PREFACE

This paper is a progress report on the work with the econometric model KOSMOS. As previous papers on KOSMOS in the Working Paper series, it is intended to constitute part of a future comprehensive report on the whole model, and hence is not completely self-contained.

A very brief discussion of the methodological issues connected with testing of constraints and the estimation method chosen, as well as a description of the way the time-series data were constructed, can be found in an earlier paper published in the Working Paper series, namely A. Markowski and L. Ernsäter, *The Supply Side in the Econometric Model KOSMOS*, Working Paper No. 37, Stockholm: National Institute of Economic Research, January 1994.

WORKING PAPER No.42b
October, 1994
Revised, December, 1994

WAGE RATE DETERMINATION IN THE ECONOMETRIC MODEL KOSMOS

ALEKSANDER MARKOWSKI

Svensk resumé på sid 18.

WAGE RATE DETERMINATION IN THE ECONOMETRIC MODEL KOSMOS

by

Alek Markowski

National Institute of Economic Research,
Box 3116, 103 62 Stockholm, Sweden

October, 1994
Revised December, 1994

CONTENTS

Introduction

This paper is a progress report on the work with the econometric model KOSMOS. As previous papers on KOSMOS in the Working Paper series, it is intended to constitute part of a future comprehensive report on the whole model, and hence is not completely self-contained.

The long-run wage rate equations for Industry and Other Business are based on the work of Forslund and Risager (1994). The equations have been reestimated and partly respecified, due to data revisions. Alternative wage rate equations, with - in the case of Industry - more plausible long-run properties, are also reported.

The next section gives a brief outline of the model as well as regression results for Industry. Regression results for Other business are reported in the subsequent section. The last two sections describe the way the central and local government wage rates are determined in the model.

Wage rate determination in industry

The approach to wage rate determination in the non-public sectors is based on a general bargaining model. In this model, the wage rate is subject to negotiations between the employers and the employees. The negotiation objective of the employees is defined in terms of the so called consumer real wage, i.e. the after-tax wage rate deflated by the consumer price index. The objective of the employers, which is an important parameter in their labour demand scheme, is defined in terms of the producer real wage, i.e. the wage rate augmented by the payroll tax and deflated by the producer price index. According to the model, the producer real wage depends on the labour market (unemployment) situation, average productivity and the so called tax wedge, i.e. the relation between the producer real wage and the consumer real wage:

(W.1) $w(1+s)/p = f\{u, q, (1+s)p_c/[(1-t)p]\}$,

where
- w - nominal wage rate,
- s - payroll tax rate,
- p - producer price,
- q - labour productivity level,
- p_c - consumer price,

t - income tax rate,
$w(1+s)/p$ - producer real wage,
$w(1-t)/p_c$ - consumer real wage,
$(1+s)p_c/[(1-t)p]$ - tax wedge.

In a log-linear model, when the coefficient of the tax wedge is equal to 1 the relation determines the consumer real wage, with no regard to the effects on producer costs. It should be noted that such a case does not actually mean that the employees have monopoly power, but rather that they attach a very small weight to the labour market situation, since high producer real wage costs can result in limited demand for labour and, thus, large unemployment. In the converse case of zero tax wedge coefficient, the producer real wage is determined with no regard to the effects on the consumer wage.

When the coefficient of the productivity term is equal to 1, again in a logarithmic model, the relation determines in practice the wage cost ratio, i.e. the share of the wage cost (inclusive of payroll taxes) in the total revenue ($w(1+s)/(pq)$ being identical to the wage cost ratio).

Equation (W.1), formulated in a log-linear form, was postulated to hold in the long-run. In the short run, the wage rate (or the bargaining process) was postulated to be affected by the deviation of the expected inflation from its long-run value, the profitability of production and the income and payroll tax rates. Only the former tax rate proved significant in regressions. A dummy variable for 1983:1 was also included in order to allow for the informal agreement between the government and the trade unions, stipulating that the latter would not demand full compensation for the inflationary effects of the 1982 devaluation of the Swedish krona.

The adjustment equation was formulated in the error-correction form. Estimation was performed using the Engle-Granger two-step method (cf. Engle and Granger (1987)), i.e. the static long-run relation was estimated first, the (lagged) residuals from this equation being subsequently employed in the estimation of the adjustment equation.

The wage rate was defined as the average wage per hour worked in industry and was computed as the ratio of the "cost-wage bill" to total hours worked in the sector. The cost-wage bill (*kostnadslönesumma*) is the wage bill adjusted for retroactive payments (caused by drawn-out wage negotiations), which shows the wage cost incurred in each period rather than the actual payments. In practice, the employment of the cost-wage bill did not prove to affect the results in any major way.

Our wage-rate measure is slightly distorted by the fact that total hours worked include the self-employed, who run their - mainly one-man - businesses without having a formal salary. The share of the self-employed (mainly free professions and farmers) in total hours worked is, however, very limited.

The payroll tax rate was computed as the ratio of the actual tax payments to the wage bill and is thus the effective rather than the statutory rate. The income tax rate is based on the statutory preliminary tax rate applicable to the average monthly income of the members of the (blue-collar) Swedish Trade Union Confederation (LO).

The producer price was represented by the implicit value added deflator for the industrial sector and the consumer price by the implicit deflator for private consumption expenditure.

The expected rate of inflation was defined, using the adaptive expectations approach, in terms of changes in the logarithm of the implicit deflator for private consumption expenditure (cf. explanation of variables in equation (W.3) below). The wage rate was postulated to be in the short run affected by the deviation of the expected inflation from its long-run value. Assuming expected inflation in the long-run is constant, only the measured level of the expected inflation was included in the equation (the long-run expected inflation level forming thus part of the intercept).

Besides adaptive expectations, the rational expectations hypothesis was also tested by including led values of the actual consumer price inflation. This approach did not improve, however, the explanatory power of the equation. The assumption of backward-looking expectations seems, furthermore, to be confirmed by the anecdotical evidence on the bargaining process during the period under study.

The profitability of production was measured as the ratio of "extraordinary" profits after tax to value added. Extraordinary profits are defined as gross trading surplus minus the imputed rental cost of the existing fixed capital stock (cf. Markowski and Ernsäter (1994), Appendix)

OLS estimation gave the following results:

(W.2)

log(wr1)

$$= \underset{(9.03280)}{0.81564} * \log(\text{wedge1}) - \underset{(3.10492)}{0.03993} * \log(u) + \underset{(7.94210)}{0.50013} * \log(q1)$$

$$- \underset{(7.36844)}{0.08332} * D8390 + \underset{(5.82361)}{1.66819}$$

Sum Sq	0.0266	Std Err	0.0249	LHS Mean	4.8046
R Sq	0.9817	R Bar Sq	0.9800	F 4, 43	577.586
D.W.(1)	1.8974	D.W.(2)	1.5990	Est. per.	70:1-93:2

(W.3)

dlog(w1)

$$= - \underset{(4.80888)}{0.59096} * \text{dlog}(w1)_{-1} + \underset{(10.3009)}{1.54675} * \text{infl}^{e}$$

$$+ \underset{(4.14736)}{0.39514} * \text{prof}_{-2} - \underset{(2.30836)}{0.40339} * \text{dlog}(1 - t) - \underset{(1.86309)}{0.04059} * D831$$

$$- \underset{(2.29388)}{0.39253} * \log[wr1/(wr1^{*})]_{-1} + \underset{(1.25140)}{0.00741} * SEAS2$$

Sum Sq	0.016	Std Err	0.0204	LHS Mean	0.044	Res Mean	0.0001
R Sq	0.6715	R Bar Sq	0.6210	F 7, 39	11.3897	%RMSE	552.1
D.W.(1)	1.8387	D.W.(2)	1.9611	Est. per.	71:1-93:2		

where

wr1 - producer real wage rate in industry (defined as above),
wedge1 - tax wedge in industry (defined as above),
u - overall unemployment rate,
q1 - labour productivity (real value added per hour worked) in industry,
D8390 - dummy equal to 1 in 1983:1-90:2, otherwise zero,
w1 - nominal wage rate in industry,
infl^{e} - expected rate of inflation,

$$\text{infl}^{e} = 0.3\ \text{dlog(pc)} + 0.7\ \text{infl}^{e}_{-1}$$

pc - implicit deflator for private consumption expenditure,
prof - production profitability measure,
t - average income tax rate,
D831 - dummy equal to 1 in 1983:1, otherwise 0,

$wr1^*$ - estimated (from eq. W.2) long-run value for wr1,
$\log[wr1/(wr1^*)]$ - residual from equation (W.2),
SEAS2 - seasonal dummy equal to 1 in the second half-year, otherwise zero,
$d\log(x) = \log(x) - \log(x)_{-1}$.

The long-run equation, (W.2), passes the Dickey-Fuller cointegration test at 5% level (the test statistic being -7.02). The equation indicates that the costs of tax increases are in the long run mainly borne by the employers, the coefficient for the tax wedge being rather close to 1 (0.82). Furthermore, it appears that the wage formation process is relatively little affected by the labour market situation (the long-run wage elasticity with respect to the unemployment rate being only 0.04). On the other hand, according to the equation, the employees are in the long run compensated for approximately half of the labour productivity increases. This can be interpreted as reflecting the fact that productivity increases are partly due to the rising capital intensity of production, financed by the employers.

The dummy variable D8390 appears to be of crucial importance, indicating a drastic fall in the long-run wage rate after 1982. Among the possible interpretations of the dummy, we favour the hypothesis that this variable reflects a change in the attitude of the Swedish Trade Union Confederation (LO), cf. Forslund and Risager (1994). It is not clear whether the shift was temporary, as implied by the dummy which is on only up to 1990, or not, since the three years after 1990 included in the sample are too turbulent (in terms of e.g. the extreme rise in unemployment) to give support to a clear conclusion. When the dummy is extended to be equal to 1 through the end period of the sample, the unemployment variable becomes completely insignificant.

The fit of equation (W.3), as well as its predictive power, are illustrated in Charts W.1 and W.2. The outside-sample forecasts in Chart W.2 are based on both first and second step regressions performed up to 1990:2.

We can note the relatively large coefficient of the dummy variable for 1983:1, which we believe is due to the lower wage settlements after the 1982 devaluation of the krona. The size of the coefficient of expected inflation, which is greater than 1, reflects the fact that the latter series varies much less than actual inflation.

The long-run equation (W.2) cannot be interpreted as a true equilibrium equation, in the sense of a general steady-state solution. It can easily be seen, that in a steady state with constant unemployment rate, constant tax wedge and constant (non-zero)

Chart W.1 Actual (solid line) and fitted (dashed line) values for the industrial wage rate equation estimated for 1971:1-93:2

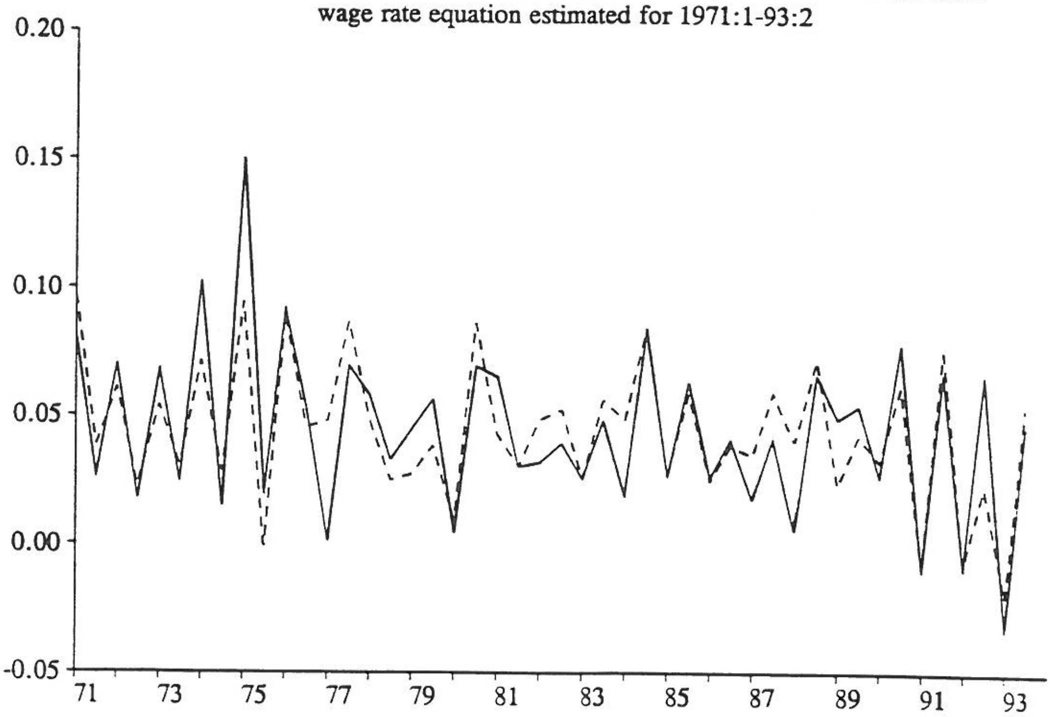
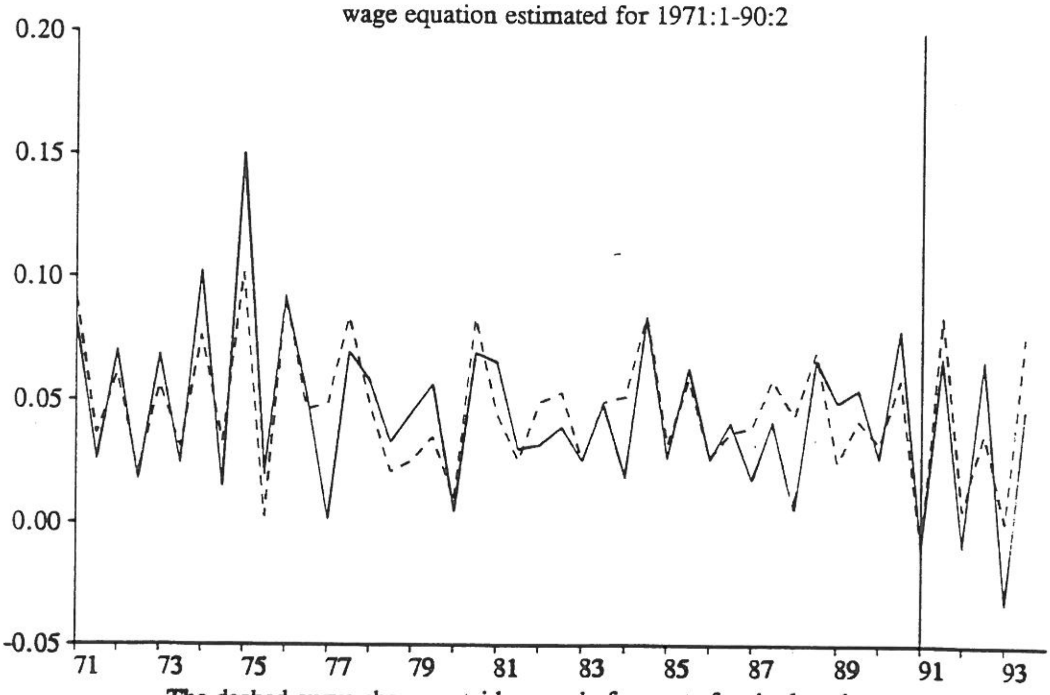


Chart W.2 Actual (solid line) and fitted (dashed line) values for the industrial wage equation estimated for 1971:1-90:2



The dashed curve shows outside-sample forecasts for the last three years

productivity growth, the gross trading profits ratio (which is the complement of the wage cost ratio) increases monotonically. This is due to the fact that a constant wage cost ratio would require full compensation of the employees for productivity increases.

The above result may be due to the problems of estimating long run relations on small samples (in our case 23 years). On the other hand, it is possible - and for a casual observer of the economic reality fully probable - that the wage formation mechanism of the last two decades actually was not compatible with any equilibrium and has caused more or less regular adjustment shocks when its disequilibrating effects had grown too large.

The following results were obtained when a unitary elasticity with respect to labour productivity was imposed on the long-run equation:

(W.4)

$$\log(wsh1) = \underset{(2.77728)}{0.18427}\log(wedge1) - \underset{(2.59580)}{0.05149}\log(u) - \underset{(5.73593)}{0.09910}D8390 - \underset{(5.496)}{0.5477}$$

Sum Sq	0.0656	Std Err	0.0386	LHS Mean	-0.2648
R Sq	0.7508	R Bar Sq	0.7338	F 3, 44	44.1781
D.W.(1)	1.1377	D.W.(2)	1.2476	Est. per.	70:1-93:2

(W.5)

$$dlog(w1) = -\underset{(6.86111)}{0.67292} * dlog(w1)_{-1} + \underset{(12.0197)}{1.62731} * infl^{e}$$
$$+ \underset{(4.09919)}{0.37100} * prof_{-2} - \underset{(2.18703)}{0.36097} * dlog(1 - t) - \underset{(1.52797)}{0.03054} * D831$$
$$- \underset{(3.26108)}{0.29090} * \log[wsh1/(wsh1^{*})]_{-1} + \underset{(1.50517)}{0.00836} * SEAS2$$

Sum Sq	0.0144	Std Err	0.0192	LHS Mean	0.0441
R Sq	0.7071	R Bar Sq	0.6620	F 7, 39	13.4486
D.W.(1)	2.0658	D.W.(2)	2.1287	Est. per.	71:1-93:2

where

wsh1 - wage cost share (or ratio) in industry (defined as above),

$wsh1^*$ - estimated (from eq. W.4) long-run value for wsh1,
$\log[wsh1/(wsh1^*)]$ - residual from equation (W.4).

The fit of equation (W.5), as well as its predictive power, are illustrated in Charts W.3 and W.4. The charts were constructed in the same way as W.1 and W.2.

The coefficient of the tax wedge in the restricted long-run equation (W.4) is much smaller than in the unrestricted one (0.18 and 0.82, respectively), implying that only approximately 1/5 of tax increases in the long run is borne by the employers. The equation passes the Dickey-Fuller cointegration test at 5% level, the test statistic being -4.01.

Generally, the adjustment equation (W.5) appears to have very much the same (or even slightly better) overall fit as equation (W.3), which was based on the unrestricted long-run relation. However, upon comparison of Charts W.1, W.2 and W.3, W.4 it can be seen that the fit of equation (W.5) is slightly worse in the last years of the sample and that the equation shows much larger outside-sample forecast errors.

The fit of the long-run equations is illustrated in Charts W.5 and W.6.

Wage rate determination in Other Business

The model behind the wage rate equation for Other Business, as well as all the variable definitions, are exactly the same as in the case of Industry (cf. the previous section).

The dummy variable for the effects of the 1982 devaluation, D831, proved insignificant. On the other hand, another dummy variable (D811) had to be added to allow for the major data problems in 1981. The cost-wage bill data were recently revised backwards to 1981 by the Central Office of Statistics. The series were further extended backwards by ourselves using the spliced paid-out-wage bill data and the unrevised difference between the paid-out-wage bill and the cost-wage bill. As can be seen from Chart W.7 below, the resultant wage rate series exhibits a marked upward shift in 1981:1. Judging from the large size of the coefficient for the dummy variable in equation (W.7) below, this shift could not be explained by the factors included in the equation.

Still another (stepwise) dummy variable (D89) was employed together with a seasonal dummy in order to allow for the apparent change in the seasonal pattern of the wage rate inflation beginning in the second half of 1989 (cf. Chart W.7).

Chart W.3 Actual (solid line) and fitted (dashed line) values for the alternative industrial wage equation estimated for 1971:1-93:2

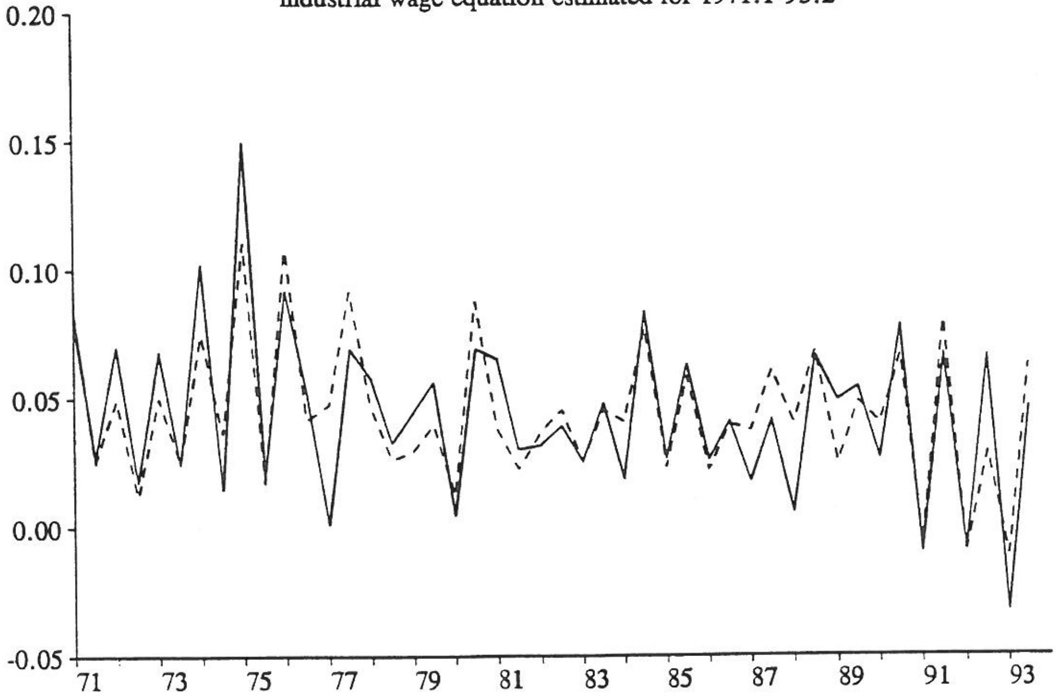
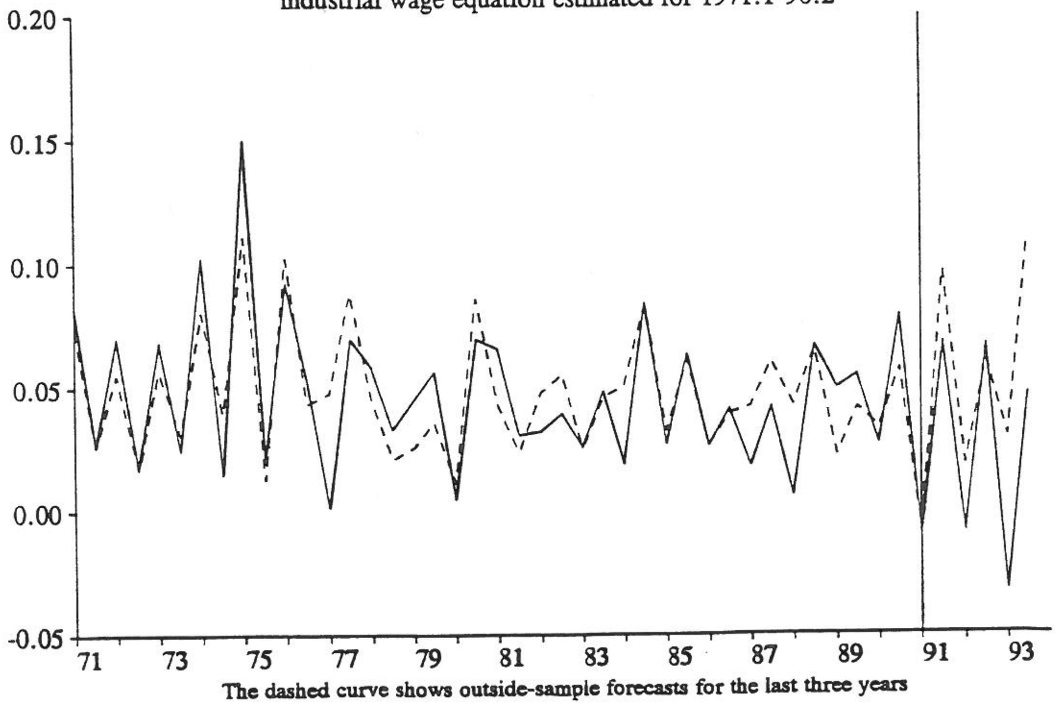


Chart W.4 Actual (solid line) and fitted (dashed line) values for the alternative industrial wage equation estimated for 1971:1-90:2



The dashed curve shows outside-sample forecasts for the last three years

Chart W.5 Long-run relation for the real wage cost:
actual values (solid line) and fitted values (dashed line)

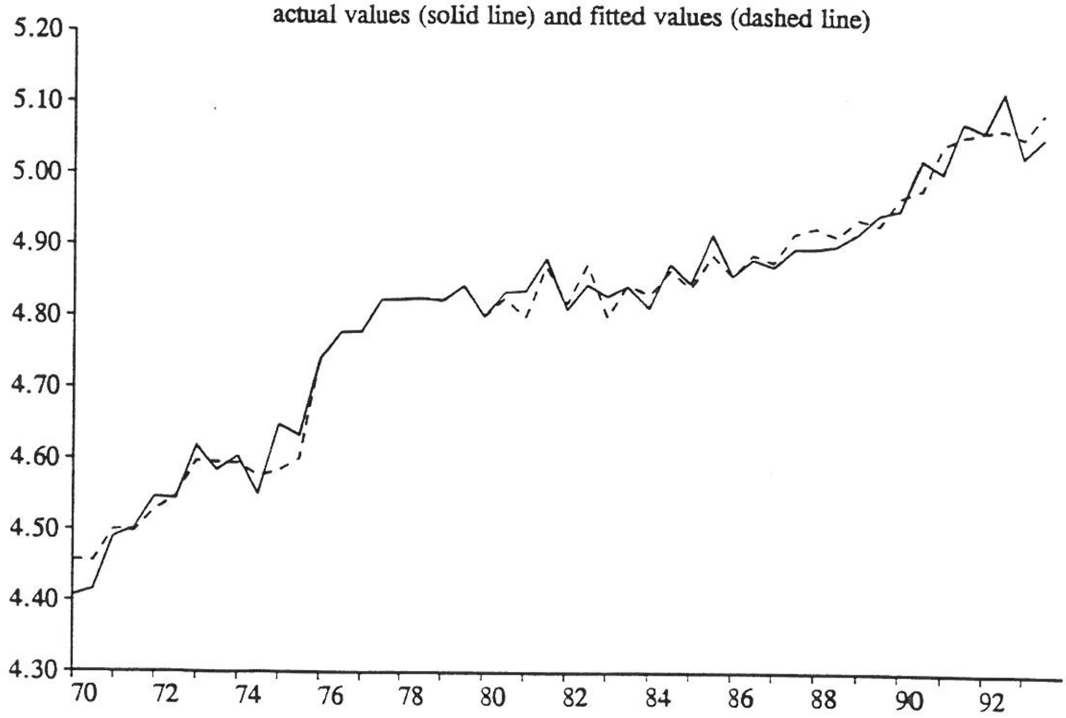
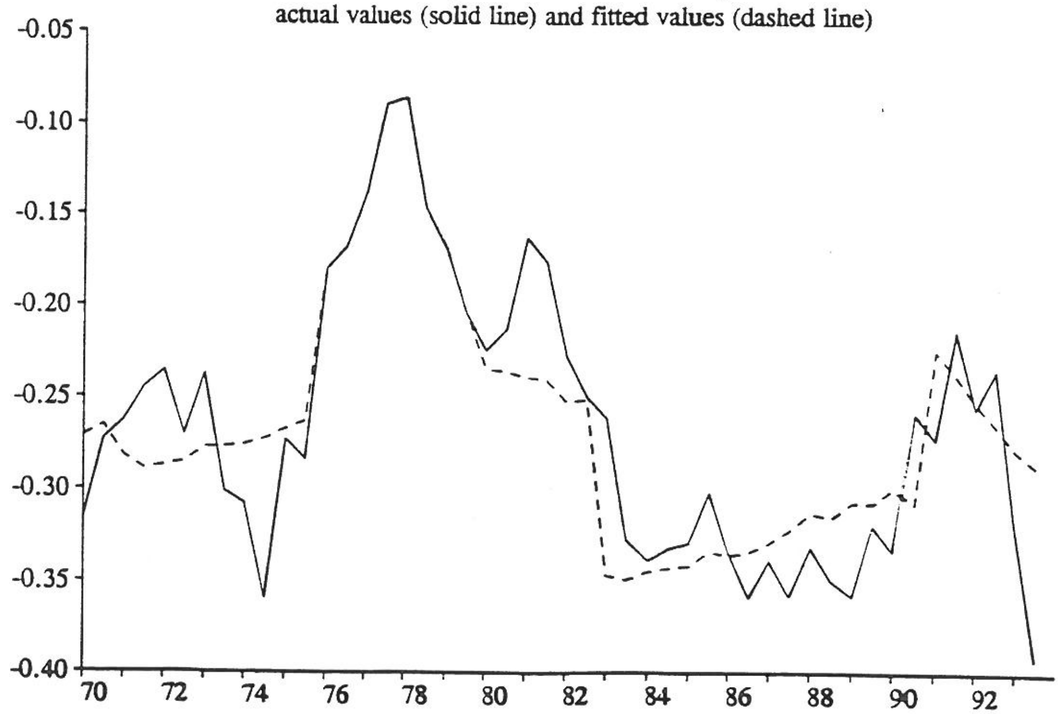


Chart W.6 Long-run relation for the wage-cost share:
actual values (solid line) and fitted values (dashed line)



The Engle-Granger two-step estimation gave the following results:

(W.6)

$$\log(wsh2) = \underset{(6.50641)}{0.29199} * \log(wedge2) - \underset{(4.83538)}{0.04276} * \log(u) - \underset{(17.4724)}{0.84759} + \underset{(1.16832)}{0.00838} * SEAS2$$

Sum Sq	0.0268	Std Err	0.0247	LHS Mean	-0.4926
R Sq	0.5639	R Bar Sq	0.5342	F 3, 44	18.9658
D.W.(1)	1.0991	D.W.(2)	1.3161	Est. per.	70:1-93:2

(W.7)

$$dlog(w2) = \underset{(1.97135)}{0.53184} * infl^e + \underset{(4.04740)}{0.46369} * dlog(q2) - \underset{(4.06951)}{0.07452} * dlog(u)_{-2} + \underset{(4.68880)}{0.07334} * D811 - \underset{(2.15182)}{0.23079} * \log[wsh2/(wsh2^*)]_{-1} - \underset{(1.73021)}{0.01421} * D89*SEAS2 + \underset{(0.2390)}{0.00283} + \underset{(7.14722)}{0.03441} * SEAS2$$

Sum Sq	0.0077	Std Err	0.0144	LHS Mean	0.0453
R Sq	0.7765	R Bar Sq	0.7342	F 7, 37	18.3587
D.W.(1)	1.7912	D.W.(2)	1.7983	Est. per.	71:2-93:2

where

wsh2 - wage cost share (or ratio) in Other Business (defined as in the previous section),

wedge2 - tax wedge in Other Business (defined as in the previous section),

w2 - nominal wage rate in Other Business (defined as in the previous section),

q2 - labour productivity (real value added per hour worked) in Other Business,

D811 - dummy variable equal to 1 in 1981:1, otherwise 0,

$wsh2^*$ - estimated (from eq. W.6) long-run value for wsh2,

$\log[wsh2/(wsh2^*)]$ - residual from equation (W.6), D89 - dummy variable equal to 1 begininining in 1989:2, otherwise 0, and other symbols as in the preceding section.

The fit of the long-run equation (W.6) is illustrated in Chart W.11. The equation passes the Dickey-Fuller cointegration test at 5% level (the test statistic being -4.10). The equation indicates that the costs of tax increases are in the long run mainly borne by the employees, the coefficient for the tax wedge being close to 30% (0.29). This might reflect the fact that the position of trade unions in Industry is probably stronger than in other sectors.

The influence of the labour market situation on the wage formation process in Other Business appears to be as weak as in Industry, the long-run wage elasticity with respect to the unemployment rate being only 0.04. On the other hand, according to the equation, the employees are in the long run fully compensated for the labour productivity increases. In accordance with our interpretation of the corresponding result for Industry, this might reflect the fact that productivity increases in Other Business to a much smaller extent than in Industry are due to the rising capital intensity of production. This is corroborated by the trend in the capital/output ratio in Other Business being significantly flatter than in Industry.

The fit of the adjustment equation (W.7), as well as its predictive power, are illustrated in Charts W.7 and W.8. The outside-sample forecasts in Chart W.8 are based on both first and second step regressions performed up to 1990:2.

Upon inspection of Chart W.7, we can note the disturbance in the seasonal pattern of the dependent variable in the 1990-ies as well as the relatively poor fit of the equation in 1991-93. The errors in the latter period become much larger in the outside-sample forecast (cf. Chart W.8).

These errors may be due to data problems, since the latest wage data revision was caused by a definition change introduced in 1991 in connection with the new tax system (whereby the definition of wage benefits was enlarged). However, it is also possible that they are due to the sharp drop in the income tax rate stipulated by the new tax system or - more probably - to the effects of the unique turbulence in the labour market observed during the period.

An alternative equation, with the long-run solution estimated simultaneously with the adjustment process, was estimated in the following form:

Chart W.7 Actual (solid line) and fitted (dashed line) values for the other business wage rate equation estimated for 1971:1-93:2

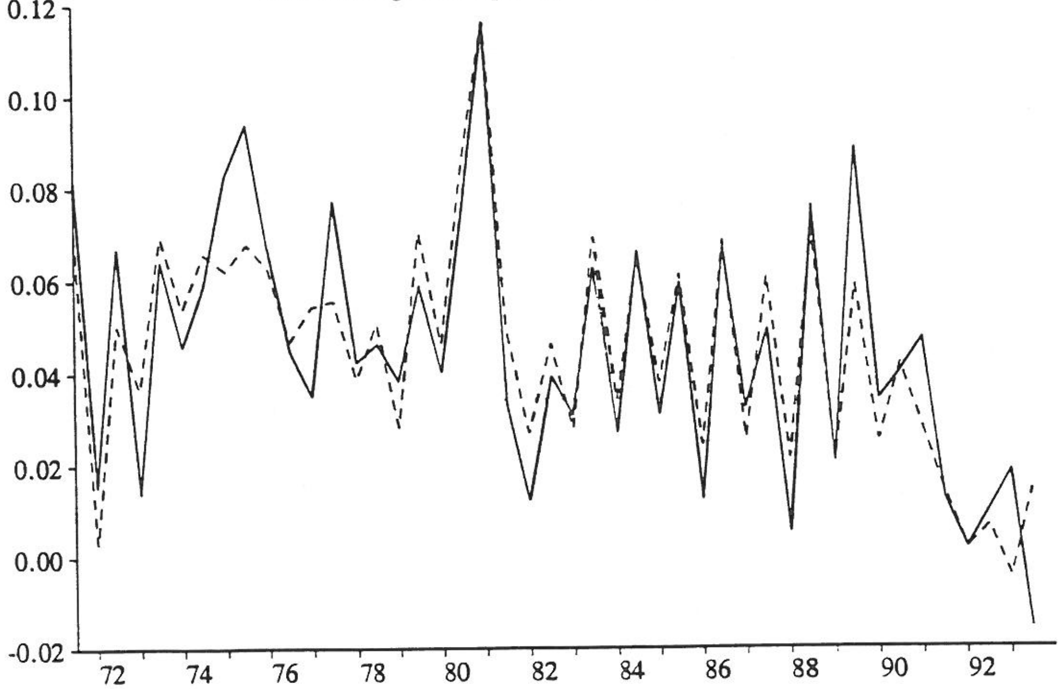
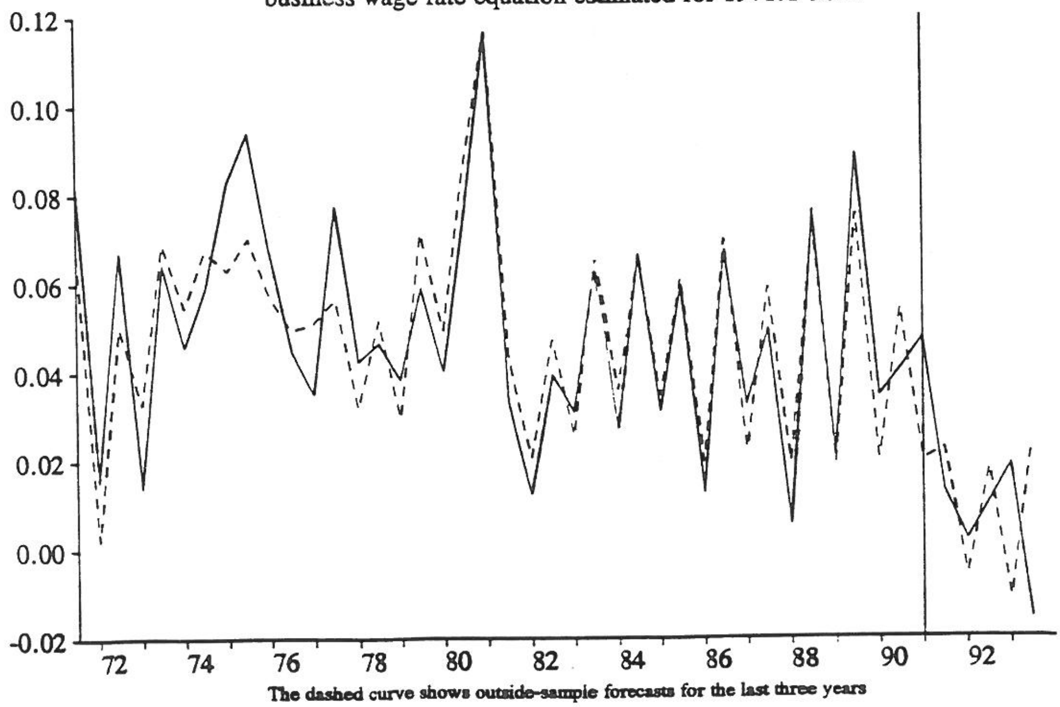


Chart W.8 Actual (solid line) and fitted (dashed line) values for the other business wage rate equation estimated for 1971:1-90:2



The dashed curve shows outside-sample forecasts for the last three years

(W.8)

$$
\begin{aligned}
\text{dlog(w2)} \\
= \ & 0.26304 * \text{infl}^{e} + 0.39228 * \text{dlog(q2)} \\
& (0.92850) \qquad\qquad (3.32869) \\
& - 0.04204 * \text{dlog(u)}_{-2} + 0.07290 * \text{D811} - 0.01458 * \text{d89*SEAS2} \\
& (1.77013) \qquad\qquad (4.87310) \qquad\qquad (1.85216) \\
& - 0.27881 * \log(\text{wsh2})_{-1} + 0.06098 * \log(\text{wedge2})_{-1} \\
& (2.58319) \qquad\qquad (1.28131) \\
& - 0.03128 * \log(\text{u})_{-1} - 0.27924 + 0.03010 * \text{SEAS2} \\
& (2.82260) \qquad\qquad (2.52609) \qquad (6.14796)
\end{aligned}
$$

Sum Sq	0.0067	Std Err	0.0138	LHS Mean	0.0453
R Sq	0.8066	R Bar Sq	0.7569	F 9, 35	16.2232
D.W.(1)	2.0045	D.W.(2)	1.9776	Est. per.	71:2-93:2

The above equation implies the following long-run solution:

log(wsh2) = 0.219 log(wedge2) - 0.112 log(u) + constant.

This equation does not pass the augmented Dickey-Fuller cointegration test, the test statistic being -1.72.

As can be seen in Charts W.9 and W.10, the overall fit and the outside-sample forecasting power of the alternative equation (W.8) appear to be somewhat worse than those of equation (W.7).

WAGE RATE DETERMINATION IN THE LOCAL GOVERNMENT SECTOR

Preliminary regressions indicated that both the local and the central government wage rates are more closely related to the wage rate level in Industry than to that in Other Business. Consequently, the public sector wage rates are here postulated to follow in the long run the wage rate in industry. The long-run wage level in the Local Government sector is, thus, determined by the factors which affect the industry wage. The long-run ratio between these two wage rates is assumed to be constant rather than being modelled here.

As can be seen in Charts W.12 and W.13, the ratio of local government wage rate to that in industry was largely decreasing up to mid-eighties. The charts indicate, furthermore,

Chart W.9 Actual (solid line) and fitted (dashed line) values for the alternative other business wage rate equation estimated for 1971:2-93:2

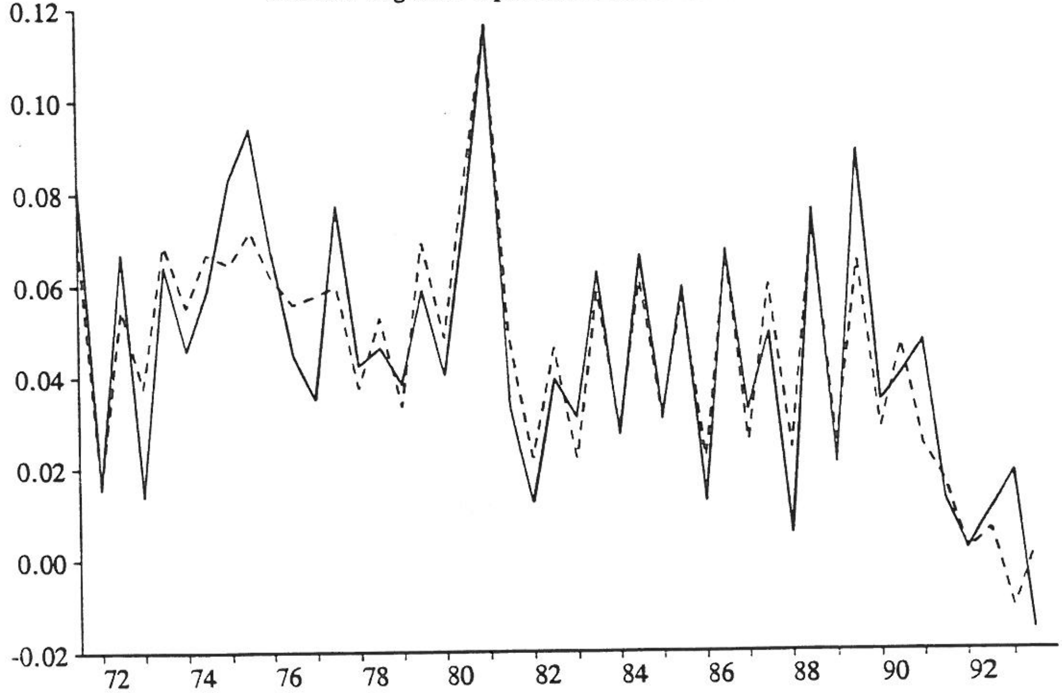
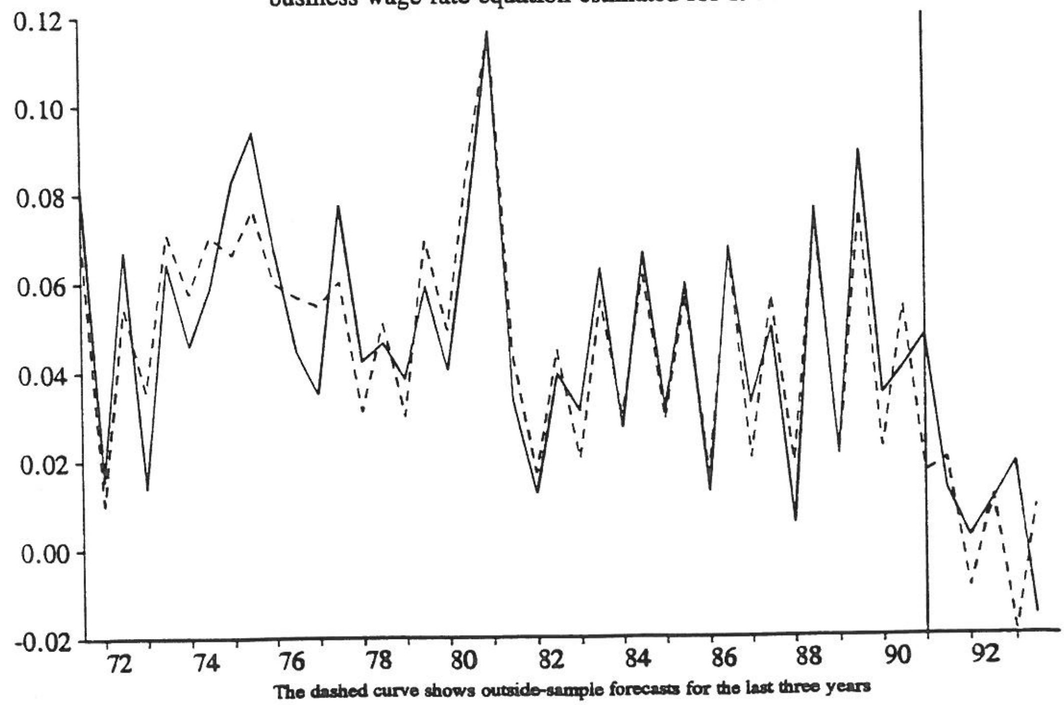
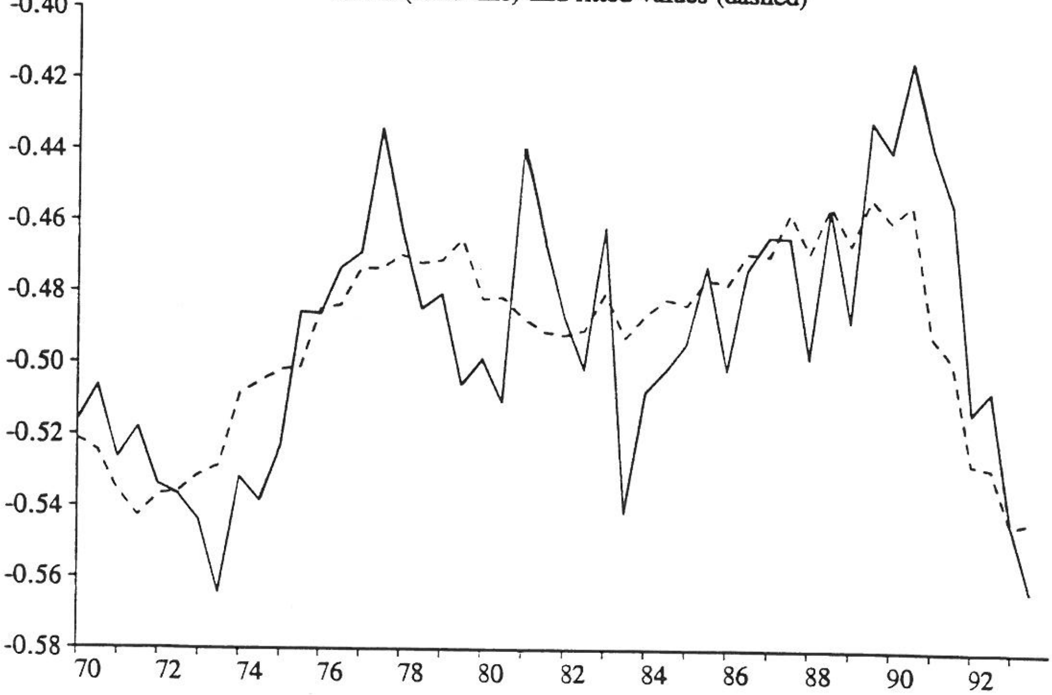


Chart W.10 Actual (solid line) and fitted (dashed line) values for the alternative other business wage rate equation estimated for 1971:2-90:2



The dashed curve shows outside-sample forecasts for the last three years

Chart W.11 Long-run relation for the wage cost share in other business: actual (solid line) and fitted values (dashed)



that the average wage per hour worked in the Local Government sector was in 1970 approximately 15% higher than in Industry.

It should be stressed in this context that our wage rate data for the 1970-ies can be subject to significant errors, due to the way they were constructed. As already mentioned, consistent data series are available only beginning in 1980 and in the case of the cost-wage bill beginning in 1981. The time series were extended backwards to 1970, by splicing the (old) series for the 1970-ies and those for the 1980-ies. This was done by multiplying the series for the 1970-ies by an appropriate constant. Since the wage-bill data and the employment data were spliced separately, their ratio - which constitutes the wage rate - can differ from what would have been obtained if the wage rate series were spliced directly. Another factor, which could have contributed to an underestimation of the industrial wage rate, is the afore mentioned inclusion of the self-employed in hours worked (cf. the section on the wage rate in industry above).

Engle-Granger estimation of the postulated relationship, explaining the local government wage rate by that in industry, gave the following results:

(W.9)

```
log(wlg)

  =     0.93009 * log(wl) + 0.28819       + 0.05869 * SEAS2
       (113.005)             (9.05719)      (5.93774)

Sum Sq         0.0482    Std Err       0.0335    LHS Mean     3.8479
R Sq           0.9967    R Bar Sq      0.9965    F  2, 43    6439.71
D.W.( 1)       0.6343    D.W.( 2)      0.8286    Est. per.  70:1-92:2
```

(W.10)

```
dlog(wlg)

  =  0.55780 * dlog(wl) - 0.29723 * log[wlg/(wlg*)]_-1 - 0.04287
    (5.23621)            (2.94637)                     (6.62659)

  +  0.11942 * SEAS2
    (18.0875)

Sum Sq         0.0199    Std Err       0.0220    LHS Mean     0.0434
R Sq           0.9033    R Bar Sq      0.8963    F  3, 41    127.703
D.W.( 1)       2.3350    D.W.( 2)      1.7535    Est. per.  70:2-92:2
```

where

wlg - nominal wage rate in the Local Government sector,

w1 - nominal wage rate in Industry.

wlg* - estimated (from eq. W.9) long-run value for wlg,

log[wlg/(wlg*)] - residual from equation (W.9),

and other symbols as in the preceding sections.

All the variables were defined analogously to those in the previous sections. The fit of the adjustment equation (W.10), as well as a test of its predictive power, are illustrated in Charts W.14 and W.15. Due to the strong seasonal pattern, the charts show the levels of the wage rate rather than the changes in its logarithm, which are the dependent variable in the equation. The outside-sample forecasts in Chart W.15 are based on both first and second step regressions performed up to 1989:2.

As can be seen, in equation (W.9) the coefficient of the industrial wage rate is smaller than one, implying that the long-run ratio wlg/w1, will decrease as w1 increases. This is illustrated in Chart W.12.

While this behaviour of the ratio is consistent with our (possibly partly erroneous) data for the last two decades, this can hardly be a truly long-run relation. The ratio wlg/w1 may be expected to continue to decrease for, say, another five years but then one would expect it to stabilise at some level. In fact, upon inspection of the chart we can note that the ratio appears to have stabilised in the second part of the 1980-ies. Indeed, when equation (W.9) is reestimated for 1985-92, the coefficient of log(w1) is almost exactly 1. Thus, a restricted long-run relation can be estimated on the data for 1985-92 in the form:

(W.11)

```
log(wlg)-log(w1)

  =  - 0.02737      + 0.05503 * SEAS2
      (5.10577)       (7.47053)

Sum Sq        0.0034    Std Err      0.0152    LHS Mean     0.0018
R Sq          0.7882    R Bar Sq     0.7740    F  1, 15    55.8088
D.W.( 1)      1.5888    D.W.( 2)     1.8322    Est. per.  84:2-92:2
```

The constant (though seasonally variable) long-run wage rate ratio, implied by this equation, is illustrated in Chart W.13. The residuals from the above long-run relation were subsequently used in the estimation of the adjustment equation, according to the

CHART W.12 RATIO OF LOCAL GOVERNMENT WAGE RATE TO THAT IN INDUSTRY.

ACTUAL (SOLID LINE) AND DERIVED FROM LONG-RUN EQUATION (DASHED)

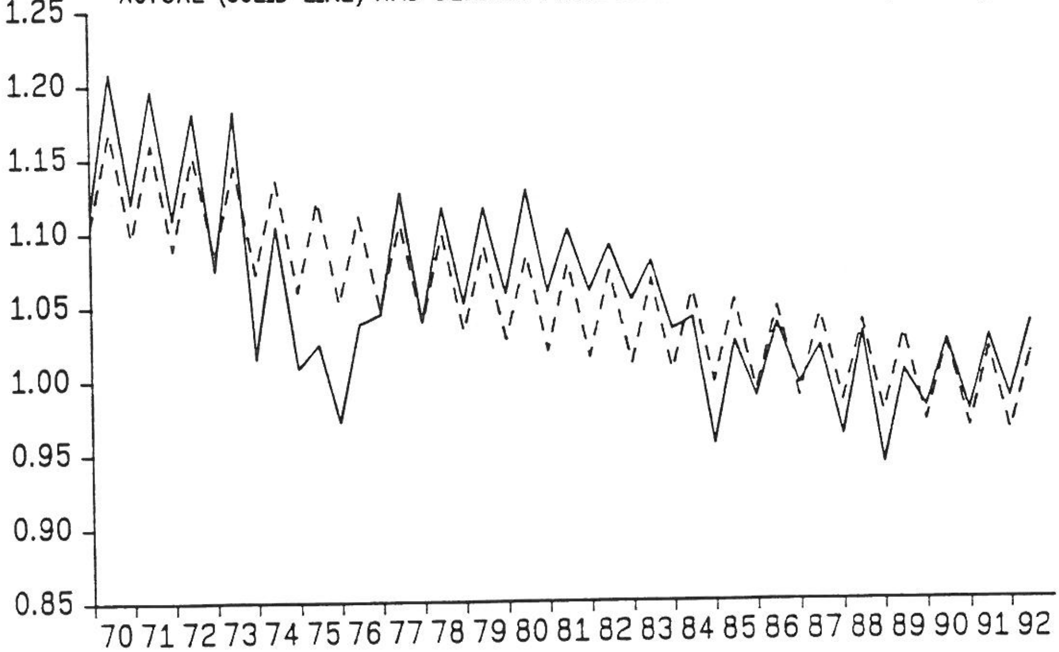
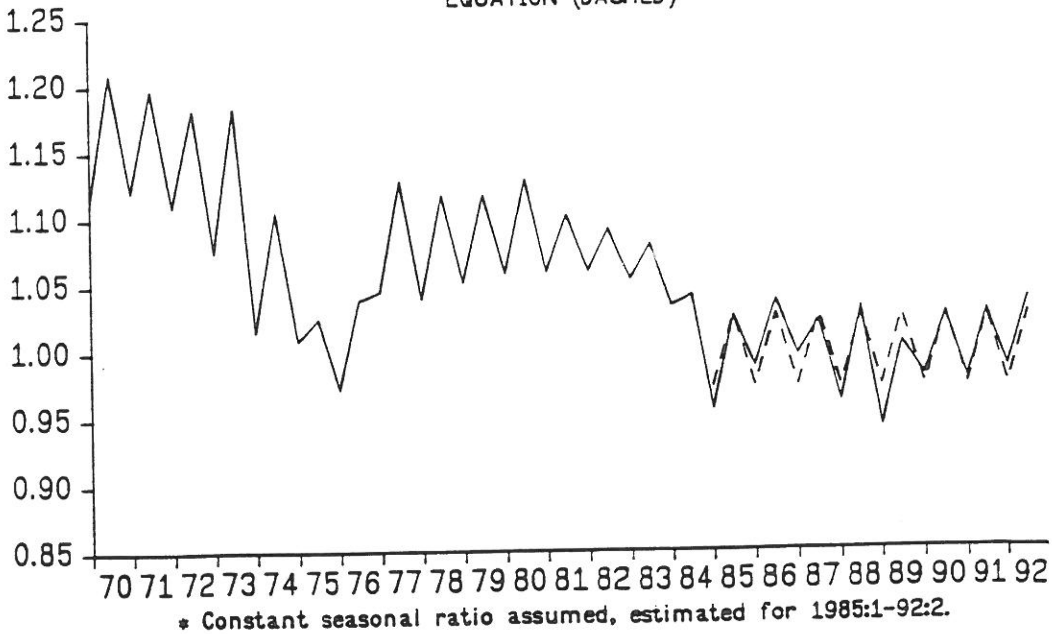


CHART W.13 RATIO OF LOCAL GOVERNMENT WAGE RATE TO THAT IN INDUSTRY.

ACTUAL (SOLID) AND DERIVED FROM PROPORTIONAL* LONG-RUN EQUATION (DASHED)



* Constant seasonal ratio assumed, estimated for 1985:1-92:2.

CHART W.14 LOCAL GOVERNMENT WAGE RATE ESTIMATED FOR 1970:2-92:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)

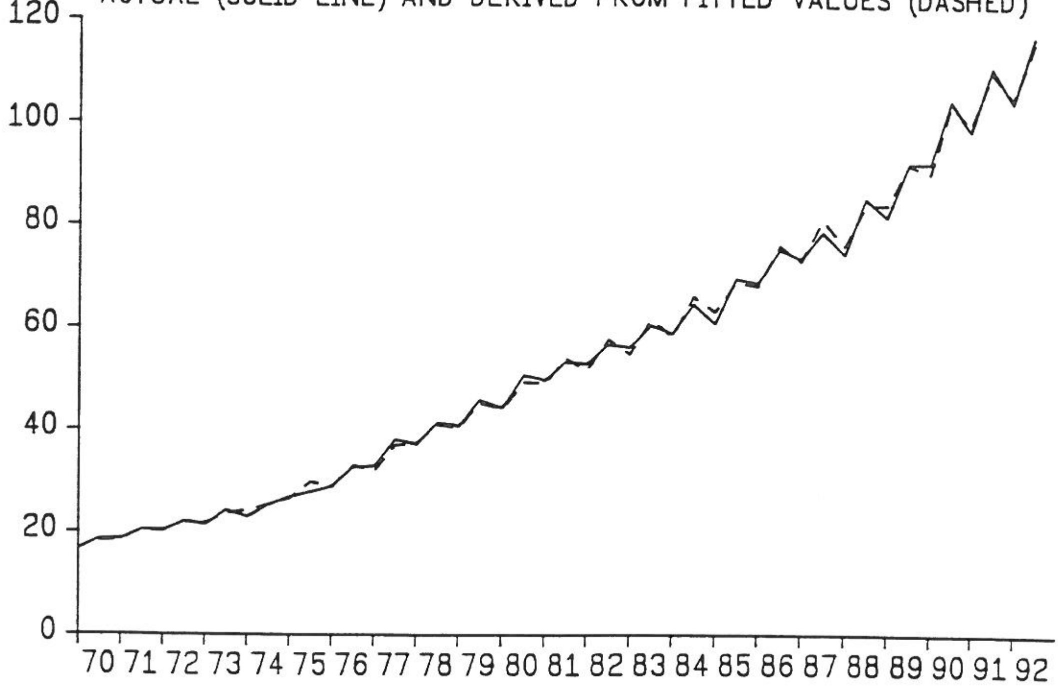
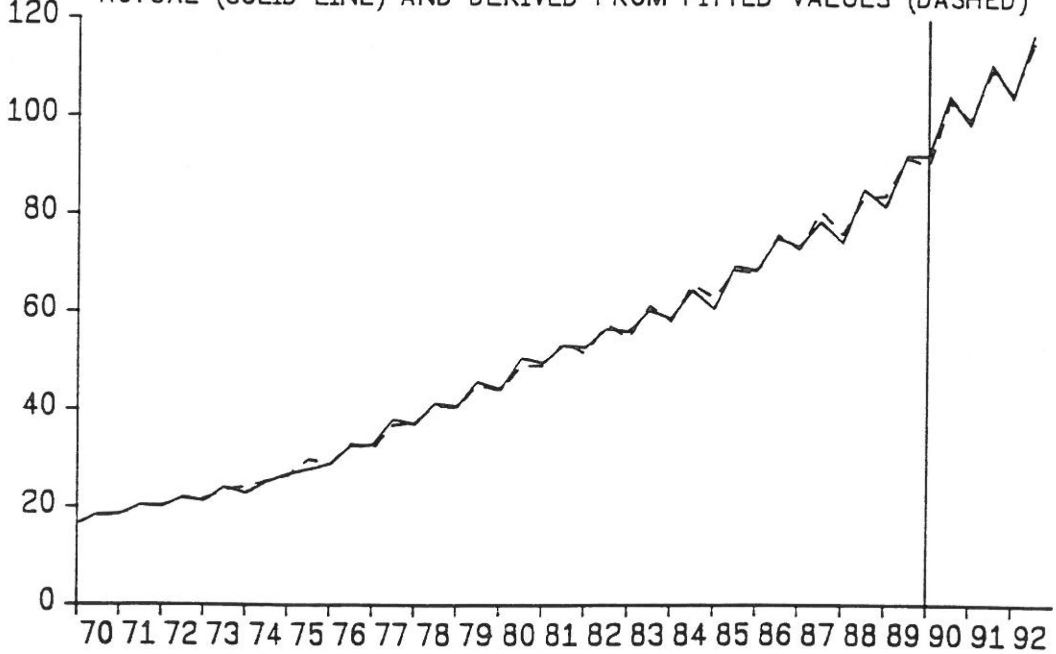


CHART W.15 LOCAL GOVERNMENT WAGE RATE ESTIMATED FOR 1970:2-89:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



Dashed curve shows outside-sample forecasts for the last three years.

Engle-Granger method. Below, we show an alternative equation, where an implicit long-run relation is estimated within the adjustment equation. In fact, the two methods in this case happen to give exactly the same results:

(W.12)

```
dlog(wlg)

=   0.70892 * dlog(w1)  - 0.85680 * log(wlg/w1)_-1  - 0.02695
   (3.17606)              (3.25442)                   (2.81123)

+   0.07446 * SEAS2
   (4.05231)
```

Sum Sq	0.0028	Std Err	0.0152	LHS Mean	0.0371
R Sq	0.9728	R Bar Sq	0.9660	F 3, 12	143.185
D.W.(1)	1.8983	D.W.(2)	2.2502	Est. per.	85:1-92:2

The fit of the equation , as well as a test of its predictive power, are illustrated in Charts W.16 and W.17, which are analogous to W.14 and W.15. It should be noted that the precision of the estimates is affected by the extremely small number of observations. Both equation (W.12) and (W.11) imply an average annual long-run ratio wgl/w1 = 1.

WAGE RATE DETERMINATION IN THE CENTRAL GOVERNMENT SECTOR

Our approach to the determination of the wage rate in the Central Government sector is exactly the same as in the case of Local Government. Engle-Granger estimation of the basic relation gave the following results:

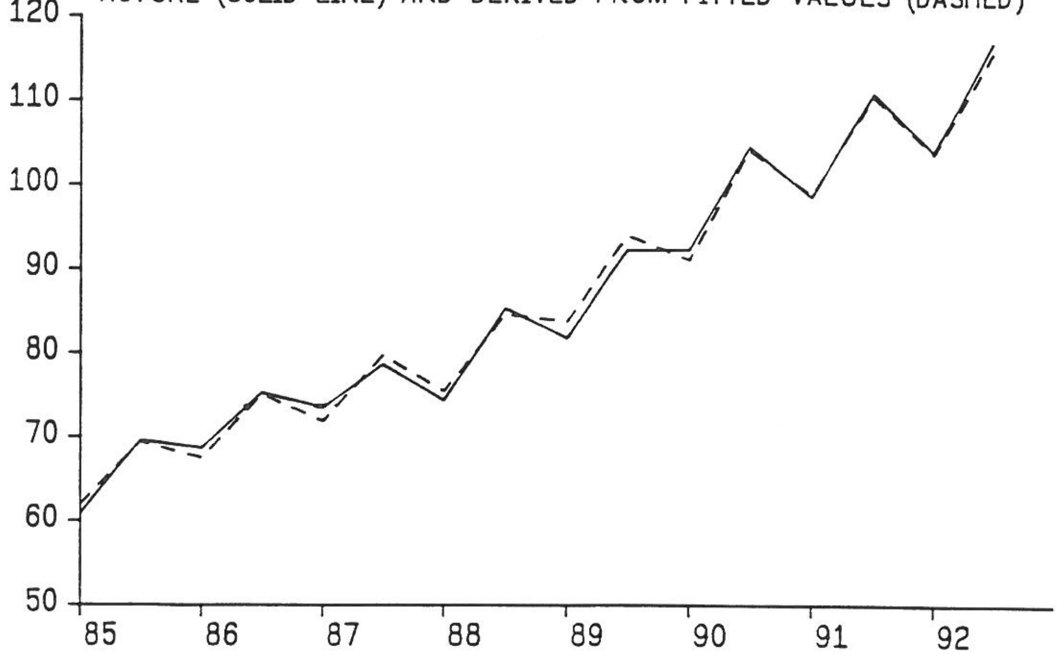
(W.13)

```
log(wcg)

  =    0.90932 * log(w1) + 0.39927      + 0.04824 * SEAS2
      (85.0651)           ( 9.6615)     (3.75776)
```

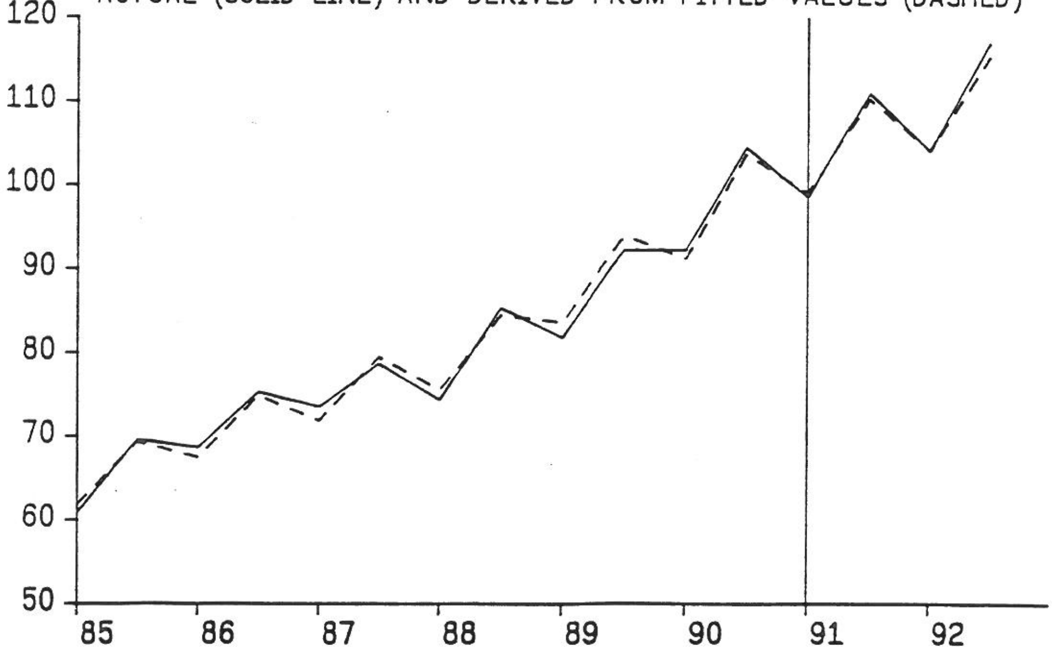
Sum Sq	0.0814	Std Err	0.0435	LHS Mean	3.8749
R Sq	0.9941	R Bar Sq	0.9939	F 2, 43	3643.66
D.W.(1)	1.0776	D.W.(2)	0.5384	Est. per.	70:1-92:2

CHART W.16 LOCAL GOVERNMENT WAGE RATE ESTIMATED FOR 1985:1-92:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



The long-run relation assumes constant seasonal ratio to industry.

CHART W.17 LOCAL GOVERNMENT WAGE RATE ESTIMATED FOR 1985:1-90:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



Dashed curve shows outside-sample forecasts for the last two years.

(W.14)

dlog(wcg)

$$= 0.45160 * \text{dlog(wlg)} - 0.40200 * \log[\text{wcg}/(\text{wcg}^*)]_{-1} - 0.00244$$
$$\quad (3.46216) \qquad\qquad\qquad (4.46136) \qquad\qquad\qquad (0.41444)$$

$$+ 0.04765 * \text{SEAS2}$$
$$\quad (2.70134)$$

Sum Sq	0.0255	Std Err	0.0250	LHS Mean	0.0421
R Sq	0.8418	R Bar Sq	0.8302	F 3, 41	72.7134
D.W.(1)	2.4285	D.W.(2)	0.9524	Est. per.	70:2-92:2

where

wcg - nominal wage rate in the Central Government sector,

wcg* - estimated (from eq. W.13) long-run value for wcg,

log[wcg/(wcg*)] - residual from equation (W.13),

and other symbols as in the preceding sections.

The fit of the adjustment equation (W.14), as well as a test of its predictive power, are illustrated in Charts W.20 and W.21, which are analogous to W.14 and W.15 above.

The central government wage rate appears to follow the wage rate in Industry less closely than the local government rate does, although in fact neither the long-run equation (W.13) nor the corresponding equation for the local government wage rate (W.9) pass the augmented Dickey-Fuller cointegration test (the test statistic values being -2.11 and -2.47, respectively). Furthermore, variation in the local government wage rate proved to be important for the explanation of the short-run changes in the central government rate; dlog(w1) was completely insignificant in this context.

As in the case of the local government, the coefficient of the industrial wage rate in equation (W.13) is smaller than 1, implying that the long-run ratio wcg/w1, will decrease as w1 increases. This is illustrated in Chart W.18.

It should be reiterated, that our data for the 1970-ies can be impaired by measurement errors (cf the section on local government wage rate above). On the other hand, we can note that the ratio wcg/w1 does not exhibit any trend in the 1980-ies. In fact, when the long-run equation (W.13) is reestimated for 1983-92, the coefficient for log(w1) is almost exactly one. A restricted long-run equation can then be estimated, analogously to

CHART W.18 RATIO OF CENTRAL GOVERNMENT WAGE RATE TO THAT IN INDUSTRY.

ACTUAL (SOLID LINE) AND DERIVED FROM LONG-RUN EQUATION (DASHED)

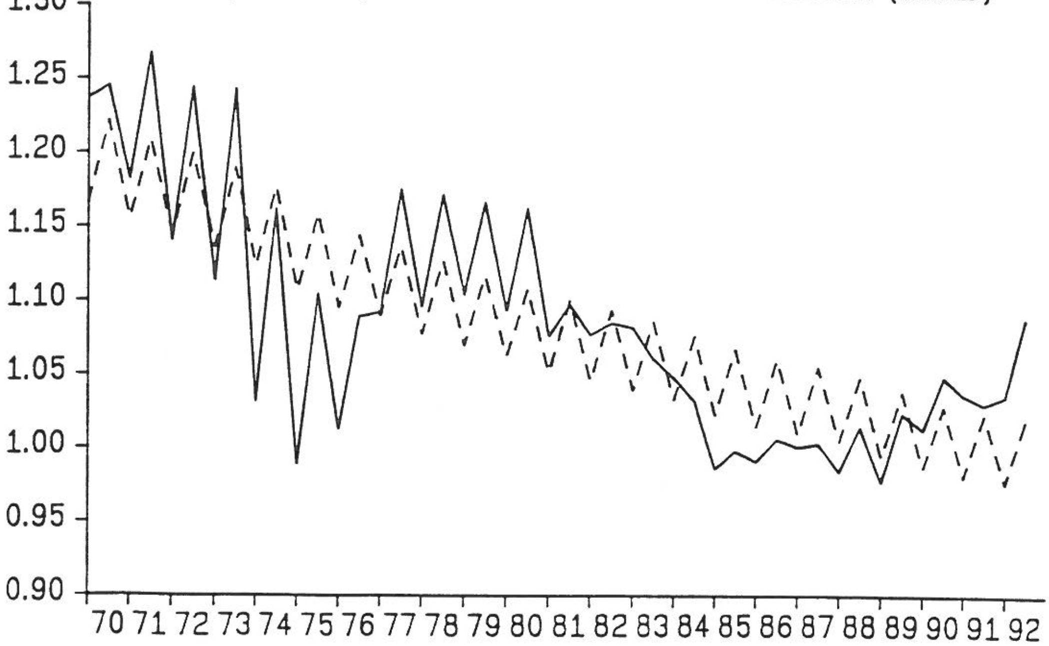
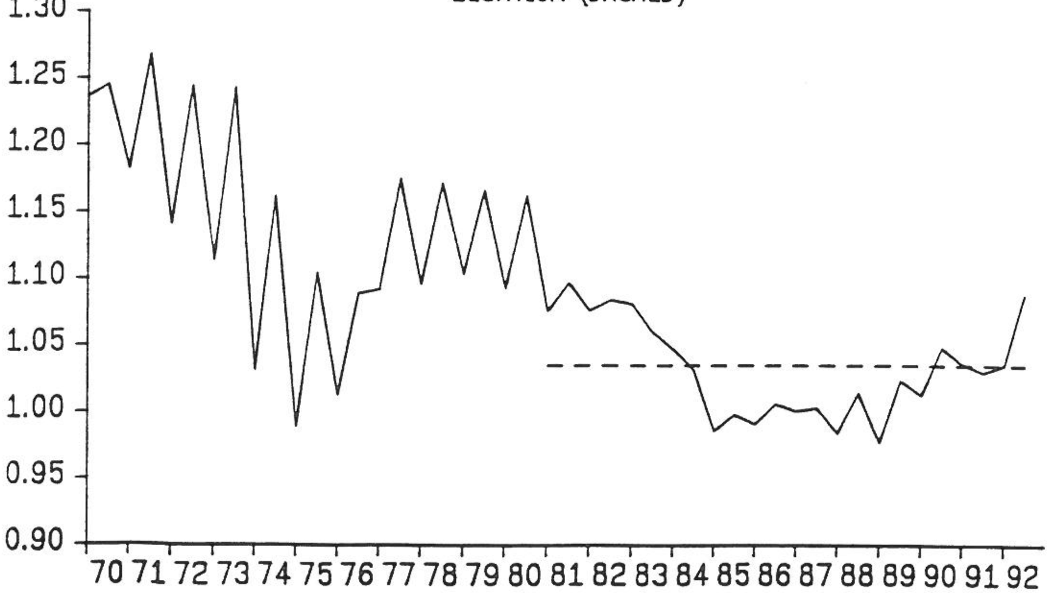


CHART W.19 RATIO OF CENTRAL GOVERNMENT WAGE RATE TO THAT IN INDUSTRY.

ACTUAL (SOLID) AND DERIVED FROM PROPORTIONAL* LONG-RUN EQUATION (DASHED)



* Constant ratio assumed, estimated for 1981:1-92:2.

CHART W.20 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1970:2-92:
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)

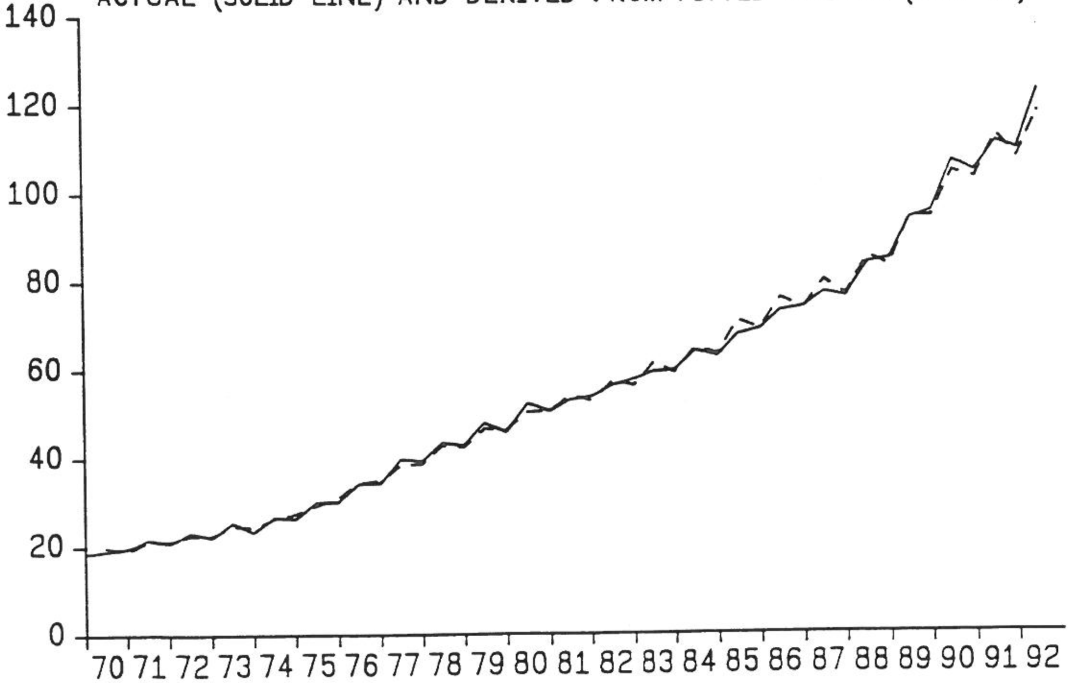
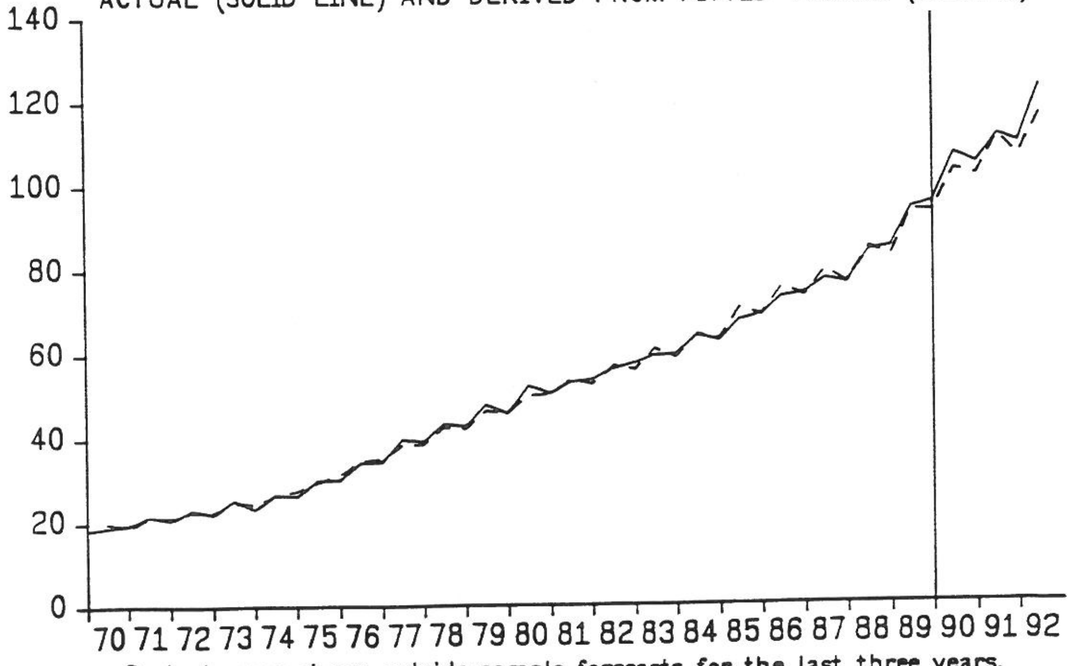


CHART W.21 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1970:2-89
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



Dashed curve shows outside-sample forecasts for the last three years.

(W.11). The restricted long-run equation does not pass the augmented Dickey-Fuller test (the test value being -1.4).

Estimation of a short-run equation, with an implicit long-run relation estimated simultaneously, gave the following results:

(W.15)

```
dlog(wcg)

=0.53768*dlog(wlg) - 0.18306 * log(wcg/w1)_-1 + 0.02324
(11.5870)            (2.29295)                   (4.87444)
```

Sum Sq	0.0050	Std Err	0.0154	LHS Mean	0.0356
R Sq	0.8890	R Bar Sq	0.8785	F 2, 21	84.1309
D.W.(1)	1.8733	D.W.(2)	1.8846	Est. per.	81:1-92:2

The fit of the equation, as well as a test of its predictive power, are illustrated in Charts W.22 and W.23. A somewhat longer estimation period, 1981-92, was chosen for the equation, since it resulted in a slightly higher long-run wage ratio wcg/w1. The long-run solution to equation (W.15) is depicted in Chart W.19. The long-run wage ratio, implied by the equation, is 1.03. When the estimation period is limited to 1983-92, this level goes down to 1.01, which upon inspection of the chart appears to be slightly too low.

Inspection of Charts W.22 and W.23 reveals that equation (W.15) tends to underestimate the second half of 1992. As can be seen in Chart W.24, this is not the case when equation (W.15) is estimated for the entire sample period 1970-92. The latter equation, shown below as (W.16), was - however - not chosen as the preferred equation, since it appears that the small residual in 1992:2 is due to the excessive seasonal pattern in the 1980-ies.

Estimation of equation (W.15) for the entire sample period gave the following results:

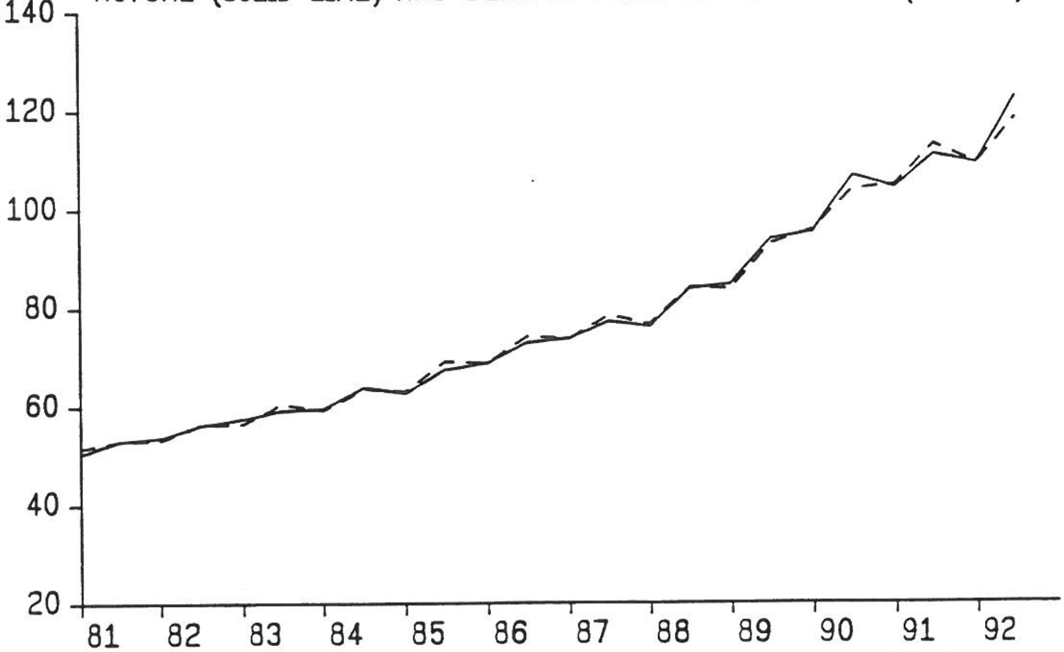
(W.16)

```
dlog(wcg)

=0.71544*dlog(wlg) - 0.19034 * log(wcg/w1)_-1 + 0.02611
(11.0746)            (3.18012)                   (3.54799)
```

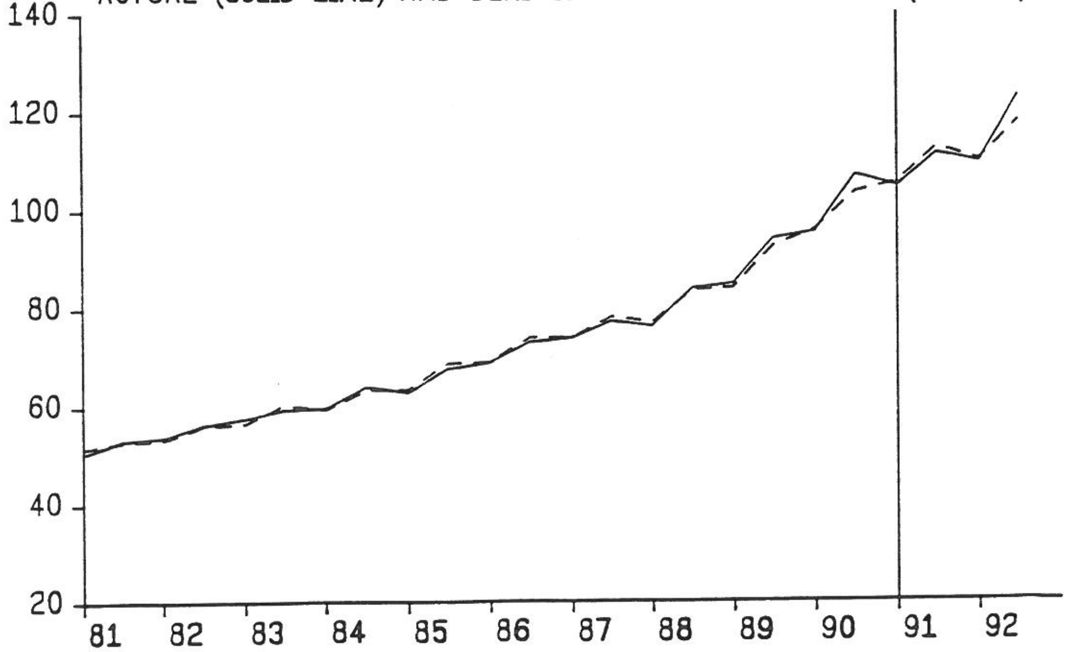
Sum Sq	0.0344	Std Err	0.0286	LHS Mean	0.0421
R Sq	0.7872	R Bar Sq	0.7770	F 2, 42	77.6644
D.W.(1)	3.0027	D.W.(2)	0.7716	Est. per.	70:2-92:2

CHART W.22 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1981:1-92:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



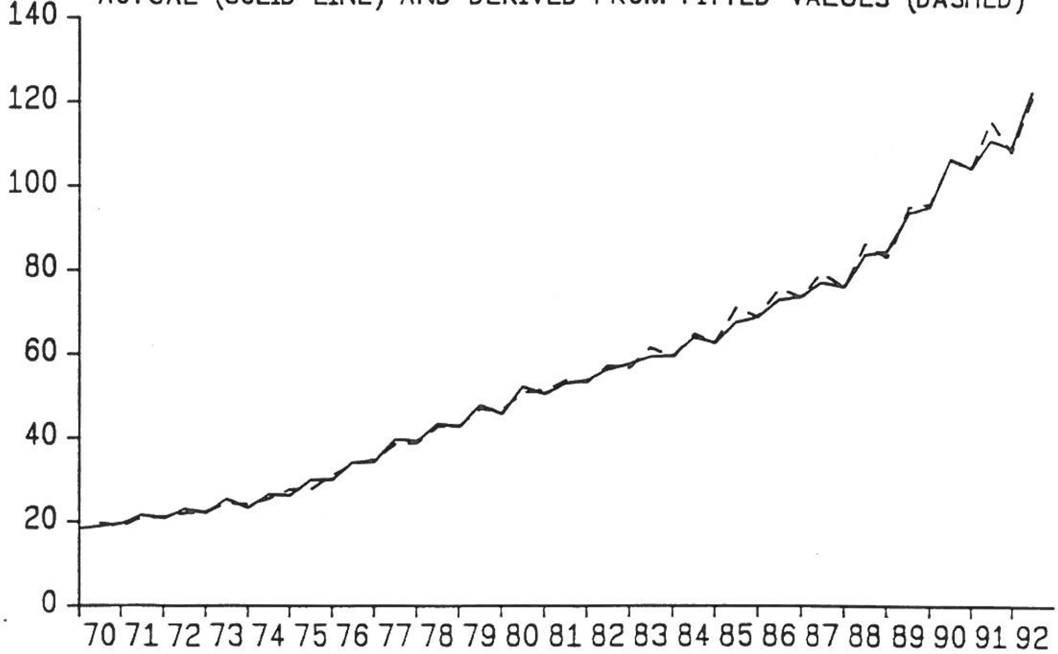
The long-run relation assumes constant wage ratio government/industry.

CHART W.23 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1981:1-89:
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



Dashed curve shows outside-sample forecasts for the last three years.

CHART W.24 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1970:1-92:2
ACTUAL (SOLID LINE) AND DERIVED FROM FITTED VALUES (DASHED)



The long-run relation assumes constant wage ratio government/industry.

Literature

Bruno, M. and J. Sachs (1985), *The Economics of World Stagflation*, Cambridge,MA: Cambridge University Press.

Charemza, W. and D. Deadman (1992), *New Directions in Econometric Practice*, Aldershot: Edward Elgar Publ.

Forslund, A. and O. Risager (1994), *Wages in Sweden: New and Old Results*, Memo 1994-22, Aarhus: Department of Economics, University of Aarhus, Denmark.

Engle R. and C. Granger (1987), "Co-integration and error correction: representation, estimation and testing", *Econometrica* 55, pp. 251-276.

Markowski, A. and L. Ernsäter (1994), *The supply side in the econometric model KOSMOS*, Working Paper No.37, Stockholm: National Institute of Economic Research, January.

LÖNEEKVATIONER

SVENSK SAMMANFATTNING

Löneekvationer för Industri och Övrigt näringsliv utgår från en generell löneförhandlingsmodell. Arbetstagares målfunktion är där uttryckt i termer av konsument-reallön (d.v.s. timlön efter skatt deflaterad med konsumentprisindex) medan arbetsgivare är inriktade på producent-reallön (d.v.s. lönekostnad per timma inkl. arbetsgivaravgifter deflaterad med producentpris). Den skattade modellen förklarar producent-reallön som en funktion av produktivitetsutveckling, arbetsmarknadsläge (arbetslöshet) samt relationen mellan konsument-reallön och producent-reallön. Resultaten för Industri indikerar att arbetstagare inte får full kompensation för produktivitetsökningar, men att de kompenseras för största delen av skatteökningar. Resultaten för Övrigt näringsliv tyder på det omvända förhållandet: full kompensation för produktivitetsökningar men mycket begränsad sådan för skatteökningar.

Titles in the Working Paper Series

Number	Author	Title	Date
1	Warne, Anders and Anders Vredin	Current Account and Business Cycles: Stylized Facts for Sweden	12/89
2	Östblom, Göran	Change in Technical Structure of the Swedish Economy	12/89
3	Söderlind, Paul	Mamtax. A Dynamic CGE Model for Tax Reform Simulations	12/89
4	Kanis, Alfred and Aleksander Markowski	The Supply Side of the Econometric Model of the NIER	11/90
5	Berg, Lennart	The Financial Sector in the SNEPQ Model	2/91
6	Ågren, Anders and Bo Jonsson	Consumer Attitudes, Buying Intentions and Consumption Expenditures. An Analysis of the Swedish Household Survey Data	4/91
7	Berg, Lennart and Reinhold Bergström	A Quarterly Consumption Function for Sweden 1979-1989	10/91
8	Öller, Lars-Erik	Good Business Cycle Forecasts - A Must for Stabilization Policies	2/92
9	Jonsson, Bo and Anders Ågren	Forecasting Car Expenditures Using Household Survey Data	2/92
10	Löfgren, Karl-Gustaf, Bo Ranneby and Sara Sjöstedt	Forecasting the Business Cycle Not Using Minimum Autocorrelation Factors	2/92
11	Gerlach, Stefan	Current Quarter Forecasts of Swedish GNP Using Monthly Variables	2/92
12	Bergström, Reinhold	The Relationship Between Manufacturing Production and Different Business Survey Series in Sweden	2/92
13	Edlund, Per-Olov and Sune Karlsson	Forecasting the Swedish Unemployment Rate: VAR vs. Transfer Function Modelling	3/92
14	Rahiala, Markku and Timo Teräsvirta	Business Survey Data in Forecasting the Output of Swedish and Finnish Metal and Engineering Industries: A Kalman Filter Approach	3/92

15	Christoffersson, Anders, Roland Roberts and Ulla Eriksson	The Relationship Between Manufacturing and Various BTS Series in Sweden Illuminated by Frequency and Complex Demodulate Methods	4/92
16	Jonsson, Bo	Sample Based Proportions as Values on an Independent Variable in a Regression Model	10/92
17	Öller, Lars-Erik	Eliciting Turning Point Warnings From Business Surveys	11/92
18	Forster, Margaret M.	Volatility, Trading Mechanisms and International Cross-Listing	12/92
19	Jonsson, Bo	Prediction With a Linear Regression Model and Errors in a Regressor	12/92
20	Gorton, Gary and Richard Rosen	Corporate Control, Portfolio Choice, and the Decline of Banking	1/93
21	Gustafsson, Claes-Håkan and Åke Holmén	The Index of Industrial Production - A Formal Description of the Process Behind It	2/93
22	Karlsson, Tohmas	A General Equilibrium Analysis of the Swedish Tax Reforms 1989-1991	2/93
23	Jonsson, Bo	Forecasting Car Expenditures Using Household Survey Data - A Comparison of Different Predictors	2/93
24	Gennotte, Gerard and Hayne Leland	Low Margins, Derivative Securities, and Volatility	2/93
25	Boot, Arnoud W.A. and Stuart I. Greenbaum	Discretion in the Regulation of U.S. Banking	4/93
26	Spiegel, Matthew and Deane J. Seppi	Does Round-the-Clock Trading Result in Pareto Improvements?	4/93
27	Seppi, Deane J.	How Important are Block Trades in the Price Discovery Process?	4/93
28	Glosten, Lawrence R	Equilibrium in an Electronic Open Limit Order Book	4/93
29	Boot, Arnoud W.A., Stuart I. Greenbaum and Anjan V. Thakor	Reputation and Discretion in Financial Contracting	4/93
30a	Bergström, Reinhold	The Full Tricotomous Scale Compared with Net Balances in Qualitative Business Survey Data - Experiences from the Swedish Business Tendency Surveys	5/93

30b	Bergström, Reinhold	Quantitative Production Series Compared with Qualitative Business Survey Series for Five Sectors of the Swedish Manufacturing Industry	5/93
31	Lin, Chien-Fu Jeff and Timo Teräsvirta	Testing the Constancy of Regression Parameters Against Continuous Change	5/93
32	Markowski, Aleksander and Parameswar Nandakumar	A Long-Run Equilibrium Model for Sweden. The Theory Behind the Long-Run Solution to the Econometric Model KOSMOS	9/93
33	Markowski, Aleksander and Tony Persson	Capital Rental Cost and the Adjustment for the Effects of the Investment Fund System in the Econometric Model KOSMOS	9/93
34	Kanis, Alfred and Bharat Barot	On Determinants on Private Consumption in Sweden	10/93
35	Kääntä, Pekka and Christer Tallbom	Using Business Survey Data for Forecasting Swedish Quantitative Business Cycle Variables. A Kalman Filter Approach	11/93
36	Ohlsson, Henry and Anders Vredin	Political Cycles and Cyclical Policies. A new test approach using fiscal forecasts	11/93
37	Markowski, Alexander and Lars Ernsäter	The Supply Side in the Econometric Model Kosmos	1/94
38	Gustafsson, Claes-Håkan	On the Consistency of Data on Production, Deliveries, and Inventories in the Swedish Manufacturing Industry	8/94
39	Rahiala, Markku and Tapani Kovalainen	Modelling Wages Subject to Both Contracted Increments and Drift by Means of a Simultaneous-Equations Model With Non-Standard Error Structure	8/94
40	Öller, Lars-Erik and Christer Tallbom	Hybrid Indicators for the Swedish Economy Based on Noisy Statistical Data and the Business Tendency Survey	10/94
41	Östblom, Göran	A Converging Triangularization Algorithm and the Intertemporal Similarity of Production Structures	10/94
42a	Markowski, Aleksander	Labour Suply, Hours Worked and Unemployment in the Econometric Model Kosmos	10/94
42b	Markowski, Aleksander	Wage Rate Determination in the Econometric Model Kosmos	10/94

43	Ahlroth, Sofia, Anders Björklund and Anders Forslund	The Output of the Swedish Education Sector	12/94
44a	Markowski, Aleksander	Private Consumption Expenditure in the Econometric Model Kosmos	12/94
44b	Markowski, Aleksander	The Input-Output Core: Determination of Inventory Investment and Other Business Output in the Econometric Model Kosmos	12/94
45	Bergström, Reinhold	The Accuracy of the Swedish National Budget Forecasts 1955-92	3/95