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AN EXPLORATIVE EMPIRICAL ANALYSIS OF THE INFLUENCE OF LABOUR FLOWS ON WAGE FORMATION USING THE JOHANSEN APPROACH

by

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and

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ABSTRACT

This study presents an explorative econometric analysis of the influence of labour market flows on wage formation. It applies the vector cointegration and common trends methodology of Johansen (1995). According to this approach, a combination of the flow of layoffs (flow from employment to unemployment) and the flow. of filled vacancies (successful matches) appears to be an adequate alternative to the unemployment rate as indicator of labour market tightness in the wage equation for The Netherlands..

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1. Introduction

Understanding the process of wage formation is crucial to macroeconomic policy analysis. Therefore much research efforts have been devoted to both theoretical and empirical studies of wage setting. Traditional empirical studies of the wage equation have the rate of unemployment (or some transformation thereof) specified either as a determinant of ***the change*** in the wage rate (Phillips-curve effect) or as a determinant of the wage level (wage-curve effect). The ***Phillips*** curve specification can be based on the theoretical model of Phelps (1968), where the firm is assumed to set the wages. Knoester and van der Windt (1987) derive a Phillips curve specification from a wage bargaining process. Usually the specification of the ***wage-curve*** is also described as outcome of a wage bargaining process between employers and trade unions. This alternative way to specify the wage formation process originates from Sargan (1964). He derives the wage level from a microeconomic theory of wage bargaining. See, e.g., Layard and Nickel1 (1986), Blanchflower and Oswald (1990), Graafland (1992). Today labour economists tend to prefer the bargaining theory to Phelps theory of wage setting behaviour by the firm, for the specification of the wage equation. That is why, from a theoretical perspective, there is some preference to have a wage-curve effect specified in the wage equation rather than a Phillips-curve effect

Therefore, the crucial difference of the wage-curve resulting from the bargaining theory in comparison with the Phillips-curve is that in the wage-curve determinants from the labour market affect the ***wage*** level, not the wage growth. In the 'traditional' specification, the location of the wage curve depends, apart from unemployment, on the other exogenous variables in the wage negotiation process. Usually it is assumed that those variables are the same as the additional exogenous determinants of the Phillips-curve specification, i.e., consumer prices (p_c), producer prices (p_y), labour productivity ***(h),*** taxes and social premiums as share of GDP (tp), and the replacement rate (rr). Consumer and producer prices are closely related and including both in a wage equation would involve multicollinearity. In our wage setting equation however, we assume that the producer price level it the essential explanatory variable for the wage rate. Hence, in log-linear form a general static specification of a wage-curve, with the wage level w as dependent variable, is:

$$\log w = \beta_0 + \beta_1 \log y, + \beta_2 \log h + \beta_3\, tp + \beta_4 \log rr + \beta_5 \boldsymbol{B} + \varepsilon \qquad (1)$$

Here ***B*** represents a measure of labour market pressure, which represents bargaining power. Its empirical specification is the major focus of this paper. As a matter of fact the bargaining theory underlying this specification of the wage equation (and similarly Phelps' theory underlying the Phillips-curve) does not ***prescribe*** that the rate of unemployment (or some transformation thereof) is the correct indicator for labour market pressure. In earlier empirical studies on wage formation this indicator was merely used because of data availability. However, recently search theory and unemployment equilibrium theory (see e.g. Pissarides, 1990) demonstrated that it is important to take account of labour market flows in empirical studies of the labour market. In the context of a model with endogenous labour market flows labour market pressure can very well be represented by the flow of layoffs in combination with the flow of filled vacancies. From that perspective our paper investigates whether data on labour flows may constitute a feasible alternative for unemployment as measure of labour market pressure in a wage equation. Our empirical analysis has an explorative character, i.e. we let as much as possible the data decide about the specification and dynamics of the wage equation. To that end we apply the formal coïntegration methodology by Johansen (199 1, 1995), which implies extensive statistical testing of long run equilibria and short run dynamics in the wage formation process.

2. Empirical evidence on wage formation using the Johansen approach

If the error term of the above specification (1) is assumed to represent a stationary error process, it implies that, when all variables in (1) are non-stationary, in the sense that they contain a unit root, these series may be cointegrated. In that case the dynamic equivalent of equation (1) should be specified as an error-correction model. It appears to be the case in our empirical investigation in the present section. Note that, in a wage-curve specification, the complication of moving from the specification in levels to an error correction specification only occurs when the variables in (1) are integrated of order 1, or I(1).

Against this background we want to know if there exists a long run equilibrium relation between the wage rate w and its usual determinants. As mentioned before, we consider the following usual explanatory variables: producer prices p_y, labour productivity ***h***, taxes and social premiums of employers and employees tp and the replacement rate rr. Moreover, as alternatives to the unemployment rate as indicators of labour market tightness and hence of the relative bargaining strength of employers versus employees, we use data on labour market flows, namely the flow of layoffs f_{eu} and the flow of filled vacancies f_{fv}, both as percentage of the labour force. The fact that time series data are available in The Netherlands for these flows allows us to consider these alternative determinants of wage formation. We note that a combination of these flows concords reasonably well with the theoretical arguments of the bargaining theory of wage formation.

The application of the formal test of the cointegration analysis by Johansen (199 1,1995) proceeds as follows. Let X be a vector with the variables of interest. We may include all labour market variables of interest in the vector X, which can then be represented as X_t = (log w, log p_y, log ***h***, tp , log rr, f_{eu}, f_{fv}) ' , Application of the Johansen procedure implies that we test for cointegration between for all seven variables simulateously and not only for a single wage equation. In this way we take account of the inter-relatedness of the wage setting process and the other variables, All variables can be considered I(1), maybe with a possible exception of the flow variables. We continue as if all variables are I(1). We will let the cointegration procedure of Johansen determine possible equilibrium relations and will focus on the role of the flows in the wage equation. As a next step we will repeat the whole procedure for a standard wage curve, where the unemployment rate, instead of the flows, acts a measure of labour market tightness. The two outcomes will finally be evaluated. See Nymoen (1992) and Hecq and Mahy (1997) for similar approaches.

We start with the vector autoregressive representation (VAR) of the system based on X. This is the first step of the Johansen approach. This VAR is specified as

$$\Delta X_t = \sum_{i=1}^{k-1} \Pi_i \Delta X_{t-i} - \Pi_k X_{t-k} + \mu + V_t, \qquad V_t \propto IID(0,\Omega) \tag{2}$$

A is the difference operator, $\Delta Z_t = Z_t - Z_{t-1}$, II is a $k x k$ parameter matrix, μ is a kxl vector of intercepts and V is a $k \times 1$ vector error process, which is independently and identically distributed with mean zero and covariance matrix Ω.

Granger's representation theorem asserts that if the coefficient matrix Π_k has reduced rank $r < k$, then there exist $k x\ r$ matrices a and β each with rank r such that $\Pi_k = \alpha\beta'$ and $\alpha\beta'$ is stationary. r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of a are known as the adjustment parameters in the vector error correction model. Johansen's method is to estimate the II-matrix in an unrestricted form, then test whether we can reject the restrictions implied by the reduced rank of II.

All the II matrices are 7x7 and the constant term μ is 7x1 in our specification of the wage curve based on (1). The cointegration analysis focuses on the matrix of coefficients Π_k:

$$\Pi_k = \alpha \beta' \tag{3}$$

where $\beta' X_{t-k}$ are linear combinations of the series X_{t-k}, which are supposed to be I(1). Only such stationary linear combinations can explain the I(0) series ΔX_t. Hence, in large samples, the columns of a should equal zero, except those columns corresponding to the stationary linear combinations. The number r of such linear combinations determines the number of cointegration relations.

We use quarterly data from 1969: I-1997:IV and start with our initial specification and consider the cointegrating relationships of all seven variables of interest simultaneously. A first order VAR appears to be sufficient to yield white noise residuals, hence k= 1. Table 1 presents the results of the cointegration test according to this Johansen procedure, when applied to X_1. We present the results of the LR-test on the presence of r cointegrating vectors.

The values found for the LR-test statistic to determine the number of cointegrating vectors are presented in Table 1 with their 5 % and 1% critical values. At a 5 % significance level we find three cointegrating vectors, at 1% significance we get two. Next we normalise the cointegrating coefficients β so that the relations can better be interpreted. Of course, we focus on the wage equation and normalise on the wage rate. Nevertheless, such a normalisation is arbitrary. Cf. Nymoen (1992) and Hecq and Mahy (1997).

** Table 1 somewhere here**

One of the unnormalised cointegrating vectors can be readily interpreted as a wage curve. After normalisation with respect to the wage rate we get

$$\log w = 1.0 \log p_y + 0.5 \log h + 1.0\, tp + 0.1 \log rr - 1.25 f_{eu} + 0.75 f_{fv}. \quad (4)$$

The empirical analysis shows that the hypothesis of homogeneity of wages with respect to producer prices cannot be rejected. The coefficient of labour productivity is rather low at 0.5. In this case it is noticeable that the coefficients of the flow variables are of similar size and have opposite signs. Hence, the estimation results point towards an interpretation of these flows in terms of the change in unemployment. Here we find a first piece of evidence of hysteresis, which is implicit in the theory of the wage-curve effect: a change in unemployment has a permanent effect on the wage rate, but when the unemployment rate (or the labour market flows) remain constant, it does not affect the wage rate.

The other two cointegrating vectors can be interpreted as equations for our labour market flows.

$$f_{eu} = 0.2 f_{fv} - 0.03 \log rr + 0.04\, tp + 0.02 \log h + 0.1 (\log w - \log p_y)$$

$$f_{fv} = f_{eu} + 0.5 \log rr - 0.5\, tp + \log h - 0.06 \log p_y + 0.3 \log w$$

See Hassink (1996) and Broersma and Hassink (1997) for a comparable specification of these labour market flows. See also Broersma and Den Butter (1999), who derive similar specifications of wages, prices and labour flows from a more theoretical approach to the labour market.

However, we should remember that the normalisation on the wage rate that we have used is an arbitrary one, The same applies to the equations for the flow variables. We do however find that there are a number of long run relations between the seven variables in X_1, one of which can be interpreted as a wage curve. Therefore we continue our explorative analysis of the wage curve by investigating a well-specified dynamic wage curve equation in the vein of the specifications of the empirical studies in the literature (see e.g. Graafland, 1990, 1992). This will be helpful in understanding the mechanisms underlying the wage curve with flows to represent tightness of the labour market. See Nymoen (1992) for a similar approach.

3. Dynamic specification of a wage curve with flows

With the results of the cointegration procedure of Johansen in the back of our mind, we therefore start with the following dynamic wage curve equation

$$\begin{aligned}\phi_0(L)\Delta \log w = \mu_0 + \phi_1(L)\Delta \log p_y + \theta_1(L)\Delta \log h + \theta_2(L)\Delta tp + \theta_3(L)\Delta \log rr + \\ \theta_4(L)\Delta f_{eu} + \theta_5(L)\Delta f_{fv} + \qquad (5)\\ \gamma(\log w + \beta_1 \log p_y + \beta_2 \log h + \beta_3 tp + \beta_4 \log rr + \beta_5 f_{eu} + \beta_6 f_{fv})_{-1},\end{aligned}$$

where

$$\phi_0(L) = 1 - \sum_{j=1}^{5} \phi_{0,j} L^j$$

$$\phi_1(L) = \sum_{j=0}^{5} \phi_{1,j} L^j$$

$$\theta_i(L) = \sum_{j=0}^{2} \theta_{i,j} L^j$$

and L is the lag operator $L^k x_t = x_{t-k}$. The error-correction part of this wage curve equation is assumed to be the one that is derived from the Johansen procedure. We assume that (5) is a sufficient representation of the data generating process (DGP) of the wage rate. This DGP is subsequently simplified by combining variables with coefficients of similar size or by omitting variables with insignificant coefficients. Later on we will test whether these parameter restrictions have been correct. The simplified wage curve model that results from this exercise is presented in Table 1. The statistics properties of this final specification are tested extensively. All results are presented in Table 2.

Table 2 somewhere here

We test on absence of residual autocorrelation, on homoscedasticity and normality of the error process. We also apply a number of tests on the stability of the model. When these tests do not reject the model specification, we have a model that can be regarded as an adequate representation of the DGP. Such a model can be used for forecasting, policy analysis and so on. The statistics in the lower part of Table 2 are: R^2, the squared multiple correlation coefficient, σ, the standard error of the regression and T, the number of observations. We use an F-test on parameter restrictions to check the validity of the simplification strategy. Absence of residual autocorrelation is tested with the F-version of the test of Godfrey (1979) and with the Ljung-Box (χ^2) test. Absence of normality is tested with the Jarque and Bera (1980) test. Absence of ARCH is tested with Engle's (1982) test and possible misspecification (heteroscedasticity) is tested with White's (1980) specification test. The stability of the model is tested with Ramsey's RESET test and a standard Chow test is used to detect predictive failure of the model. We apply a number of recursive tests, like the CUSUM(Q) test and recursively estimated coefficients in order to detect possible instability of the model. The t-values corresponding to the estimated coefficient values are in parenthesis. For brevity reasons plots of recursive tests, other than those of Figure 1 and 2, are not presented here but are available from the authors upon request. For the same reason we do not report misspecification test results for the general model. If the simplified is not rejected and if it is a valid simplification of the general model, then the specification of the general model is also not rejected.

Table 2 shows that the simplified model is a valid simplification of the DGP of the wage curve in (5). Also there appears to be not a single misspecification test that rejects this simplified model. Also none of the recursive tests point towards instability of the model. Figure 1 presents the recursively estimated residuals and figure 2 gives the recursively estimated coefficients of the model. Neither outlying residual values nor unstable coefficient values appear to show up.

The dynamic part of the model shows that the change in the wage rate is determined by a weighted average of lagged wage changes and a weighted average of lagged (producers) price changes. It shows how the wage rate depends on an averages of lagged wages and prices. There is also a positive effect of the change in productivity on wage changes. A change in the taxes and premiums is (partly) passed through in wage changes. Finally, an increase in the flow of filled vacancies implies increase in the wage rate; it indicates that, when more people find a job, wage claims may go up and employers may offer higher wages in order to attract the best workers.

The error correction part of the models of Table 2 is equation (4), which sterns directly from the results of the Johansen procedure. This equation (4) shows that in equilibrium changes in prices, and in taxes and premiums are completely passed on in wages. Changes in labour productivity are passed on only for 50 % . A 1 %-point increase in the flow of layoffs leads to a fall in the wage rate of 1.25 %-point, while a similar increase in the flow of filled vacancies causes the wage rate to increase with 0.75%-point. The presence of such a long run equilibrium error-correction term in the wage curve (as found by the Johansen test) is confirmed in the results of Table 2. Note that the adjustment parameter y in (5) takes on a small value of about -0.05. Such a low value implies a relatively slow adjustment of the (equilibrium) wage rate to adverse shocks in one of the driving variables. Low values of the adjustment parameter are usually associated with an inflexible labour market. We need however comparison with similar models for other countries to draw conclusions from this value for The Netherlands.

4. A traditional wage curve specification with the unemployment rate

Next, we want to compare this wage curve (5), where flows represent labour market tightness, with the traditional specification of the wage-curve where labour market tightness is represented by the unemployment rate. We will repeat the Johansen-procedure to a vector of variables including the wage rate but not the two flows. Hence $X_2 = (\log w, \log p_y, \log h, tp, \log rr, ur)'$. The Johansen procedure will again determine the cointegrating relations among the variables of X_2. The outcome of the LR-test that determines the number of cointegrating vectors is presented in Table 3. The presence of two cointegrating relations cannot be rejected at a 5 % significance level. Again we face the question of normalisation of the cointegrating vectors. Also in case of X_2 we can identify one relation as an equilibrium wage curve, as in (1). After normalisation we get

$$\log w = 1.0 \log p_y + 0.6 \log h + 1.5\, tp + 0.25 \log rr - 1.5\, ur. \qquad (6)$$

This is close to specification (4), where instead of unemployment the two flows represent tightness. Note however the most important difference between (4) and (6). Where in (6) it is the level of unemployment that represents labour market tightness with respect to the level of the wage rate, in (4) it is the difference between the two flows, which essentially equals the *change* in unemployment, which relate to the level of the wage rate.

As a second cointegration relation we might get an unemployment relation after normalisation.

$$ur = 0.2 (\log w - \log p_y) - 0.05 \log h - 0.2\, tp + 0.1 \log rr$$

We will again focus on the standard specification of the wage curve and apply the same procedure as in section 3. The general model specification is simplified and the results are presented in Table 4. The dynamic part of the model shows a similar set of explanatory variables as those of Table 2. The wage rate changes depend on a weighted average of lagged wage rate changes and of current and lagged price changes. In addition also the change in labour productivity, the change in taxes and social premiums and the change in unemployment affect the wage rate change in the short run. The long run equilibrium relation is again represented by the error-correction part of the model, which stems from the Johansen procedure. This also resembles the one of the previous specification of Table 1. There is a significant long run relation between wages (producer) prices, labour productivity, taxes and premiums, the replacement rate and the unemployment rate.

This traditional specification of the wage curve of Table 4 appears, from a first glance at the diagnostic tests, less acceptable than the one of Table 2 with flow variables. The traditional wage curve suffers from functional form misspecification according to the RESET-test. There is also some evidence that the residuals of the model are not normally distributed. The first flaw may affect the stability of the model, the second may affect the distribution of the parameters, which may then no longer follow a t-distribution. When we finally check the stability of the standard model according recursively estimated residuals and coefficients in Figures 3 and 4. We see that both the residuals and some parameters are less stable than those in Figures 1 and 2, which are based on the model with labour flows. These differences pertain to the period before 1982 with respect to the residuals, notably 1975 : 1, 1977: 1 and 1982: 1 and to the intercept, c(O), and the adjustment parameter, c(7), with respect to the constancy of the parameters. Both parameter values move upwards from 1993 onwards, instead of remaining constant. Hence, although many tests do not indicate severe misspecification, this traditional wage-curve specification seems less stable than the wage-curve specification with labour market flows as indicators of labour market tightness an bargaining power of employees.

Finally we want to make a more thorough comparison between the two model specifications. Based on economic theoretical considerations, we have argued that there is no reason why labour market flows should not be able to represent labour market tightness in a wage curve setting, as opposed to the usual level of unemployment. So theoretically speaking there is no preference for one specification above the other. However, based on (statistical) validity of the specification, we prefer the wage curve with flow variables of Table 2. This model is more stable than the usual wage-curve specification. As a final comparison, we can also apply a so-called encompassing test (c.f. Mizon and Richard, 1986). Encompassing tests indicate whether one of two non-nested specifications is preferred above the other. We apply a joint F-test as encompassing test. This implies estimating a model in which both specifications are nested and testing whether each of our two specifications is a valid simplification of this joint model.

We find that the wave curve with labour market flows is encompassed by the standard wage curve at a 5 % significance level. The F-test based on the joint model yields F(2,99) = 1.103. On the other hand the wage curve with labour market flows also encompasses the standard wage curve at a 5 % level: the F-test based on the joint model yields F(2,99) = 2.7 18. So basically both models encompass each other. It implies that this formal test does not lead to a preference for one of the alternative specifications. This corroborates the theoretical equivalence of both wage curve specifications. Yet, according to our "eyeball" arguments above, there seems to be a preference for the specification with labour market flows to represent labour market tightness.

5. Concluding remarks

This paper empirically investigates the influence of labour market flows on wage formation. In our analysis for The Netherlands we applied the multivariate cointegration approach of Johansen. Traditionally wage equations include either a Phillips-curve or a wage-curve effect using unemployment as an indicator of labour market tightness. The theoretical foundation of the Phillips-curve, which is based on wage setting behaviour of the firm, and of the wage curve, which is based on bargaining between employers and employees, leaves scope for a wider set of indicators of labour market tightness than unemployment. Usually wage equations are estimated with unemployment as indicator for labour market tightness as unemployment data are readily available, and are at the core of policy discussions. However, now that time series data on labour flows have become available for The Netherlands, we are able to specify and estimate a wage-curve specification with labour flows as determinants, using the vector cointegration and common trends methodology of Johansen.

Our estimates show that a combination of the outflow from employment to unemployment (layoffs) and the outflow of vacancies (successful matches) as indicators of labour market tightness qualify for inclusion into the wage equation indeed. The dynamic specification of the wage curve with these flows appears to perform from a statistical point of view at least as well as the traditional specification with unemployment as determinant of wage formation. This corroborates with the theoretical foundation of the wage equation which describes wage formation as the outcome of a bargaining game between employers and employees, where the relative bargaining power depends on labour market tightness. Especially in the context of equilibrium search theory labour market flows are relevant for the outcome of the bargaining, and therefore for wage formation.

Table 1. Results of cointegration analysis of X_1 in the case of 7 variables.

Number of cointegrating vectors	LR-test	Critical values 5 %	1 %
0	223.8*	131.7	143.1
at most 1	140.3*	102.1	111.0
at most 2	82.65*	76.07	84.45
at most 3	48.43	53.12	60.16
at most 4	28.23	34.91	41.07
at most 5	14.00	19.96	24.60
at most 6	6.12	9.24	12.97

* is significant at 5 %

Table 2. Estimation and test results of wage curve (5) for The Netherlands, 1969:I-1997:IV (SURE)

Explanatory variables	general specification		simplified specification	
constant	-0.143	(-2.032)	-0.158	(-2.625)
$\Delta\log w_{t-1}$	-0.021	(-0.190)		
$\Delta\log w_{t-2}$	0.196	(1.814)		
$\Delta\log w_{t-3}$	-0.048	(-0.429)		
$\Delta\log w_{t-4}$	-0.184	(1.765)		
$\Delta\log w_{t-5}$	0.313	(2.995)		
$\Delta(\log w_{t-2} + \log w_{t-4} + \log w_{t-5})$	0.230	(9.193)		
$\Delta\log p_{y,J}$	0.103	(1.409)		
$\Delta\log p_{y,t-1}$	0.058	(0.793)		
$\Delta\log p_{y,t-2}$	0.160	(2.146)		
$\Delta\log p_{y,t-3}$	0.088	(1.209)		
$\Delta\log p_{y,t-4}$	0.091	(1.257)		
$\Delta\log p_{y,t-5}$	-0.080	(-1.144)		
$\Delta(\log p_{y,t} + \log p_{y,t-2} + \log p_{y,t-3} + \log p_{y,t-4} - \log p_{y,t-5})$	0.092	(3.497)		
$\Delta\log h_t$	0.055	(1.702)	0.051	(2.209)
$\Delta\log h_{t-1}$	0.014	(0.375)		
$\Delta\log h_{t-2}$	0.001	(0.040)		
tp_t	0.082	(0.914)	0.124	(1.828)
tp_{t-1}	-0.106	(-1.092)		
tp_{t-2}	-0.039	(-0.431)		
$\Delta\log rr_t$	0.404	(0.379)		
$\Delta\log rr_{t-1}$	0.181	(0.096)		
$\Delta\log rr_{t-2}$	-0.600	(-0.580)		
$\Delta f_{eu,t}$	0.521	(0.441)		
$\Delta f_{eu,t-1}$	-0.985	(-0.916)		
$\Delta f_{eu,t-2}$	0.475	(0.403)		
$\Delta f_{fv,t}$	0.309	(1.264)	0.269	(1.600)
$\Delta f_{fv,t-1}$	-0.113	(-0.533)		
$\Delta f_{fv,t-2}$	0.029	(0.116)		
$(\log w - \log p_y - 0.5\log h - tp - 0.1\log rr +$ 1 [illegible]	-0.047	(-2.023)	-0.053	(-2.766)
R^2	0.762		0.737	
σ	0.007		0.007	
T	106		109	
Simplification $F(21,81)$			0.544	
Autocorrelation $F(1,101)$			0.032	
$F(5,97)$			0.182	
$\chi^2(12)$			14.09	
Normality $\chi^2(2)$			2.654	
ARCH $F(1,108)$			0.434	
$F(5,104)$			0.434	
White $F(13,96)$			1.186	
RESET $F(8,101)$			1.864	
Forecast Chow $F(20,82)$			0.497	

Table 3. Results of cointegration analysis of X_2 in the case of 6 variables.

Number of cointegrating vectors	LR-test	Critical values 5%	1%
0	205.3*	102.1	111.0
at most 1	118.9*	76.07	84.45
at most 2	49.50	53.12	60.16
at most 3	28.99	34.91	41.07
at most 4	10.84	19.96	24.60
at most 5	2.49	9.24	12.97

* is significant at 5%

Table 4. Estimation and test results of a traditional wage curve for The Netherlands, 1969:I-1997:IV, (SURE)

Explanatory variables		general specification	simplified specification
constant		-0.307 (-2.313)	-0.252 (-2.320)
$\Delta \log w_{t-1}$		-0.014 (-0.140)	
$\Delta \log w_{t-2}$		0.160 (1.596)	
$\Delta \log w_{t-3}$		-0.052 (-0.483)	
$\Delta \log w_{t-4}$		0.168 (1.687)	
$\Delta \log w_{t-5}$		0.293 (2.979)	
$\Delta(\log w_{t-2} + \log w_{t-4} + \log w_{t-5})$		0.213 (7.636)	
$\Delta \log p_{y,t}$		0.107 (1.564)	
$\Delta \log p_{y,t-1}$		0.045 (0.624)	
$\Delta \log p_{y,t-2}$		0.138 (1.950)	
$\Delta \log p_{y,t-3}$		0.109 (1.666)	
$\Delta \log p_{y,t-4}$		0.119 (1.879)	
$\Delta \log p_{y,t-5}$		-0.073 (-1.140)	
$\Delta(\log p_{y,t} + \log p_{y,t-2} + \log p_{y,t-3} + \log p_{y,t-4} - \log p_{y,t-5})$		0.095 (3.577)	
$\Delta \log h_t$		0.059 (1.907)	0.052 (2.232)
$\Delta \log h_{t-1}$		0.013 (0.366)	
$\Delta \log h_{t-2}$		0.008 (0.232)	
tp_t		0.083 (0.984)	0.124 (1.852)
tp_{t-1}		-0.142 (-1.505)	
tp_{t-2}		-0.027 (-0.3 15)	
$\Delta \log rr_t$		0.264 (0.270)	
$\Delta \log rr_{t-1}$		0.478 (0.279)	
$\Delta \log rr_{t-2}$		-0.776 (-0.821)	
Δur_t		-0.256 (-0.903)	
Δur_{t-1}		0.137 (0.486)	
Δur_{t-2}		-0.377 (-1.324)	-0.444 (-1.981)
$(\log w - \log p_y - 0.5\log h - tp - 0.1\log rr + 1.5ur)_{t-1}$		-0.071 (-2.302)	-0.059 (-2.321)
R^2		0.776	0.742
σ		0.007	0.007
T		109	109
Simplification	$F(21,84)$		0.698
Autocorrelation	$F(1,101)$		0.002
	$F(5,97)$		0.229
	$\chi^2(12)$		11.39
Normality	$\chi^2(2)$		5.064†
ARCH	$F(1,108)$		0.240
	$F(5,104)$		0.706
White	$F(13,96)$		0.792
RESET	$F(8,101)$		2.695*
Forecast Chow	$F(20,82)$		1.322

* is significant at 5 %

† is significant at 10%.

Figure 1. Recursively estimated residuals of' the wage curve (5), with labour market flows.

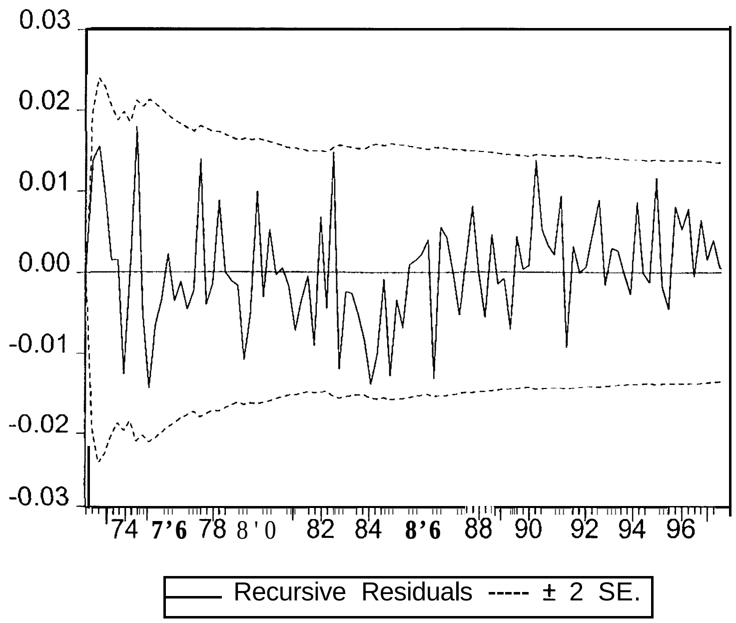


Figure 2. Recursively estimated coefficients of the wage curve (5) with labour market flows

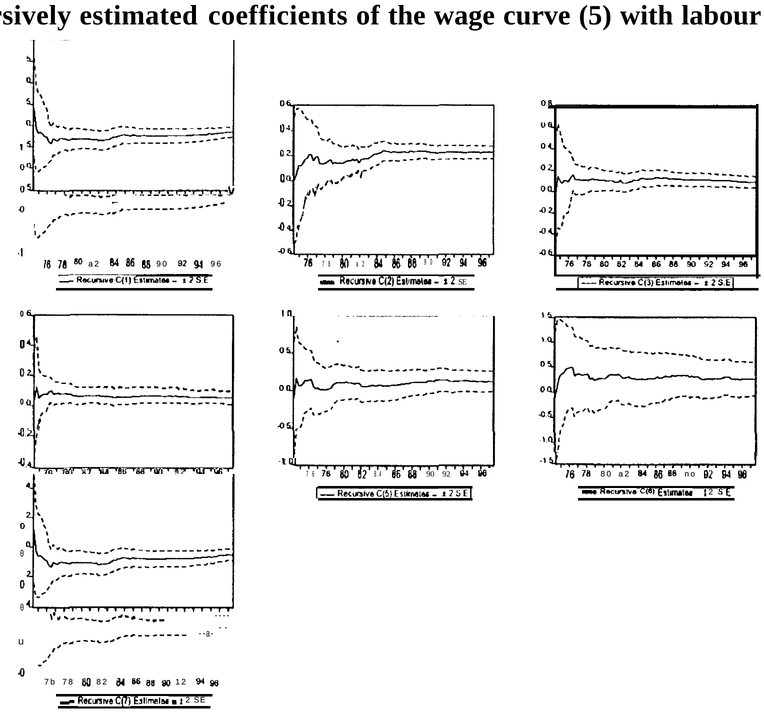


Figure 3. Recursively estimated residuals of the standard wage curve

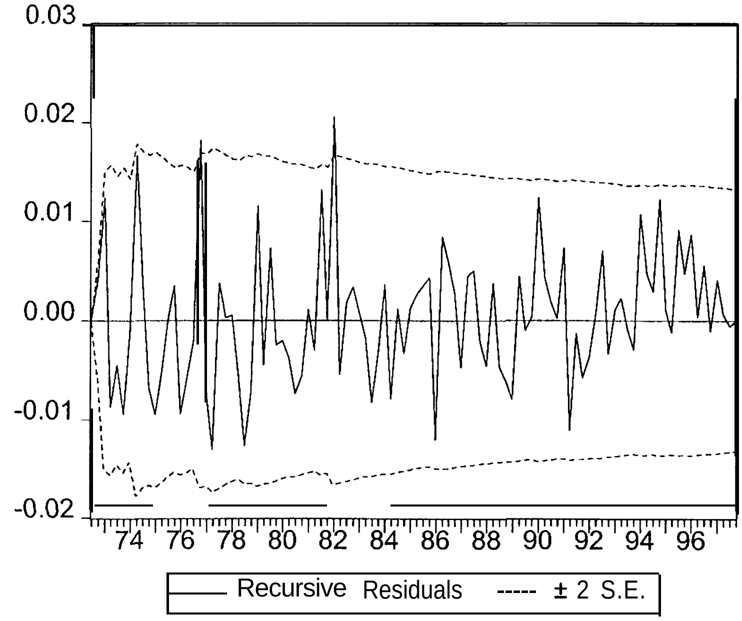
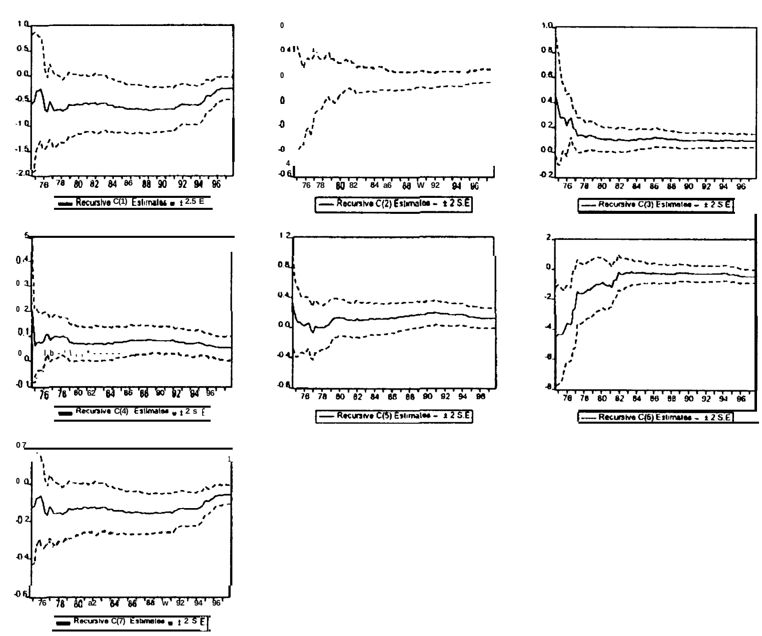


Figure 4. Recursively estimated coefficients of the standard wage curve



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DATA APPENDIX: DEFINITIONS AND SOURCES

The quarterly data of this study were mainly taken from the OECD, ***Main Economic Indicators (MEI)***. Yearly data, which were interpolated to yield quarterly series, were mainly obtained from the Netherlands Central Planning Bureau (CPB), ***Lange reeksen (LR)***. Interpolation was **done by means of** a **third** order polynomial function, see also Hassink and Broersma (1996). The Netherlands Central Bureau of Statistics is abbreviated as CBS.

w: index of hourly wage rates in manufacturing
source: OECD, *MEI*.

p_c: price **index** of total consumption
source: OECD, *MEI*.

p_y: price index of total production
source: OECD, *MEI*.

h: measure of labour productivity in the market sector.
source: CPB, ***LR.***

rr: replacement ratio, defined as the average benefit level with respect to the minimum wage
source: CPB, ***LR.***

tp: taxes and social premiums of employers and employees taken together, as percentage of the gross wage costs of the market sector.
source: CPB, ***LR.***

f_{eu}: flow of employed persons into unemployment, as percentage of the labour force. 1969.1- 1989.4 is interpolated. This interpolation causes a break between 1989 and 1990. Dummy variables could not adequately correct for this.
source: Sociale Verzekeringraad, *Kroniek* ***van de*** *sociale* ***verzekeringen.***

f_{fv}: flow of filled vacancies, as percentage of the labour force. We have used yearly data on vacancy flows of the Public Employment Office of the period 1970-1978 from Hartog (1980) to calculate average vacancy durations. For 1980-1987, we have used CBS vacancy survey data and applied the method described in Van Ours and Ridder (199 1). Quarterly data for 1969:I- 1988:III were obtained through interpolation. For 1988:IV-1997 IV, we use data from the CBS, *Sociaal economische maandstatistiek*.