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.

WAGE RATE DETERMINATION IN THE
ECONOMETRIC MODEL KOSMOS

ALEKSANDER MARKOWSKI
WAGE RATE DETERMINATION IN THE ECONOMETRIC MODEL KOSMOS

by

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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) \[ \frac{w(1+s)}{p} = f\{u, q, (1+s)p_e/[(1-t)p]\}, \]

where
- \( w \) - nominal wage rate,
- \( s \) - payroll tax rate,
- \( p \) - producer price,
- \( q \) - labour productivity level,
- \( p_e \) - consumer price,
\[ t \text{ - income tax rate,} \]
\[ \frac{w(1+s)}{p} \text{ - producer real wage,} \]
\[ \frac{w(1-t)}{p_e} \text{ - consumer real wage,} \]
\[ \frac{(1+s)p_e}{[(1-t)p]} \text{ - tax wedge.} \]

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 (kostnadsloönesumma) is the wage bill adjusted for retroactive payments (caused by draw-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 anecdotal 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)

$$\log(wr1)$$

$$= 0.81564 \times \log(wedge1) - 0.03993 \times \log(u) + 0.50013 \times \log(q1)$$

(9.03280)

$$- 0.08332 \times D8390 + 1.66819$$

(7.36844)

(7.94210)

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)

$$d\log(w1)$$

$$= -0.59096 \times d\log(w1)_{-1} + 1.54675 \times \text{infl}^e$$

(4.80888)

$$+ 0.39514 \times \text{prof}_{-2} - 0.40339 \times d\log(1 - t) - 0.04059 \times D831$$

(4.14736)

$$- 0.39253 \times \log[wr1/(wr1^*)]_{-1} + 0.00741 \times \text{SEAS}2$$

(2.29388)

(1.25140)

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,

$$\text{infl}^e = 0.3 \times d\log(pc) + 0.7 \times \text{infl}^e_{-1}$$

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,
dlog(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

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

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

\[(W.4)\]

\[
\log(wsh1) = 0.18427 \times \log(wedge1) - 0.05149 \times \log(u) - 0.09910 \times D8390 - 0.5477
\]

\[
(2.77728)(2.59580)(5.73593)(5.496)
\]

| 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 |

\[(W.5)\]

\[
d\log(w1) = -0.67292 \times d\log(w1)_{-1} + 1.62731 \times \text{infl}_e
\]

\[
(6.86111)(12.0197)
\]

\[
+ 0.37100 \times \text{prof}_{-2} - 0.36097 \times d\log(1 - t) - 0.03054 \times D831
\]

\[
(4.09919)(2.18703)(1.52797)
\]

\[- 0.29090 \times \log[wsh1/(wsh1^*)]_{-1} + 0.00836 \times \text{SEAS2}
\]

\[
(3.26108)(1.50517)
\]

| 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)

\[
\log(\text{wsh2}) = 0.29199 \times \log(\text{wedge2}) - 0.04276 \times \log(u) - 0.84759 + 0.00838 \times \text{SEAS2}
\]

\[
\begin{align*}
\text{Sum Sq} & \quad 0.0268 & \text{Std Err} & \quad 0.0247 & \text{LHS Mean} & \quad -0.4926 \\
\text{R Sq} & \quad 0.5639 & \text{R Bar Sq} & \quad 0.5342 & \text{F} & \quad 3, 44 & 18.9658 \\
D.W.(1) & \quad 1.0991 & D.W.(2) & \quad 1.3161 & \text{Est. per.} & \quad 70:1-93:2
\end{align*}
\]

(W.7)

\[
d\log(\text{w2}) = 0.53184 \times \text{infl}^e + 0.46369 \times d\log(q2) - 0.07452 \times d\log(u)_{-2} + 0.07334 \times D811 - 0.23079 \times \log[\text{wsh2}/(\text{wsh2}^*)]_{-1} - 0.01421 \times D89*\text{SEAS2} + 0.00283
\]

\[
\begin{align*}
\text{Sum Sq} & \quad 0.0077 & \text{Std Err} & \quad 0.0144 & \text{LHS Mean} & \quad 0.0453 \\
\text{R Sq} & \quad 0.7765 & \text{R Bar Sq} & \quad 0.7342 & \text{F} & \quad 7, 37 & 18.3587 \\
D.W.(1) & \quad 1.7912 & D.W.(2) & \quad 1.7983 & \text{Est. per.} & \quad 71:2-93:2
\end{align*}
\]

where

- \text{wsh2} - wage cost share (or ratio) in Other Business (defined as in the previous section),
- \text{wedge2} - tax wedge in Other Business (defined as in the previous section),
- \text{w2} - nominal wage rate in Other Business (defined as in the previous section),
- \text{q2} - labour productivity (real value added per hour worked) in Other Business,
- \text{D811} - dummy variable equal to 1 in 1981:1, otherwise 0,
- \text{wsh2*} - estimated (from eq. W.6) long-run value for \text{wsh2},
- \log[\text{wsh2}/(\text{wsh2}^*)] - residual from equation (W.6),
D89 - dummy variable equal to 1 beginning 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

The dashed curve shows outside-sample forecasts for the last three years.
(W.8)

d\log(w2)
\begin{align*}
&= 0.26304 \times \text{infl}e + 0.39228 \times d\log(q2) \\
&\quad - 0.04204 \times d\log(u)_{-2} + 0.07290 \times D811 - 0.01458 \times d89*SEAS2 \\
&\quad - 0.27881 \times \log(wsh2)_{-1} + 0.06098 \times \log(wedge2)_{-1} \\
&\quad - 0.03128 \times \log(u)_{-1} - 0.27924 + 0.03010 \times SEAS2
\end{align*}

\begin{align*}
\text{Sum Sq} &\quad 0.0067 & \text{Std Err} &\quad 0.0138 & \text{LHS Mean} &\quad 0.0453 \\
\text{R Sq} &\quad 0.8066 & \text{R Bar Sq} &\quad 0.7569 & \text{F} &\quad 9, 35 & 16.2232 \\
\text{D.W. (1)} &\quad 2.0045 & \text{D.W. (2)} &\quad 1.9776 & \text{Est. per.} &\quad 71:2-93:2
\end{align*}

The above equation implies the following long-run solution:

\[ \log(wsh2) = 0.219 \log(wedge2) - 0.112 \log(u) + \text{constant}. \]

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

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 aforementioned 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)
\[
\log(w_{lg}) = 0.9309 \times \log(w_{l}) + 0.2882 + 0.05869 \times SEAS2
\]

(W.10)
\[
d\log(w_{lg}) = 0.55780 \times d\log(w_{l}) - 0.29723 \times \log[w_{lg}/(w_{lg}^*)]_{-1} - 0.04287 + 0.11942 \times SEAS2
\]
where

\( \text{wig} \) - nominal wage rate in the Local Government sector,
\( \text{w1} \) - nominal wage rate in Industry.
\( \text{wig}^* \) - estimated (from eq. W.9) long-run value for wig,
\( \log[\text{wig}/(\text{wig}^*)] \) - 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 \( \text{wig}/\text{w1} \), will decrease as \( \text{w1} \) 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 \( \text{wig}/\text{w1} \)
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 \( \log(\text{w1}) \) is almost exactly 1.
Thus, a restricted long-run relation can be estimated on the data for 1985-92 in the
form:

(W.11)

\[
\log(\text{wig}) - \log(\text{w1}) = -0.02737 + 0.05503 \times \text{SEAS2} \\
(5.10577) \quad (7.47053)
\]

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<th>Sum Sq</th>
<th>Std Err</th>
<th>LHS Mean</th>
<th>R Sq</th>
<th>R Bar Sq</th>
<th>F 1, 15</th>
<th>Est. per. 84:2-92:2</th>
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</tr>
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</table>

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)

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)

\[
\begin{align*}
\text{dlog}(\text{wlg}) &= 0.70892 \times \text{dlog}(\text{w1}) - 0.85680 \times \log(\text{wlg}/\text{w1})_{-1} - 0.02695 \\
(3.17606) & \quad (3.25442) & \quad (2.81123) \\
+ & 0.07446 \times \text{SEAS2} \\
(4.05231)
\end{align*}
\]

\[
\begin{array}{c|c|c|c|c}
\text{Sum Sq} & 0.0028 & \text{Std Err} & 0.0152 & \text{LHS Mean} & 0.0371 \\
\text{R Sq} & 0.9728 & \text{R Bar Sq} & 0.9660 & \text{F} & 3, 12 & 143.185 \\
\text{D.W.(1)} & 1.8983 & \text{D.W.(2)} & 2.2502 & \text{Est. per.} & 85:1-92:2 \\
\end{array}
\]

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)

\[
\begin{align*}
\text{log}(\text{wcg}) &= 0.90932 \times \log(\text{w1}) + 0.39927 + 0.04824 \times \text{SEAS2} \\
(85.0651) & \quad (9.6615) & \quad (3.75776)
\end{align*}
\]

\[
\begin{array}{c|c|c|c|c|c}
\text{Sum Sq} & 0.0814 & \text{Std Err} & 0.0435 & \text{LHS Mean} & 3.8749 \\
\text{R Sq} & 0.9941 & \text{R Bar Sq} & 0.9939 & \text{F} & 2, 43 & 3643.66 \\
\text{D.W.(1)} & 1.0776 & \text{D.W.(2)} & 0.5384 & \text{Est. per.} & 70:1-92:2 \\
\end{array}
\]
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.
\[(W.14)\]
\[
d\log(wcg) = 0.45160 \times d\log(wlg) - 0.40200 \times \log[\frac{wcg}{(wcg^*)}] - 0.00244 \\
\quad (3.46216) \quad (4.46136) \quad (0.41444)
\]
\[+ 0.04765 \times SEAS2 \quad (2.70134)\]

where

\[wcg\quad \text{nominal wage rate in the Central Government sector,}\]

\[wcg^*\quad \text{estimated (from eq. W.13) long-run value for wcg,}\]

\[\log[\frac{wcg}{(wcg^*)}]\quad \text{residual from equation (W.13),}\]

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; \(d\log(wl)\) 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 \(wcg/wl\), will decrease as \(wl\) 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 \(wcg/wl\) 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 \(\log(wl)\) 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)

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)

\[ \text{dlog}(\text{wcg}) = 0.53768 \times \text{dlog}(\text{wlg}) - 0.18306 \times \log(\text{wcg}/\text{w1})_{-1} + 0.02324 \]

\[
\begin{array}{lcccc}
\text{Sum Sq} & 0.0050 & \text{Std Err} & 0.0154 & \text{LHS Mean} & 0.0356 \\
\text{R Sq} & 0.8890 & \text{R Bar Sq} & 0.8785 & F & 2, 21 & 84.1309 \\
\text{D.W.}(1) & 1.8733 & \text{D.W.}(2) & 1.8846 & \text{Est. per.} & 81:1-92:2 \\
\end{array}
\]

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)

\[ \text{dlog}(\text{wcg}) = 0.71544 \times \text{dlog}(\text{wlg}) - 0.19034 \times \log(\text{wcg}/\text{w1})_{-1} + 0.02611 \]

\[
\begin{array}{lcccc}
\text{Sum Sq} & 0.0344 & \text{Std Err} & 0.0286 & \text{LHS Mean} & 0.0421 \\
\text{R Sq} & 0.7872 & \text{R Bar Sq} & 0.7770 & F & 2, 42 & 77.6644 \\
\text{D.W.}(1) & 3.0027 & \text{D.W.}(2) & 0.7716 & \text{Est. per.} & 70:2-92:2 \\
\end{array}
\]
CHART W.22 CENTRAL GOVERNMENT WAGE RATE ESTIMATED FOR 1981:1–92:II
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


Lönekvationer för Industri och Övrigt näringsliv utgår från en generell löneförhandlingsmodell. Arbetsgivares målfunktion är där uttryckt i termen av konsumentreallön (d.v.s. timlön efter skatt deflaterad med konsumentprisindex) medan arbetsgivare är inriktade på producentreallön (d.v.s. lönekostnad per timma inkl. arbetsgivaravgifter deflaterad med producentpris). Den skattade modellen förklarar producentreallön som en funktion av produktivitetsutveckling, arbetsmarknadsläge (arbetslöshet) samt relationen mellan konsumentreallön och producentreallön. Resultaten för Industri indikerar att arbetsstagare 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.
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