as

$$\theta = \frac{\alpha_6}{1-\alpha_5} \tag{3.15}$$

Estimation results for equation (3.13) are reported in table 3.1. The estimate of the consumption power parameter suggests that 26 percent of the budget slack is appropriated for consumption. The speed of adjustment towards the desired allocation is estimated to be 0.37, meaning that 37 percent of the deviation from the last period's ideal consumption ratio is corrected for in the present period consumption minimum requirement. There is severe sluggishness in the adjustment.

The effect through the coefficient α_4 contributes to reinforce the inertia in the adjustment to increases in real disposable income. To calculate the dynamic multipliers, one also have to take into account effects from the level terms of the model. However, the effect implies that the budget slack is larger when real disposable income is growing than when it is not, ceteris paribus.

We now turn to the econometric modelling of local government net real investment. Probably because of multicollinearity between A_t and the lagged consumption budget share, we were not able to derive a precise estimate of μ in the investment equation. 2.23.C shows that the restriction $\mu = 1$ excludes the lagged consumption budget share from the real investment equation. This restriction is not rejected by the data, and does not contradict the estimated consumption equation, so it has been imposed on the empirical model.

The lagged depreciation budget share effect is significantly negative in the investment equation. Hence, real investment is adjusted in order to stabilize the capital stock relative to income. A high capital stock induces low investment, and a low capital stock induces high investment.

A debt ratio effect is not significant in the investment equation. Real investment is not adjusted to stabilize the debt ratio in the long run. The dissimilarity of the consumption and investment equation in this respect may reflect that borrowing for real investment is not restricted in the Local Government Act, while borrowing for current expenditures is prohibited. It is legitimate to accumulate debt if at the same time the capital stock is piled up proportionately. The local government debt burden does not interfer directly with the use of real investment for long run stabilization of the capital stock.

As in the consumption equation, there are no long run substitution effects from changes in relative prices, but some substitution occurs in the short and medium term when relative prices change.

The preferred net real investment equation is

$$\frac{Q_t \Delta K_t}{Y_t} = \beta_1 - \beta_2 B_t(\Delta q_t - \Delta p_t) + \beta_3 B_t(\Delta q_{t-1} - \Delta p_{t-1}) - \beta_4 B_t(\Delta y_t - \Delta \overline{p}_t) \\ - \beta_5 B_t(\Delta y_{t-1} - \Delta \overline{p}_{t-1}) + B_t \Delta k_{t-1} - \beta_6 (A_t + B_t \Delta k_{t-1}) - \beta_7 (v_{t-1} + d_{t-1} - y_{t-1}) \tag{3.16}$$

Table 3.2 Preferred estimated real investment equation (3.16)

	Estimation method: OLS	Period: 1973 - 1991	
Parameter	Estimate	Standard-error	T-statistic
β_1	0.19	0.15	1.31
β_2	0.05	0.02	2.29
β_3	0.06	0.02	2.63
β_4	0.09	0.02	5.46
β_5	0.09	0.02	4.17
β_6	0.45	0.06	6.98
β_7	0.09	0.04	2.24

$\hat{\sigma}$=0.0061	DW=2.17	NORM χ(2)=3.01	RESET F(1,11)=0.12
LM F(1,11)=0.63	LM F(2,10)=0.37	LM F(4,8)=0.30	ARCH F(1,10)=0.30

All parameters in equation (3.16) are positively signed. When the assumption $\mu = 1$ is adopted, the power parameter is identified as $\kappa = \beta_6$. A test for the coefficient for lagged capital stock change in the net real investment disagreement point, shows that the coefficient does not differ significantly from 1. The null hypothesis for the test is that the coefficient for lagged capital stock growth in the reduced form real investment equation equals $1 - \kappa = 1 - \beta_6$. The test statistic for the restriction is F(1,11)=2.17, and it is imposed on the model formulation. The result may be interpreted as an element of incrementalism in the real investment disagreement point tied to the investment flow, and not to the capital stock as in equation (2.20.A).

The positive sign of β_3 may indicate that high inflation in investment prices either induces provisional postponement of projects or transfers of expenses to the next year budget.

Estimation results for equation (3.16) are reported in table 3.2. The estimate for β_6 is significantly positive. According to the estimate, 45 percent of the budget slack is appropriated for net real investment. This is high, considering that the real investment budget share is low compared to that of consumption.

The effects through the coefficients β_4 and β_5 contribute to reinforce the inertia in the adjustment to increases in real disposable income. To calculate the dynamic multipliers, one also have to take into account effects from the level terms of the model. However, the effects imply that the budget slack is larger when real disposable income is growing than when it is not, ceteris paribus.

Having determined consumption and real investment in equations (3.13) and (3.16), financial investments plus real estate purchases follow residually from the budget constraint (3.9). Using the estimated equations and equation (2.14), an estimate of the budget surplus power parameter is available. The estimate is $\omega = 1 - \gamma - \kappa = 1 - \alpha_5 - \beta_6 = 0.29$.

None of the reported misspecification tests for the two estimated equations are significant at the 5 percent level. That is, the two equations are not rejected because of autocorrelation, heteroscedasticity or non-normality in the residuals, or incorrect functional form.

Recursive parameter estimates and standard deviations are shown graphically in Appendix C.[7] Except for the moderate instability in some of the consumption equation parameters before 1983, and in β_6 in1985, all the parameters of the model are seen to be quite stable throughout. It may appear that the reforms of the 1980s did not give rise to major structural shifts at the macro level.

The exogeneity assumption for disposable income has been inspected with the aid of Hausman (1978) tests. The first step is to estimate a reduced form model for nominal disposable income. To avoid any simultaneity bias, only lagged variables are included among the regressors. The regressors are the lagged first differences of local government financial wealth, the overall price index for local government expenditures, the interest rate on housholds liabilities in private financial institutions, private consumption, mainland gross domestic product, aggregate unemployment and a constant term. Equations (3.13) and (3.16) are augmented with the regressor formed by the residuals from the estimated equation for disposable income. The null hypothesis is that the related coefficient is equal to zero. If the residuals from the estimated equation for disposable income are correlated with the residuals in equations (3.13) or (3.16), the exogeneity assumption for disposable income is impaired, and the least squares estimators are invalidated due to inconsistency. The t-statistics are 0.85 and 0.28 in the consumption and real investment equation, respectively. Thus, the null hypothesis is not rejected, and the exogeneity assumption can be retained.

4. Model simulations

The next task to be undertaken is an integration of the estimated equations of chapter 3 with some definitional relationships, to obtain a complete model of local government spending behaviour. The dynamic effects of exogenous shocks to the model are then simulated.

[7] Recursive estimates show the time path of the estimates when the period of estimation is changed. Instability reduces the confidence in the ability of the model to predict the data.

To start with, some of the previously stated equations are reiterated. The econometric equations are

$$\frac{P_t \Delta G_t}{Y_t} = \alpha_1 + \alpha_2 A_t(\Delta q_{t-1} - \Delta p_{t-1}) - \alpha_3 A_t(\Delta v_{t-1} - \Delta p_{t-1}) - \alpha_4 A_t(\Delta y_{t-1} - \Delta \bar{p}_{t-1})$$
$$+ \alpha_5(1 - A_t) - \alpha_6\left[(p_{t-1} + g_{t-1} - y_{t-1}) - (v_{t-1} + d_{t-1} - y_{t-1}) - f(\frac{W_{t-1}}{Y_{t-1}})\right] \quad (4.1)$$

$$\frac{Q_t \Delta K_t}{Y_t} = \beta_1 - \beta_2 B_t(\Delta q_t - \Delta p_t) + \beta_3 B_t(\Delta q_{t-1} - \Delta p_{t-1}) - \beta_4 B_t(\Delta y_t - \Delta \bar{p}_t)$$
$$- \beta_5 B_t(\Delta y_{t-1} - \Delta \bar{p}_{t-1}) + B_t \Delta k_{t-1} - \beta_6(A_t + B_t \Delta k_{t-1}) - \beta_7(v_{t-1} + d_{t-1} - y_{t-1}) \quad (4.2)$$

where the coefficients are given by the estimates in tables 3.1 and 3.2. The budget constraint is

$$P_t G_t + Q_t \Delta K_t + F_t + S_t = Y_t \quad (4.3)$$

Net financial wealth is affected by changes in valuation.

$$W_t = \mu_t(W_{t-1} + S_t) \quad (4.4)$$

W_t is net wealth corrected for valuation changes up till period t. μ_t is the correction factor in period t, wich is equal to 1 when there are no valuation changes and zero real estate net purchases so that S_t equals net financial investments ΔW_t. Depreciation is assumed to be proportional to the lagged capital stock.

$$D_t = \delta_t K_{t-1} \quad (4.5)$$

where δ_t is the rate of depreciation. Net interest income is part of disposable income, and depends on net wealth and the average nominal interest rate.

$$Y_t = X_t + R_t \tag{4.6}$$

$$R_t = i_t \frac{W_t + W_{t-1}}{2} \tag{4.7}$$

X_t	Disposable income exclusive of net interest income
R_t	Net interest income
i_t	Average nominal interest rate

The nominal interest rate depends on the real interest rate and the rate of inflation.

$$i_t = r_t + \tfrac{1}{2}(\Delta\overline{p}_t + \Delta\overline{p}_{t-1}) \tag{4.8}$$

Here, some inertia from changes in inflation to the average nominal interest rate are imposed on the model. Finally, the overall price index for local government expenditures is included in the model.

$$\overline{P}_t = \frac{P_t G_t + Q_t \Delta K_t}{G_t + \Delta K_t} \tag{4.9}$$

To make the model complete, we also have to substitute for A_t and B_t from (3.11) and (3.12), for the definition in (3.14) and for the definitions $y_t = \log Y_t$, $p_t = \log P_t$ et cetera. Then, the system contains nine endogenous variables:

$$G_t, K_t, W_t, S_t, D_t, Y_t, R_t, i_t, \overline{P}_t$$

And the exogenous variables are

$$P_t, Q_t, V_t, X_t, F_t, r_t, \delta_t, \mu_t$$

In order to simulate shocks in exogenous variables, the first step is to create a post-sample model simulated reference path. The initial values of the exogenous variables are set equal to the observations in the last year of the sample, 1991, which is the starting point for the simulations. For the subsequent years of the reference path, each exogenous variable is either held constant, or it's growth rate is held constant. In the reference path, the exogenous prices and the rate of depreciation are held constant at the 1991 level. The real interest rate is 5 percent, the net purchase of real estate in Oslo is zero, and the debt valuation change factor is 1 from 1992 and onwards. Exogenous nominal income, X_t, is growing with a rate of 2 percent from 1991 and onwards.

As prices are constant in the reference path, the growth rates in real and nominal magnitudes are equal. The trajectories of disposable income, consumption, real investment and net debt in the reference path from 1991 to 2030 are shown in figure D.1. of Appendix D. The upward trends in the endogenous variables are driven by the growth in exogenous income. All figures in appendix D are in nominal terms.

A shock in exogenous income

In this simulation, exogenous income is increased permanently with 1 billion Norwegian kroner in 1994, compared to the reference path. All other exogenous inputs are identical to those of the reference path. The resultant dynamic absolute deviations from the reference path in consumption, real investment and net debt are reproduced in figure D.2.

The model simulation implies that there is considerable sluggishness in the adjustment of local government spending to increases in real income. In the year of impact and the following year, this brings about relatively high budget surpluses, and a corresponding reduction in the net debt. Later on, spending is increased sufficently so that lower budget surpluses than in the reference path are incurred. Spending becomes so high that the increase in net debt is overshooting its target. The high debt ratio thus incurred has a dampening effect on consumption. At the end of the simulation period, the increase in consumption is at the lower side of 1 billion kroner, the increase in real investment is approaching zero, and the increase in net debt is between zero and 1 billion kroner.

An inflationary shock

In this simulation, exogenous income and prices are increased permanently with 1 percent in 1994, as compared to the reference path. The corresponding increase in inflation is temporary. The resultant dynamic percentage deviations from the reference path in consumption, real investment and net debt are reproduced in figure D.3.

The simulation indicate that non-homogeneities are present in the model in the short run and the medium run. Yet, the econometric equations are static homogenous of degree zero in nominal magnitudes. The non-homogeneity could stem from the accounting relations, especially equations (4.3) - (4.7). From (4.3), a 1 percent increase in nominal expenditures and disposable income, implies that the increase in the budget surplus must be 1 percent, assuming zero net purchases of real estate. But from (4.4), because the lagged debt level is predetermined, it is exceptional if the percentage increase in net wealth equals the percentage increase in the budget surplus. And when the net wealth is negative, the budget surplus has to decrease in order to make the net debt increase with 1 percent. Again from (4.3), if the budget surplus decreases, the nominal expenditures have to increase by more than 1 percent if disposable income increases by 1 percent. Thus, nominal homogeneity in the short run is unlikely to occur.

As a consequence of a temporary increase in the nominal interest rate induced by the jump in prices, there is a significant increase in the interest payments in the short run. This entails that the increase in disposable income is less than 1 percent in the year of impact and the following year. Thus, there is scope for an increase in the budget deficit and the net debt in the short run. However, the debt increase is less than 1 percent. After the lapse of two periods, there seems to be a reaction to the preceding heavy budget deficits, manifested notably in a downturn in net real investment relative to the reference path. Subsequently, real investment is overshooting a 1 percent increase relative to the reference path. In the long run, all real magnitudes are unaffected by the inflationary shock.

A shock in the real interest rate

In this simulation, the real interest rate is increased permanantly with 1 percentage point in 1994, as compared to the reference path. The resultant dynamic percentage deviations from the reference path in consumption, real investment and net debt are reproduced in figure D.4.

From equation (4.6) - (4.8), it appears that the shock is quite similar to a permanent reduction in income. The similarity is confirmed by a comparison of figure D.4 and D.2. Besides, the effect depends on the the level of net debt in the reference path.

5. Conclusion

The bargaining theory framework turn out to be conducive to empirical modelling of aggregate local government spending behaviour. The preferred econometric equations are fairly well-behaved, and have interesting interpretations. They indicate that the disagreement points are combinations of the status quo allocation and long run relationships between budget shares. The long run relationships serve to stabilize consumption, the real capital stock and the net debt relative to disposable income. According to the empirical model, 45 percent of the budget slack in a given period is allocated to net real investment expenditures. The exogeneity assumption for disposable income is not rejected by Hausman tests.

Model simulations show that the sluggishness in spending is considerable in the adjustment to exogenous shocks. A positive shift in real income will in the short run lead to reductions in the net debt, due to the sluggish spending adjustment. But as spending adjustments take place, the effect on the net debt is reversed, so the long run effect is positive.

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Appendix A. Variables and definitions

Y_t Local government nominal disposable income. Comprises tax income plus net transfers from the central government plus net interest income minus subsidies and transfers to the private sector minus dividend payments in local government enterprises. Fees and charges are not included.

G_t Local government consumption in fixed prices. Equals current expenditures plus depreciation minus fees and charges.

K_t Local government capital stock

ΔK_t Local government net real investment in fixed prices

D_t Local government depreciation in fixed prices

δ_t Local government rate of depreciation

P_t Local government consumption price index

Q_t Local government net real investment price index

V_t Price per unit of local government depreciation

$\overline{P}_t$ Overall price index for local government expenditures. The index is a weighed average of consumption and investment prices.

W_t Local government net financial wealth

ΔW_t Local government net financial investments

μ_t Correction factor for valuation changes in the net wealth and non-zero net purchases of real estate

S_t Local government net financial investments plus net purchases of real estate (Oslo not included)

F_t Net purchases of real estate in Oslo

R_t Local government net interest income

i_t Average nominal interest rate on local government net debt. Computed as the proportion of net interest payments to the average of current and lagged net debt.

r_t Average real interest rate on local government net debt. Equals the nominal interest rate minus the average of current and lagged inflation in the overall price index for local government expenditures.

X_t Local government disposable income exclusive net interest income

Appendix B. Test statistics

$\hat{\sigma}$	Standard error of regression
DW	The Durbin Watson test for first order autocorrelation in the error term.
LM F(j,T-N-j)	Lagrange multiplier test for j-th order autocorrelation in the error term. Harvey (1981).
ARCH F(1,T-N-2)	Test for first order autoregressive conditional heteroscedasticity in the error term. Engle (1982).
NORM $\chi(2)$	Test for normally distributed error term. Jarque and Bera (1980).
RESET F(2,T-N-2)	Ramsey-test for misspecification. Ramsey (1969).

T is the number of sample observations, and N is the number of estimated parameters in the equation.

Figure C.1. Recursive estimates - equation (3.13)
Coefficient: alpha 1

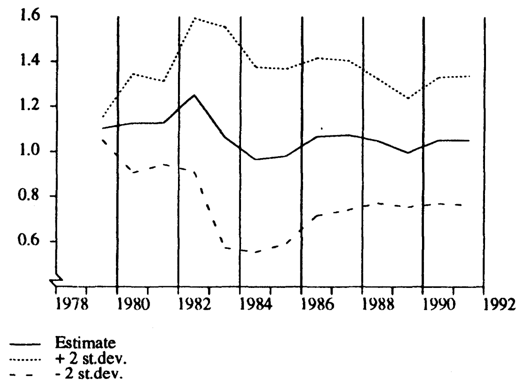


Figure C.2. Recursive estimates - equation (3.13)
Coefficient: - alpha 2

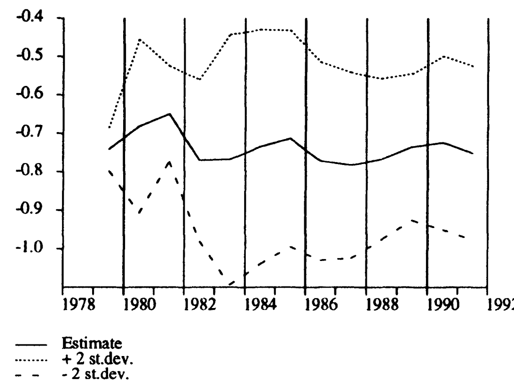


Figure C.3. Recursive estimates - equation (3.13)
Coefficient: alpha 3

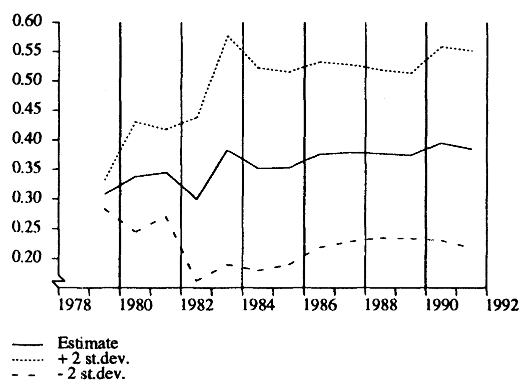


Figure C.4. Recursive estimates - equation (3.13)
Coefficient: - alpha 4

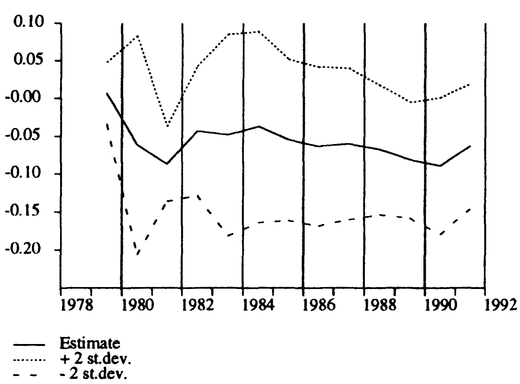


Figure C.5. Recursive estimates - equation (3.13)
Coefficient: - alpha 5

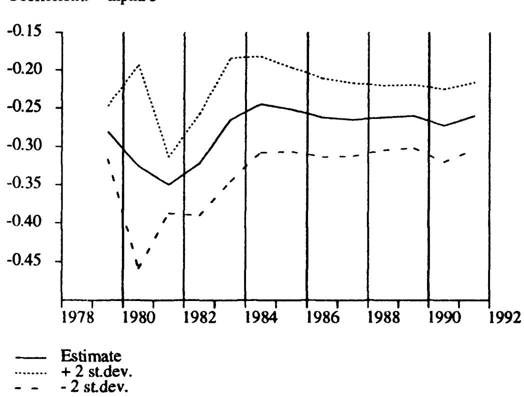


Figure C.6. Recursive estimates - equation (3.13)
Coefficient: - alpha 6

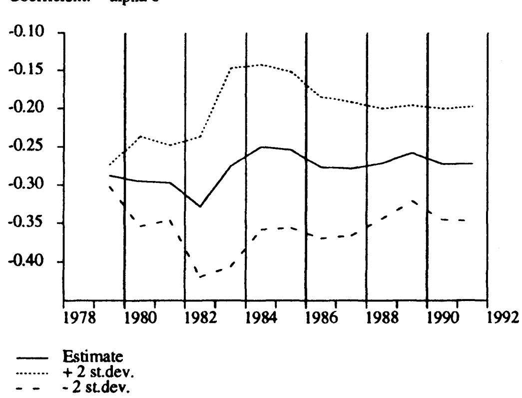


Figure C.7. Recursive estimates - equation (3.16)
Coefficient: beta 1

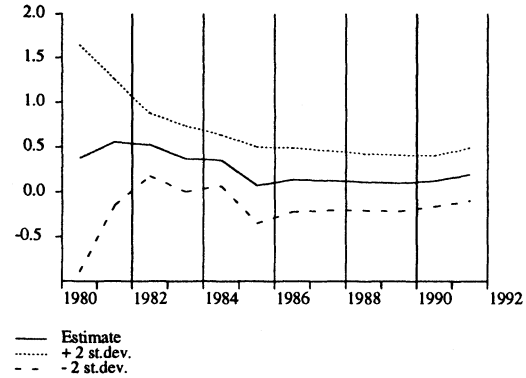


Figure C.8. Recursive estimates - equation (3.16)
Coefficient: - beta 2

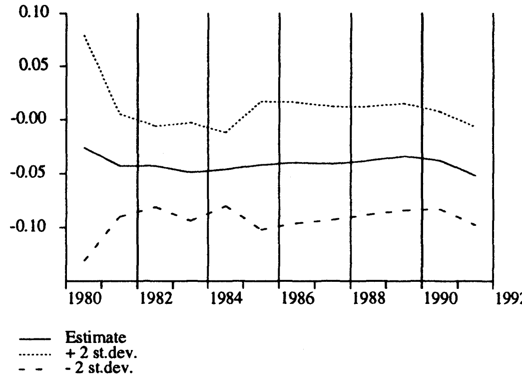


Figure C.9. Recursive estimates - equation (3.16)
Coefficient: beta 3

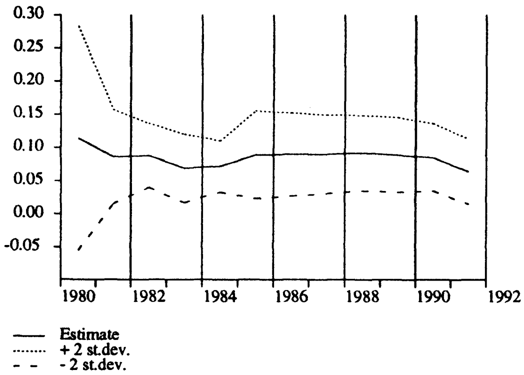


Figure C.10. Recursive estimates - equation (3.16)
Coefficient: - beta 4

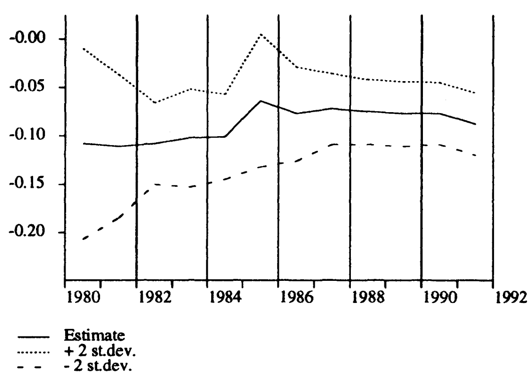


Figure C.11. Recursive estimates - equation (3.16)
Coefficient: - beta 5

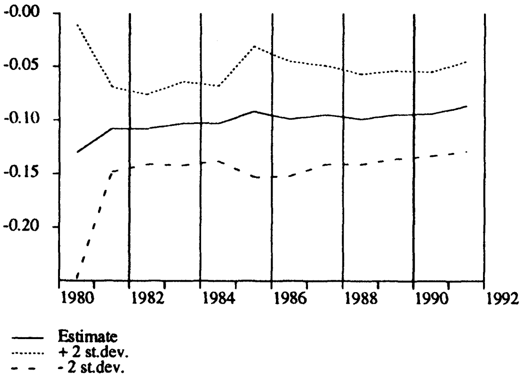


Figure C.12. Recursive estimates - equation (3.16)
Coefficient: - beta 6

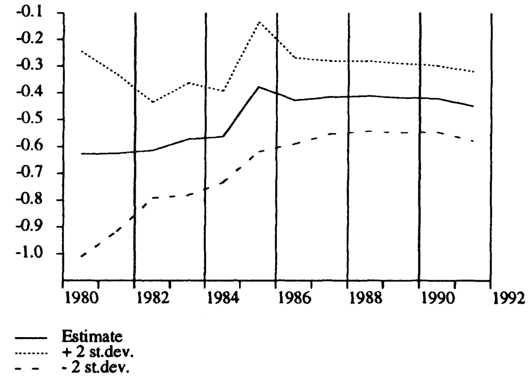
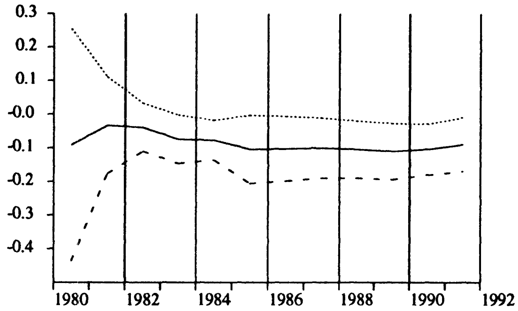


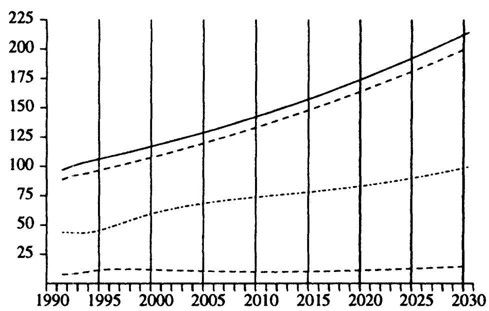
Figure C.13. Recursive estimates - equation (3.16)
Coefficient: - beta 7



—— Estimate
.... + 2 st.dev.
- - - 2 st.dev.

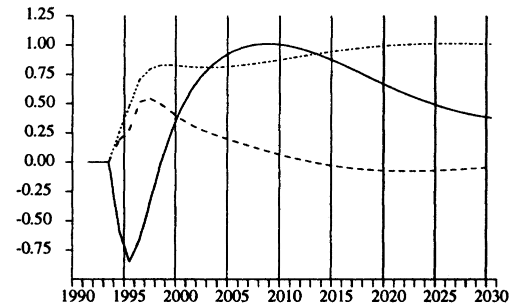
Appendix D. Simulating shocks in exogenous variables

Figure D.1. Reference path
Billion kroner



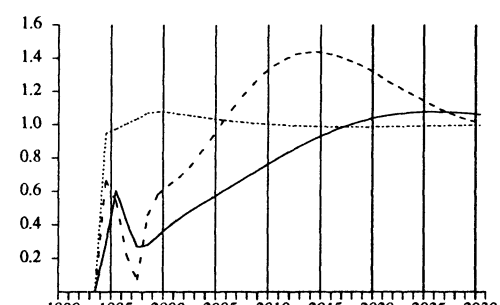
—— Disposable income
.... Net debt
- - Consumption
- - - Net real investment

Figure D.2. A shock in exogenous income
Absolute change in billions



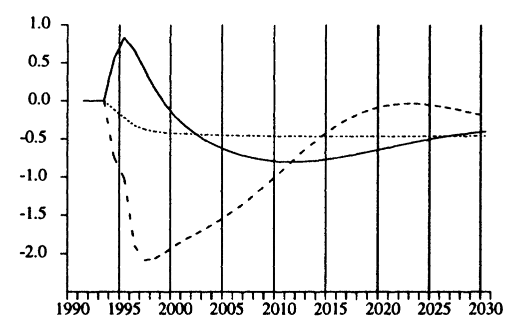
—— Net debt
.... Consumption
- - Net real investment

Figure D.3. An inflationary shock
Nominal percentage change



—— Net debt
.... Consumption
- - Net real investment

Figure D.4. A shock in the real interest rate
Percentage change



—— Net debt
.... Consumption
- - Net real investment

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