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Abstract:
An extended community preference model including real and financial investments is estimated on accounting time-series data for the local public sector in Norway. The estimation results indicate considerable sluggishness in local public spending, both in current expenditure and investment spending. A positive shift in grants or taxes 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.

The long run elasticities of factor demand and net debt with respect to exogeneous income constraints do not differ significantly from unity. The estimated price elasticities suggest that factor demand is close to neutral-elastic in the long run. Higher factor prices involve higher production costs, and local authorities are thus induced to increase user charges.

Keywords: Local government, local public finance, public expenditure, investment, public debt.

JEL classification: C32, H72, H74.

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1. Introduction

Spending, saving and taxation decisions in local governments are intertwined through a budget constraint. This paper formulates a model which allows for the simultaneous determination of local public factor demand, fee income and budget deficit. The model is adapted to the Norwegian institutional setting.

Most of the local public tax income in Norway can be regarded as exogenous, as tax rates and tax bases are set by the national government. Local authorities have only one tax instrument of their own, which is income from fees and charges. Other taxes are in effect national taxes coupled with a transfer from the central government to the local governments, and is thus linked closely to the grant system. Except for fee income, the bulk of local public income work as general grants. Hence, it is reasonable to split local public income into two categories only, of which the main part will be taken as exogenous.

The simultaneity of spending, saving and taxation decisions has not been fully explored in empirical studies of government economic behaviour. Steps in this direction have been taken by Inman (1989), who has estimated a model of the local decision to tax, and Roubini and Sachs (1989), where cross-country variations in spending and budget deficits are explained.

On Norwegian data, local public priorities between service sectors have been modelled by Borge and Rattsø (1993). However, their dynamic model does not account for saving and charging decisions. Fee income is endogenous in Borge and Rattsø (1994), but there is still no account for saving.

Public sector growth has not proved easy to explain (Lybeck and Henrekson (1988)), but it is assumed here that grants (including taxes) from the national government to local governments depend on productivity growth and activity level in the private economy, and political factors. Any feedback mechanisms from local public behaviour to growth in grants and taxes are assumed to be so weak that they can be neglected. Hausman tests are reported to substantiate the exogeneity assumption for grant and tax income.

The approach in this article is to use aggregate time series to model local public economic behaviour. Since we disregard cross-sectional variations, and the local public sector growth is determined mainly by the national government, political factors are thought to be less relevant to the study. And so, focus is put on the dynamics of economic variables in a traditional community preference model.

The estimation results indicate considerable sluggishness in local public spending, both in current expenditure and investment spending. A positive shift in grants or taxes 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.

The long run elasticities of factor demands and net debt with respect to exogeneous income constraints equal unity in the model presented below. The estimated price elasticities suggest that factor demands are close to neutral-elastic in the long run. Higher factor prices involve higher production costs, and local authorities are thus induced to increase user charges.

Chapter 2 presents a community preference model adapted to local government in Norway. In chapter 3, the model is estimated on annual time series data for the period 1973 - 1992. Chapter 4 contains simulation results for the empirical model.

2. A model of local public factor demand, fee income and budget deficit

The median voter model has serious shortcomings in the case of Norway, since local public decisions are taken in a multi-dimensional space, and voters confront a multi-party system. Another conventional model of local public behaviour is the community preference model.[1] In this model, the local authority is treated like a single household maximizing a utility function, given a budget constraint. It is more general than the median voter model, as it may represent several views regarding whose preferences are guiding the policy outcome.

Preferences in the standard community preference model are specified over local public services and private goods. The present paper focuses on the determination of income and outlay by economic type. As in Borge and Rattsø (1994), fee income is the major local tax instrument in the choice between private consumption and local public service production. The analysis concerns one aggregated public good, and gives no account for the allocation of expenditures over local public institutional sectors. On the other hand, two extensions are made compared to the standard model. First, local public producer behaviour is incorporated in the framework, in order to explain the demand

[1] For surveys of these models, see Inman (1979), Wildasin (1986) and Rubinfeld (1987).

for real capital and for labour and material inputs. Second, the choice between present and future goods is related to the endogenous budget deficit.

Local public spending and taxation decisions are closely related through the budget constraint. The restriction in period *t* is

$$(2.1) \quad Y_t + C_t^G = P_t^B B_t + P_t^D D_t + P_t^I \Delta K_t + \Delta W_t$$

Y_t is nominal disposable income (including tax and grant income) and C_t^G is nominal fee income. Y_t is exogenous from the point of view of local authorities, so C_t^G is the only local tax instrument. Two types of factor inputs are specified in the constraint: B_t are operating costs or current expenditure in real terms, and P_t^B the corresponding price. That is, labour and material inputs are treated jointly, as an aggregate. K_t is real capital, and P_t^I is the corresponding price. W_t is nominal net financial wealth, and thus, ΔW_t is the budget surplus.[2] When ΔW_t is negative, there is a budget deficit. D_t is real depreciation, and P_t^D the corresponding price. Depreciation is mainly predetermined. This is reflected in the relationship

$$(2.2) \quad D_t = \delta_t K_{t-1}$$

where δ_t is the rate of depreciation. The relevant restriction for private households is

$$(2.3) \quad Y_t^P = C_t^P + C_t^G$$

Y_t^P is nominal private disposable income, and C_t^P is nominal private consumption exclusive of user fees and charges paid for local public services.[3] The trade-off between local public service production and private consumption is evident from (2.3).

Nominal fee income C_t^G could be split into a price and a volume component. We will assume that nominal fee income is entirely controlled by the local government. This may arise from inelastic or rationed demand for the charged services. The model does not explain the division of fees into prices and quantities.[4]

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[2] Valuation changes in net wealth and real estate net purchases are neglected in (2.1).
[3] To simplify, private saving is suppressed in (2.3).
[4] A reason for this is the lack of reliable price data.

We assume that decision-makers have a fairly accurate understanding of the prevailing production possibilities in local public service provsion.

(2.4) $X_t = X(B_t, K_t)$

X_t is output, and $X(\cdot)$ is a long-run production function. Operating costs and real capital are variable factor inputs, with positive marginal productivities.

The local authority has preferences for high current service production and low user charges. This derives from a pressure to respond to citizens needs and wants. Politicians and bureacrats are sensitive to such pressure because they need democratic and financial support.

Gramlich (1969) adds a motive to balance the operating budget, derived from a statutory constraint against borrowing for current expenditure. Like in numerous other countries, local government in Norway faces a balanced budget law. However, Leonard (1986) has emphasized that there is considerable slack in such balance rules, since actual spending may deviate from the budget submitted prior to the fiscal year. Hence, it is reasonable to assume that decision-makers are concerned over the long-run implications from debt accumulation, rather than current fluctuations in the deficit. The financial situation influences the ability of the local authority to supply services at low charges. High accumulated debt reduces the fiscal capacity and freedom of action. And the higher the debt is, the higher are borrowing costs. In the extreme, loss of control with the public debt is at risk. A simple way to model preferences for future public and private goods, is to include a debt aversion motive in the utility function.

(2.5) $U_t = U(X_t, \frac{C_t^P}{P_t^C}, \frac{W_t}{P_t^G})$

U_t is local government utility, P_t^C is a private consumption deflator, and P_t^G is a deflator for local public expenditures. The local authority has preferences for current public and private goods, and for a high future fiscal capacity.

U_t is maximized subject to (2.1)-(2.4), assuming that local public disposable income, private disposable income, and prices are exogenous. This procedure implies that the authority chooses a cost minimizing factor combination. Otherwise, it would be possible to increase output without increasing fee income or the deficit. Consequently, standard results from producer and consumer theory apply to our model.

Consider the effects of an increase in local public disposable income. In the normal case, this will lead to higher local public service production, higher private consumption exclusive of fees, and higher financial wealth. Fee income is reduced, so that some of the extra public revenues are transferred to private households. The increase in production implies higher demand for real capital, labour and material inputs. Similar effects occur when there is an increase in private disposable income, except that fee income increases. Some of the extra private revenues are seized by the local authority.

The theoretical results for fee income derives from the assumption that private consumption exclusive of fees is a normal good. Increased income induces both higher local public service production and higher private consumption. Fee income is the instrument to reallocate resources between private and public sector, depending on where the income increase comes. To think of financial wealth as a normal good is contradicted by the fact that financial wealth as a fraction of income has been declining for decades. We will therefore proceed on the assumption that financial wealth is an inferior good.

The reduced form model describes current expenditure, real capital, fee income and financial wealth as functions of local public disposable income, private disposable income, and prices.

$$(2.6) \quad (B_t, K_t, C_t^G, W_t) = f(Y_t, Y_t^P, \mathbf{P}_t)$$

where $\mathbf{P}_t$ is a price vector. (2.6) is a long-run equilibrium, and need not be satisfied at any point in time. Due to inertia, spending will adjust gradually to exogenous shocks. Usual explanations for inertia are the presence of adjustment costs, and the habit of decision-makers to form adaptive expectations over uncertain incomes and prices.

3. Empirical modelling

In this chapter, a dynamic and stochastic version of the model of section 2 is estimated. For the system to fulfil the budget constraint (2.1), net real investment is assigned to be a residual variable. The experience here is that the general simultaneous system specification has a richness of parameters which is hard to disentangle in FIML-estimation. Consequently, the empirical modelling is founded on the OLS method. The preferred equations are reestimated as a system, and the simulations in chapter 4 use FIML-estimates.

The empirical modelling starts with a general model specification, and the model is simplified by means of empirical testing. The general model ought to be theory consistent, restrict the dynamics of the process as little as possible, and be parametrized to obtain explanatory variables that are near orthogonal. The general model is simplified to the smallest version that is compatible with the data, and the preferred model is extensively evaluated.

The local public sector comprises about 450 municipalities at the local level and 19 counties at the intermediate level of government. The main data source is the National Accounts of Norway, which is based on annual accounting data delivered by municipalities and counties. Data for real capital and depreciation are derived on the basis of economic life projections and some other special assumptions. A complete index of variables and definitions is reproduced in appendix A.

The experience from the empirical modelling here is that private disposable income does not enter significantly into econometric equations for local public spending or financial wealth. Local public income inclusive of fees, Y_t^G, is defined by

$$(3.1) \qquad Y_t^G = Y_t + C_t^G$$

By using Y_t^G as a regressor, an indirect effect of private income is included in the model. Higher private disposable income induces higher fees. The corresponding increase in income inclusive of fees affects local public expenditure and investment.

As an approximation, the log-linear functional form is applied. Since the net wealth is not bounded to be positive, and is in fact negative, the log-form is not tenable in this case. Thus, a somewhat different transformation is applied to the wealth variable. The wealth ratio, WR_t^G, is defined by

$$(3.2) \qquad WR_t^G = \frac{W_t}{Y_t^G}$$

and the transformation $f(x) = \log\left[\frac{e^x}{1+e^x}\right]$ is applied to the wealth ratio. Like the ordinary log-transformation, $f(\cdot)$ is increasing and concave. But in contrast to logarithms, $f(\cdot)$ is defined over non-positive numbers.

We have imposed a priori static price homogeneity restrictions on the model. When all exogenous prices and nominal incomes increase by 1 percent, no endogenous real magnitudes will change. A motivation for this is the theoretical result that rational decision-makers will be influenced only by real variables, at least in the long run. The deflator for total local public expenditure is used to calculate real amounts. It is defined as the average of the prices of current expenditure, depreciation and real investment.

$$(3.3)\qquad P_t^G = \frac{P_t^B B_t + P_t^D D_t + P_t^I \Delta K_t}{B_t + D_t + \Delta K_t}$$

Two types of price substitution effects are estimated. First, there is factor substitution between real capital and current expenditure. Second, there is substitution between private consumption and local public expenditure.

The purpose of sections 3.1 - 3.3 is to estimate price and income elasticities in local public budget-making. Apart from price homogeneity, these elasticities are unrestricted in the general specification. Lagged budget shares of endogenous variables are included in the specification. In addition, real income and relative prices are included. If some of these additional terms show up with significant effects, one can make inference about deviations in long run income elasticities and direct price elasticities from unity. Throughout, the natural logarith of a variable with upper-case letters is denoted with lower-case letters. $b_t = \log B_t$ et cetera.

3.1 Demand for current expenditure

The most general equation for current expenditure that is estimated takes the form

$$(3.4)\qquad \begin{aligned} &\Delta(p_t^B + b_t - y_t^G) = a_1 + a_2\Delta(p_{t-1}^B + b_{t-1} - y_{t-1}^G) + a_3\Delta(y_t - p_t^G) + a_4\Delta(y_{t-1} - p_{t-1}^G) \\ &+a_5\Delta(p_t^B - p_t^G) + a_6\Delta(p_{t-1}^B - p_{t-1}^G) + a_7\Delta(p_t^C - p_t^G) + a_8\Delta(p_{t-1}^C - p_{t-1}^G) \\ &+a_9(p_{t-1}^B + b_{t-1} - y_{t-1}^G) + a_{10}(p_{t-1}^D + d_{t-1} - y_{t-1}^G) + a_{11}f(WR_{t-1}^G) \\ &+a_{13}(y_{t-1}^G - p_{t-1}^G) + a_{13}(p_{t-1}^B - p_{t-1}^G) + a_{14}(p_{t-1}^C - p_{t-1}^G) + \varepsilon_{1t} \end{aligned}$$

where ε_{1t} is a stochastic error term. As a result of price homogeneity, all terms in (3.4) are real magnitudes. The left-hand side variable is the budget share of current expenditure, on logarithmic first difference form. The lagged budget share of current expenditure is also included on the righ-hand side, at difference and level form. If a_9 is negative, there is an error correction mechanism, implying a long run relationship between current expenditure, income and prices.

Real disposable income, the relative price of current expenditure, and the relative price of private consumption, are included as first differences with two lags, and as lagged levels. These terms take account of dynamic effects from shifting income and prices. To avoid simultaneity bias, the short run derivative of current expenditure with respect to fee income is set equal to 1.

In addition to the budget share of current expenditure, the budget share of depreciation and the wealth ratio are included as lagged levels. A positive coefficient for the depreciation budget share implies that the budget share of current expenditure increases when real capital and depreciation is high relative to income. A positive coefficient for the wealth ratio implies that the budget share of current expenditure increases when net wealth is high relative to income.

Although the OLS-estimate for the coefficient a_5 was significant, it turned out to be insignificant in FIML-estimations. For the sake of parsimony, the variable with coefficient a_5 was left out the model. After further simplification, we arrived at the preferred equation for current expenditure

$$(3.5) \quad \begin{aligned} &\Delta p_t^B + \Delta b_t - \Delta y_t^G = \alpha_1 - \alpha_2(\Delta y_t - \Delta p_t^G) - \alpha_3(p_{t-1}^B + b_{t-1} - y_{t-1}^G) \\ &+\alpha_4(p_{t-1}^D + d_{t-1} - y_{t-1}^G) + \alpha_5 f(WR_{t-1}^G) \end{aligned}$$

The significant estimate for α_3 confirms that there is error correction in the budget share of current expenditure. The target level of the current expenditure budget share is higher, the higher the capital stock, and the higher the financial wealth. When accumulated real and financial investment are becoming high relative to income, the local authority gives more priority to current expenditure. The effect through α_4 is scarcely significant, but it is included to capture long run stabilization of real capital in the model.

The only first difference term included is the rate of growth in real disposable income. The negative sign for α_2 means that the budget share of current expenditure will decrease in the short run when real disposable income increases. High α_2 implies high short run sluggishness in the adjustment of current expenditure to changes in income.

Table 3.1 Preferred estimated equation for current expenditure

Parameter	Estimation method: OLS Estimate	Period: 1973 - 1992 Standard-error	T-statistic
α_1	0.54	0.28	1.89
α_2	0.61	0.07	9.09
α_3	0.35	0.06	5.41
α_4	0.09	0.08	1.09
α_5	0.15	0.08	1.90

$\bar{R}^2$=0.88	DW=2.35	NORM χ(2)=0.69	RESET F(1,14)=0.46
LM F(1,14)=1.48	LM F(2,13)=1.21	LM F(4,11)=0.90	ARCH F(1,13)=0.34

The lagged level of real local public income, and all relative price terms, are excluded from the model. The estimations give no strong support for such income and substitution effects. Thus, for given budget shares of depreciation and wealth, the hypothesis of unity long run price and income elasticities is not rejected.

3.2 A model of fee income

In the sample period, the growth rate in local public fee income has on average exceeded that of local public disposable income, which in its turn has grown at a higher pace than private disposable income. High growth in taxes and fees relative to private disposable income can be explained by income-elastic demand for public services, which is referred to as Wagner's Law (Wagner, 1883). This would imply that the long run fee income elasticity with respect to private disposable income is greater than one. However, Wagner's Law has little bearing on the matter, as income elasticities showed up with wrong signs in the estimations. Contrary to the predictions, the private disposable income effect on fees was negative, and the local public disposable income effect on fees was positiv in the long run.

These results call in question whether the framework of chapter 2 is sufficient for an understanding of the high trend growth in fees. In particular, a possible shortcoming is that characteristics of the political process are left unspecified in the model. Client groups have strong incentives to lobby for improved quality and increased production of the services from which they benefit. When the groups lobby for higher spending levels, they impose negative fiscal externalities on each other. The costs will be spread out as higher user charges on several services, so the client group can be a free rider in its own cause. Also, the self-interests of bureaucrats and politicians may favor public sector growth. One reason for the high growth in fee income can be that those who benefit from higher spending are more powerful than those who pay the charges.

In a panel data study, Borge and Rattsø (1994) find that increased socialist influence increases the size of the local public sector, while a strong political leadership has an advantage in opposing pressure to increase spending. The reduced form model for fee income is extended with effects from party composition and fragmentation in local politics.

Even if these factors can explain some of the cross-sectional variation in fee income, it is less obvoius that they can explain the high trend growth in fees. The socialist influence has on average been decreasing rather than increasing over the sample period. The hypothesis that the high aggregate growth in fees ows to a weakening of political leadership may be more promising, although we would not expect political strength to fall trendwise over long periods of time. Borge and Rattsø has no clear-cut explanation for the upward trend in fees, as time dummies are included in their model specification.

It seems that the contribution of political factors to fee income growth is not easily accounted for at the macro level. As a first approximation, these factors are tentatively taken care of by including a time trend in the model.[5] Although not entirely satisfactory, the biases that may arise from this approach will not necessarily interfer seriously with the dynamics of spending in our model, because fee income constitutes only a minor part of local public revenues.

The most general equation for fee income that is estimated is

$$
\begin{aligned}
\text{(3.6)} \quad & \Delta(c_t^G - y_t^P) = b_1 + b_2\Delta(c_{t-1}^G - y_{t-1}^P) + b_3\Delta(y_t - p_t^C) + b_4\Delta(y_{t-1} - p_{t-1}^C) \\
& + b_5\Delta(y_t^P - p_t^C) + b_6\Delta(y_{t-1}^P - p_{t-1}^C) + b_7\Delta(p_t^G - p_t^C) + b_8\Delta(p_{t-1}^G - p_{t-1}^C) \\
& + b_9(c_{t-1}^G - y_{t-1}^P) + b_{10}(p_{t-1}^D + d_{t-1} - y_{t-1}^G) + b_{11}f(WR_{t-1}^G) \\
& + b_{12}(p_{t-1}^G - p_{t-1}^C) + b_{13}t + \varepsilon_{2t}
\end{aligned}
$$

[5] We find no significant effect of the time trend in the equations for current expenditure and local public debt.

where the consumer price index P_t^C is used as deflator. The left-hand side variable is the budget share of fees in private disposable income, on logarithmic first difference form. The lagged budget share of fees is also included on the righ-hand side, at difference and level form. If b_9 is negative, the formulation imposes a unit long run elasticity of fees with respect to private disposable income. If $b_9 = 0$, none of the trend growth in fee income is attributed to higher private demand. A zero long run elasticity with respect to local public disposable income is imposed in (3.6). The time trend with coefficient b_{13} is included to account for the trend growth in fees above private income growth.

Real local public disposable income, and real private disposable income are included as first differences with two lags. These terms account for short run and intermediate dynamic effects from shifts in income. The relative price of local public expenditure to private consumption is included as first difference with two lags, and as lagged level. We expect that higher factor prices and higher costs in local public service production will induce higher user charges, so that b_7, b_8 and b_{12} should not be negative. One reason for this is the central regulation stating that charges can not exceed the costs of providing a service. To the extent that the regulation is effective, fees will depend positively on factor prices.

In addition to the private budget share of fees, the local public budget share of depreciation and the wealth ratio are included as lagged levels. A negative coefficient for the depreciation budget share implies that the private budget share of fees decreases when local public real capital and depreciation is high relative to income. A negative coefficient for the wealth ratio implies that the private budget share of fees decreases when local public net wealth is high relative to income.

The estimate for b_7 was negative. This implies a short run reduction in fees in response to higher costs in local service production, which is unreasonable. The effect was omitted from the model. The OLS-estimate for the coefficient b_5 was significantly positive, but it was insignificant in FIML-estimations. The related variable was also left out of the model. After further simplification, we arrived at equation (3.7).

$$(3.7) \quad \Delta c_t^G - \Delta y_t^P = -\beta_1(\Delta y_t - \Delta p_t^C) - \beta_2(c_{t-1}^G - y_{t-1}^P) - \beta_3 f(WR_{t-1}^G) + \beta_4(p_{t-1}^G - p_{t-1}^C) + \beta_5 t$$

In the short run, increases in local public real disposable income will reduce the rate of growth in fee income. There is error-correction in the share of fees in private disposable income, so the share is stabilized in the long run, given relative prices, the wealth ratio, and the factors behind the time trend. There is a significant long run effect from relative price changes on fee income. Higher public input prices relative to private consumption prices lead to higher charges. The long run elasticities of fees with respect to prices do not differ significantly from unity (in absolute value), which follows from the approximate equality of β_4 and β_2.

Table 3.2 Preferred estimated equation for fee income

	Estimation method: OLS	Period: 1973 - 1992	
Parameter	Estimate	Standard-error	T-statistic
β_1	0.58	0.19	3.09
β_2	0.66	0.16	4.07
β_3	0.82	0.29	2.81
β_4	0.67	0.17	3.98
β_5	0.05	0.01	4.12

$\overline{R}^2$=0.83	DW=2.23	NORM χ(2)=0.71	RESET F(1,14)=0.03
LM F(1,14)=0.97	LM F(2,13)=1.41	LM F(4,11)=1.66	ARCH F(1,13)=0.04

We find evidence for increased growth in fees when the local public wealth ratio is low. According to the estimations, fee income growth is not affected by the budget share of depreciation. Increases in charges are used to control financial wealth, but not to stabilize real capital relative to income.

The results are conditional on the simplifying measure of using a time trend, and we have to emphasize that there is scope for improvement. In other respects, the specification is in accordance with the theoretical framework of chapter 2.

3.3 Determination of the local public debt

The left-hand side of the equation for local public debt is the change in the wealth ratio function. The modelling starts out with a general equation analogous to (3.4), including budget shares, relative prices, relative income and real disposable income on the right-hand side.

$$
(3.8)\quad \begin{aligned}
\Delta f(WR_t) &= c_1 + c_2\Delta f(WR_{t-1}) + c_3\Delta(y_t - p_t^G) + c_4\Delta(y_{t-1} - p_{t-1}^G) \\
&+ c_5\Delta(p_t^B - p_t^G) + c_6\Delta(p_{t-1}^B - p_{t-1}^G) + c_7\Delta(p_t^C - p_t^G) + c_8\Delta(p_{t-1}^C - p_{t-1}^G) \\
&+ c_9(p_{t-1}^G + g_{t-1} - y_{t-1}^G) + c_{10}(p_{t-1}^D + d_{t-1} - y_{t-1}^G) + c_{11}f(WR_{t-1}^G) \\
&+ c_{12}(y_{t-1}^G - p_{t-1}^G) + c_{13}(p_{t-1}^B - p_{t-1}^G) + c_{14}(p_{t-1}^C - p_{t-1}^G) + c_{15}D91 + c_{16}D92 + \varepsilon_{3t}
\end{aligned}
$$

WR_t is the fraction of net wealth to local public disposable income (exclusive of fees), while the wealth ratio WR_t^G defined in (3.2) has income inclusive of fees in the denominator. To avoid simultaneity bias, the short run derivative of net wealth with respect to fee income is set equal to zero.

$D91$ and $D92$ are dummy variables for some technical adjustments in local public financial accounting in 1991 and 1992.[6] The term with coefficient c_9 was included after some heuristic specification experiments. G_t is total local public expenditure, defined by

$$(3.9)\quad G_t = B_t + D_t + \Delta K_t$$

and it follows from (2.1), (2.3), (3.1), (3.3) and (3.9) that

$$(3.10)\quad Y_t^G = P_t^G G_t + \Delta W_t$$

It is seen that the term with coefficient c_9 is by definition closely related to the budget share of the budget surplus.

The general equation (3.8) was simplified to

$$
(3.11)\quad \begin{aligned}
&\Delta f(WR_t) = -\gamma_1 + \gamma_2(\Delta y_t - \Delta p_t^G) - \gamma_3(p_{t-1}^G + g_{t-1} - y_{t-1}^G) \\
&-\gamma_4 f(WR_{t-1}^G) + \gamma_5 D91 - \gamma_6 D92
\end{aligned}
$$

The significant estimate for γ_4 confirms that there is error correction in the wealth ratio. When the wealth ratio has become low, the local authority takes measures to reduce the deficit. In the short run, an increase in real disposable income will increase the wealth ratio with a high elasticity. The short run effect is primarily increased financial investment, and not increased total expenditure. The effect

[6] The technical adjustments were connected to privatization of the enterprise Oslo Energy in 1991, and a change in accounting method for holiday allowances in 1992. D91 equals 0 before 1991, and 1 from 1991 and onwards. D92 equals 0 before 1992, and 1 from 1992 and onwards. We find no significant effect of the dummies in the equation for current expenditure.

through γ_3 contributes to medium term sluggishness in financial investment, as high financial investment implies that the budget share of total expenditure is low, which contributes to high financial investment in the subsequent period, according to equation (3.11). The signs of the dummy variable effects are as expected.

Table 3.3 Preferred estimated equation for local public debt

	Estimation method: OLS	Period: 1973 - 1992	
Parameter	Estimate	Standard-error	T-statistic
γ_1	0.23	0.06	3.80
γ_2	0.73	0.05	14.45
γ_3	0.36	0.08	4.54
γ_4	0.24	0.07	3.41
γ_5	0.03	0.01	3.12
γ_6	0.08	0.01	6.48

$\overline{R}^2$=0.94	DW=2.42	NORM χ(2)=0.52	RESET F(1,13)=3.05
LM F(1,13)=1.15	LM F(2,12)=2.15	LM F(4,10)=1.13	ARCH F(1,11)=1.36

The budget share of depreciation was omitted from the equation, due to insignificant coefficient estimate. All terms containing relative prices was omitted for the same reason. The estimate for the lagged real income coefficient c_{12} is also insignificant, so the hypothesis of a unity long run income elasticity in the net debt is not rejected.

3.4 Model evaluation

The empirical model constituted by equations (3.5), (3.7) and (3.11) is in accordance with the theory outlined in section 2. Model parameters are correctly signed, and have reasonable magnitude. The inclusion of a time trend in the equation for fees suggests that the perspective could gain from a broadening, at least as concerns the decision to collect charges. A topic as yet unsettled is the influence of political and institutional factors. The stability of the model could also be undermined by technical change in local service production.

However, the reported diagnostic tests do not indicate serious misspecification problems like autocorrelation, heteroscedasticity, non-normality, or incorrect functional form. Also, it turns out that parameter estimates are quite stable through the 1980s and up to 1992, except for some instability in the equation for current expenditure at the outset of the 1980s. Recursive estimates and standard deviations are shown graphically in Appendix D.

The exogeneity assumption for local public disposable income has been inspected with the aid of Hausman's (1978) test. The first step is to estimate a reduced form model for nominal disposable income. The regressors are the lagged first differences of mainland gross domestic product, the consumer price index, aggregate unemployment, the interest rate on housholds' liabilities in private financial institutions, and a constant term. Next, equations (3.5), (3.7) and (3.11) were augmented with the residuals from the estimated equation for disposable income. The null hypothesis is that the related coefficient is equal to zero. If it is not, the exogeneity assumption for disposable income is impaired, and the least squares estimators are inconsistent. The relevant t-statistics for the three equations are 0.16, 0.57 and 0.56. Thus, the null hypothesis is not rejected, and the exogeneity assumption can be retained.

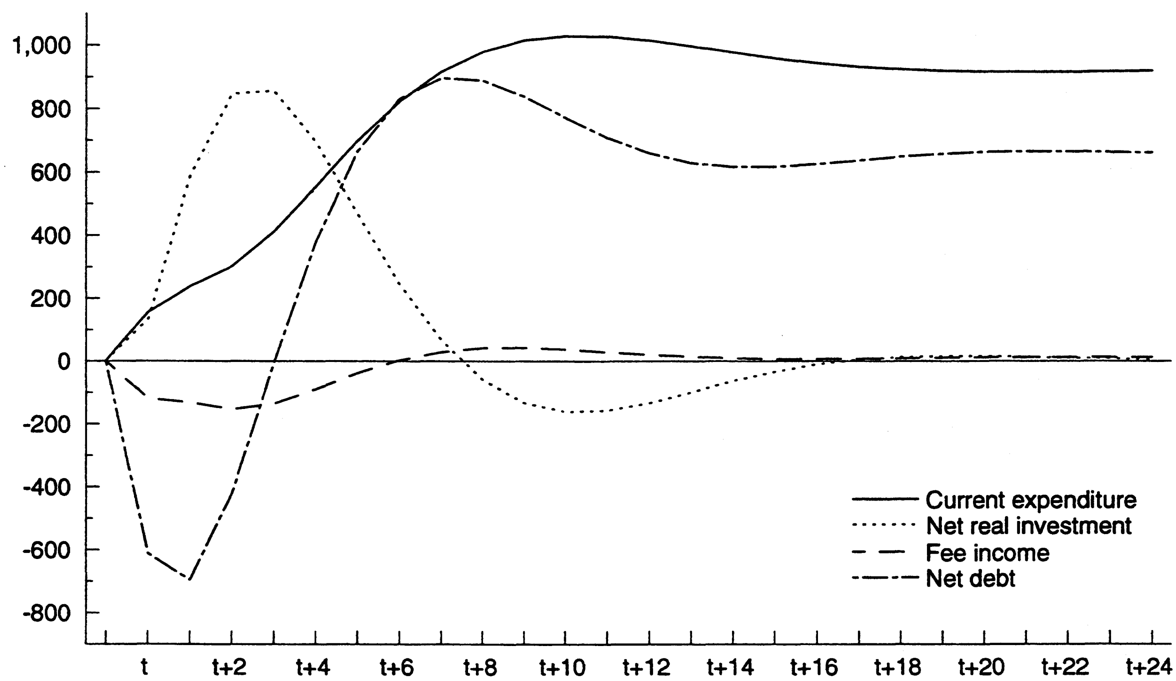
The three preferred equations have been reestimated as a system using FIML. The results are reported in Appendix C. Except for the parameters α_1 and α_4, all FIML-estimates lay within the range of 2 standard deviations from the corresponding OLS-estimate.

4. Model simulations

Equations (3.4), (3.7) and (3.11) togheter with the budget constraint and some other definitions form a dynamic model of local government spending, charging and investment behaviour. Dynamic effects from exogenous shocks can now to be studied by means of model simulations.

Figure 4.1 shows the absolute change in current expenditure, net real investment, fee income and net debt when local public real disposable income (exclusive of net interest income) increases permanently by 1 billon Norwegian kroner compared to a reference path. The model simulation implies that there is considerable sluggishness in the adjustment of local government spending to increases in real income. When the change occurs (in period *t*), this brings about relatively low budget deficits, 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. The increase in investment spending reaches a peak three years after the shock, and then declines to zero. Current expenditure increases gradually to a level a little below 1 billion kroner. There is a medium term decline in fee income, while the long run effect is zero. The long run increase in net debt is about 660 millions. Higher net debt brings about higher net interest costs, which explains why total expenditure increases by less than 1 billion in the long run.

Figure 4.1. Effects of a 1 billion increase in local public disposable income. Changes in millions.



The simulation results for real investment are found to be sensitive to the choice of residual variable in the estimation. In Langørgen (1994) the budget surplus is residual instead of net real investment. The simulated maximum increase in net real investment is about 500 millions, well below the 850 millions reported here. Hence, there is considerable uncertainty associated with the simulated increase in net real investment.

Figure 4.2 shows dynamic effects when private real disposable income increases permanently by 1 billion kroner compared to a reference path. Fee income immediately increases by almost 50 millions, and then increases slightly and stays at the higher level. The increase in net real investment spending reaches a peak three years after impact, and then declines to zero. Current expenditure increases by about 50 millions in the long run, while the net debt increases by about 35 millions in the long run.

Figure 4.2. Effects of a 1 billion increase in private disposable income. Changes in millions.

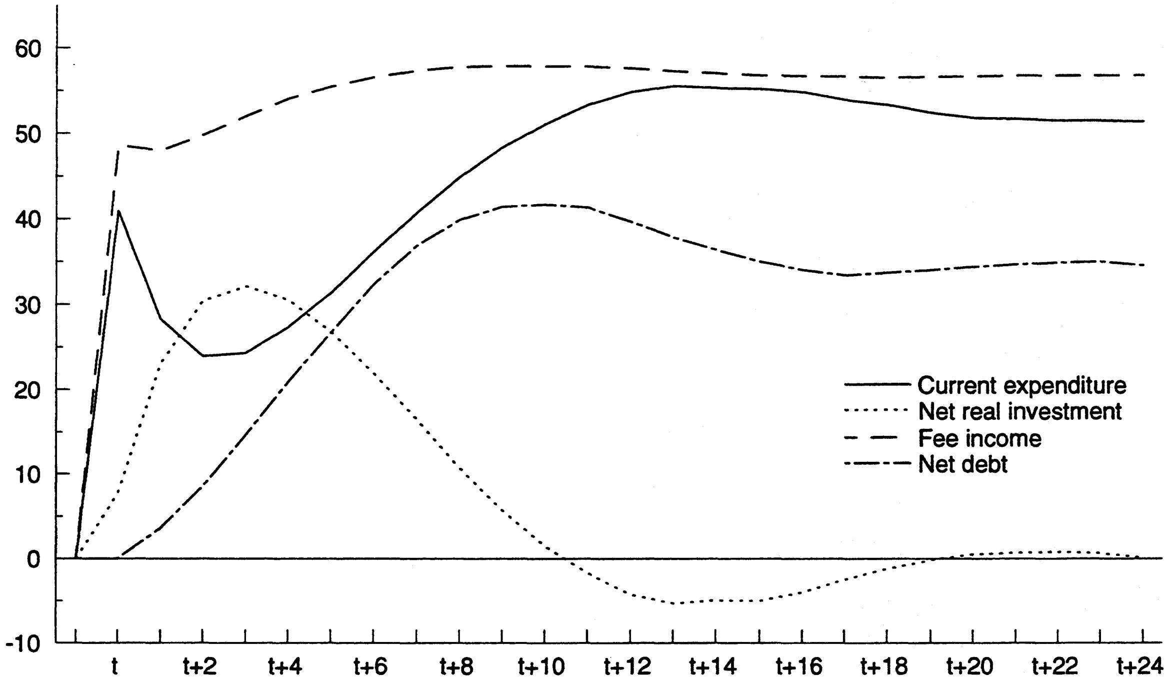


Figure 4.3. Effects of a 1 percentage point increase in private and local public incomes. Changes in per cent.

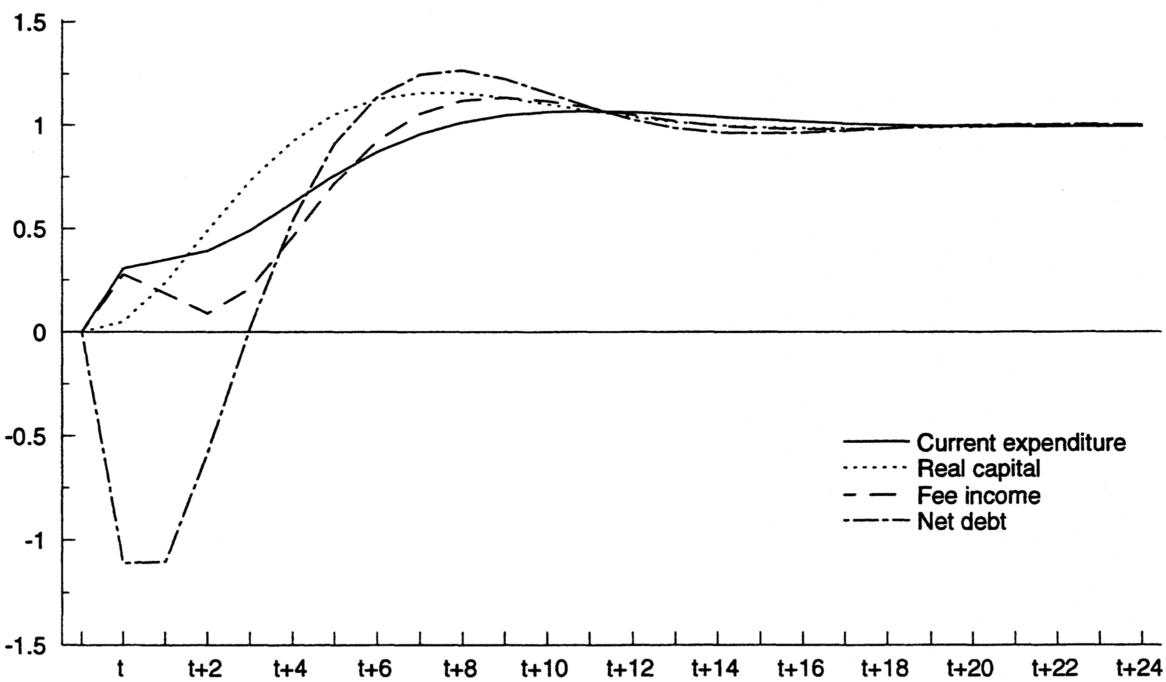


Figure 4.3 shows dynamic effects when local public real disposable income and private real disposable income increase permanently by 1 per cent in period *t*. Net debt first falls by about 1 percent, due to

sluggishness in spending. In the long run, current expenditure, fee income, real capital and net debt increase by 1 per cent.

We find that in the long run, a 1 percentage point increase in the average real rate of interest on local public net debt, will lead to a fall in current expenditure, real capital and net debt by nearly 0.6 per cent. The effect operates through a reduction in local public disposable income, which is defined as the sum of taxes, net grants and net interest income. Thus the long run fee income elasticity is zero.

5. Concluding remarks

Using the community preference model, and relying on economic explanatory factors, we are able to estimate stable and well-behaved equations for local public current expenditure and net debt. To get similar results for fee income, a time trend has been introduced in the model. This may point to a need for model extensions.

The estimation results indicate considerable sluggishness in local public spending, both in current expenditure and investment spending. A positive shift in grants or taxes will in the short run lead to reductions in the net debt. But as spending adjustments take place, the effect on the net debt is reversed, so the long run effect is positive.

The long run elasticities of factor demands and net debt with respect to exogeneous income constraints do not differ significantly from unity. The estimated price elasticities suggest that factor demands are close to neutral-elastic in the long run. Higher factor prices involve higher production costs, and local authorities are thus induced to increase user charges.

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Appendix A. Variables and definitions

B_t	Local public real current expenditure.
C_t^G	Local public fee income.
C_t^P	Private consumption exclusive of user charges for local public services.
D_t	Local public depreciation in fixed prices.
D91	Dummy for privatization of the enterprise Oslo Energy in 1991. Equals 0 before 1991, and 1 from 1991 and onwards.
D92	Dummy for change in accounting method for holiday allowances in 1992. Equals 0 before 1992, and 1 from 1992 and onwards.
G_t	Total local public expenditure, equals current expenditures plus gross real investment.
K_t	Local public capital stock.
ΔK_t	Local public net real investment in fixed prices.
P_t^j	Price deflator for spending item j, j = B (current expenditure), D (depreciation), G (Total public expenditure), I (net real investment), C (private consumption).
W_t	Local public nominal net financial wealth.
ΔW_t	Local public net financial investments.
WR_t	Local public wealth ratio (exclusive of fees). The proportion of W_t to Y_t.
WR_t^G	Local public wealth ratio (inclusive of fees). The proportion of W_t to Y_t^G.
Y_t	Local public nominal disposable income. Comprises tax income plus net grants and transfers plus net interest income. Fees and charges are not included.
Y_t^G	Local public nominal income inclusive of fees. $Y_t^G = Y_t + C_t^G$.
Y_t^P	Private nominal income disposable for consumption.

Appendix B. Test statistics

$\overline{R}^2$	Adjusted squared multiple correlation coefficient.
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.

Appendix C. FIML reestimation

«T-statistics» in brackets

Equation (3.5)

α_1	α_2	α_3	α_4	α_5
1.13	0.60	0.44	0.33	0.15
(6.11)	(9.80)	(11.77)	(6.09)	(2.09)

Equation (3.7)

β_1	β_2	β_3	β_4	β_5
0.68	0.80	1.06	0.82	0.05
(4.11)	(8.07)	(4.48)	(7.76)	(8.09)

Equation (3.11)

γ_1	γ_2	γ_3	γ_4	γ_5	γ_6
0.27	0.74	0.48	0.28	0.04	0.07
(4.76)	(14.22)	(7.75)	(4.40)	(6.45)	(9.22)

Appendix D. Recursive estimates

Figure D.1. Recursive estimates - equation (3.5)
Coefficient: alpha 1

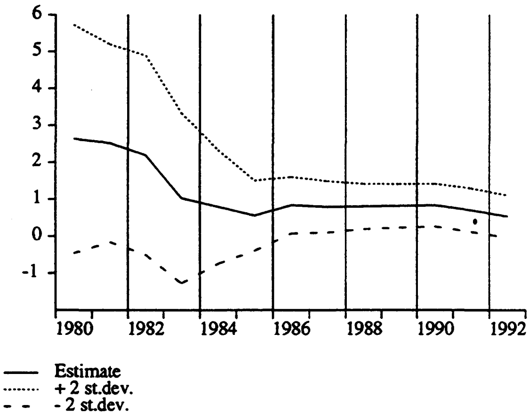


Figure D.2. Recursive estimates - equation (3.5)
Coefficient: - alpha 2

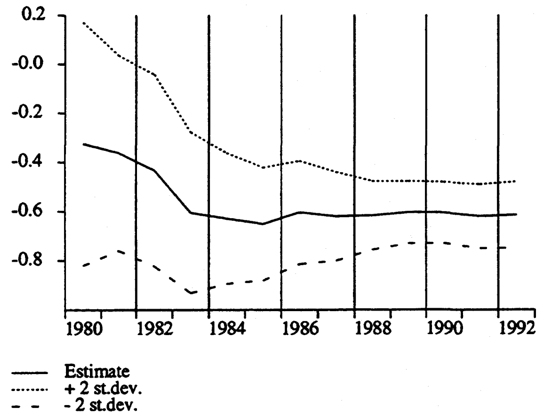


Figure D.3. Recursive estimates - equation (3.5)
Coefficient: - alpha 3

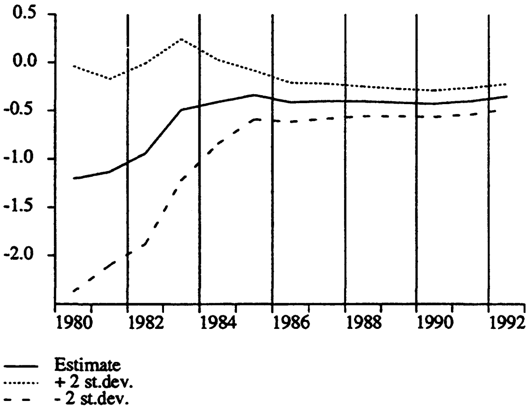


Figure D.4. Recursive estimates - equation (3.5)
Coefficient: alpha 4

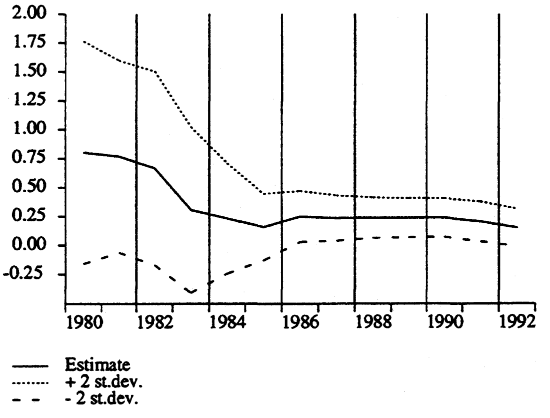


Figure D.5. Recursive estimates - equation (3.5)
Coefficient: alpha 5

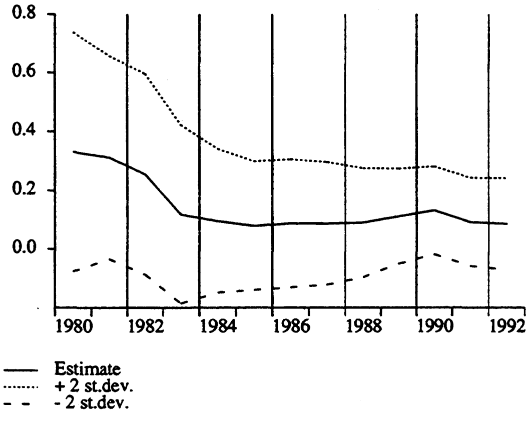


Figure D.6. Recursive estimates - equation (3.7)
Coefficient: - beta 1

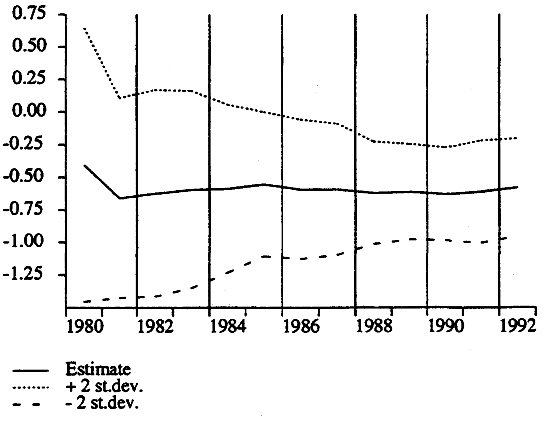


Figure D.7. Recursive estimates - equation (3.7)
Coefficient: - beta 2

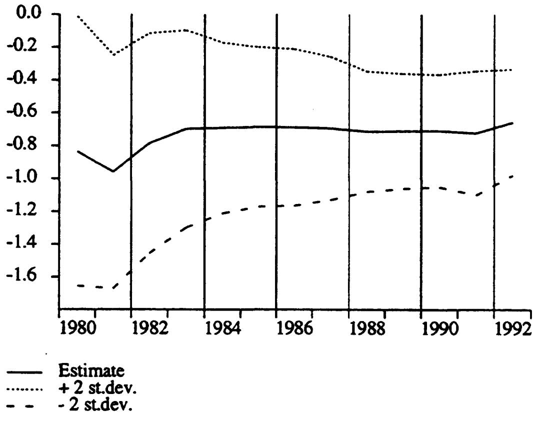


Figure D.8. Recursive estimates - equation (3.7)
Coefficient: - beta 3

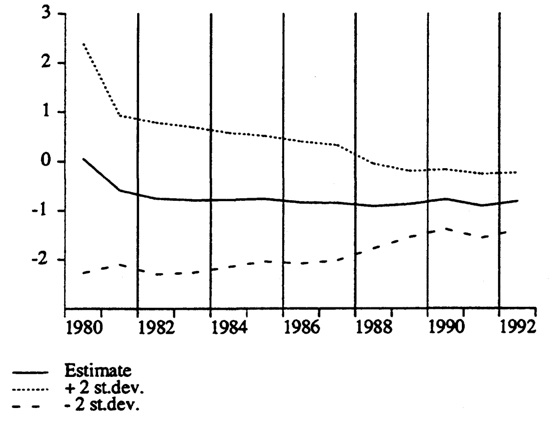


Figure D.9. Recursive estimates - equation (3.7)
Coefficient: beta 4

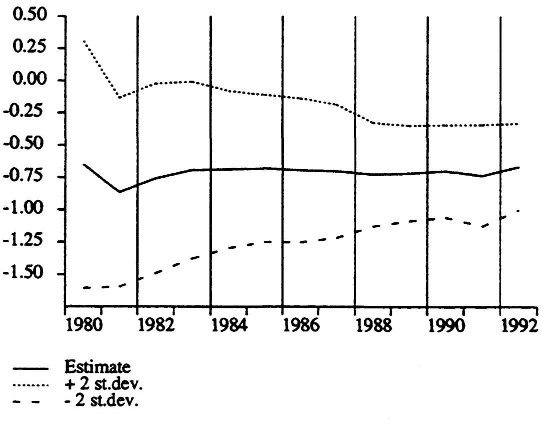


Figure D.10. Recursive estimates - equation (3.7)
Coefficient: beta 5

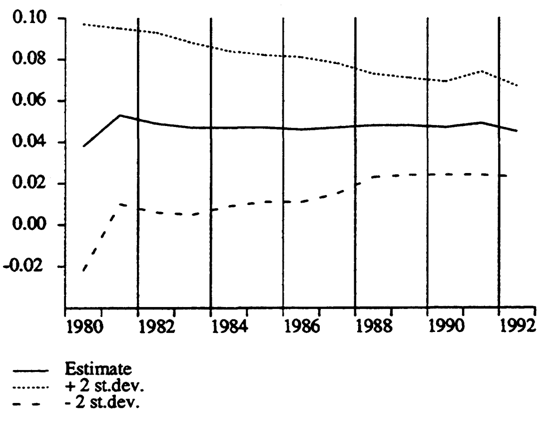


Figure D.11. Recursive estimates - equation (3.11)
Coefficient: - gamma 1

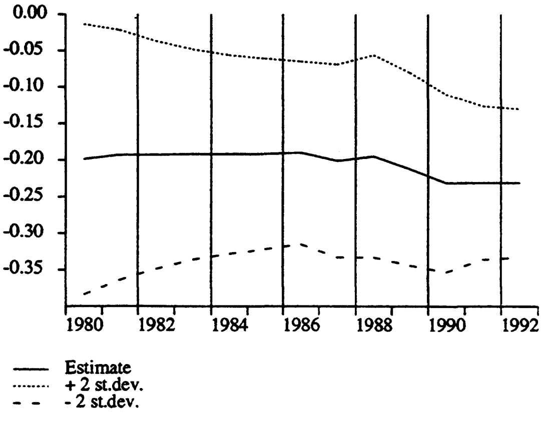


Figure D.12. Recursive estimates - equation (3.11)
Coefficient: gamma 2

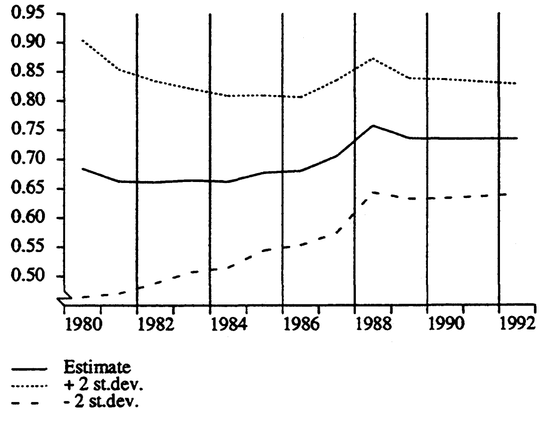


Figure D.13. Recursive estimates - equation (3.11)
Coefficient: - gamma 3

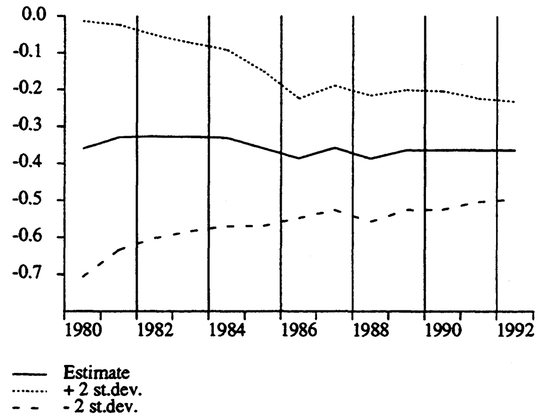
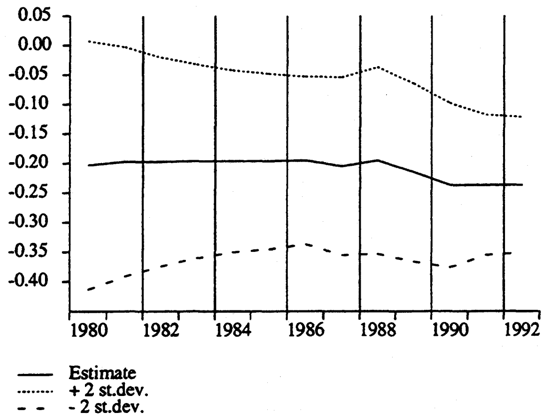


Figure D.14. Recursive estimates - equation (3.11)
Coefficient: - gamma 4



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