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The Equilibrium Rate of Unemployment in the Netherlands*

Peter Broer, Nick Draper and Frederik Huizinga**

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** e-mail: dpb@cpb.nl, dagd@cpb.nl, fhh@cpb.nl

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CPB Netherlands Bureau for Economic Policy Analysis
Van Stolkweg 14
P.O. Box 80510
2508 GM The Hague, The Netherlands

Telephone +31 70 33 83 380
Telefax +31 70 33 83 350

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1 Introduction

The high level of unemployment in OECD Europe remains one of the puzzles of empirical macroeconomics. In recent years the unemployment rate shows a tendency to fall in some countries, but overall its level remains high (OECD (1997)). This is somewhat surprising in view of the considerable policy effort that has been made to redress the adverse supply conditions that are generally held responsible for the high rate of unemployment. This raises the question whether these policy reforms were ineffective, or still have to yield their full benefit. Is the present high rate of unemployment in Western Europe a consequence of slow adjustment to structural reforms and are we heading towards an era of low unemployment, or are other factors at work, that prevent us to reap the benefits of the reforms? This paper considers these questions in a structural empirical model of wage and price setting and employment dynamics for the Netherlands.

In the sixties and seventies the unemployment debate was dominated by the properties of the Phillips curve. After the seminal contribution of Friedman (1968), the idea that this curve offers a menu of different unemployment-inflation combinations came to be abandoned. Instead, the ‘natural rate’ hypothesis was adopted, whereby the long-run value of unemployment consistent with constant inflation is a variable determined outside of the core macro econometric model. Indeed, in virtually all empirical models of that time the natural rate is determined by the constant term of the Phillips curve. Within this framework the continuous increase in the rate of unemployment in Western Europe in the seventies was both unexpected and inexplicable.

To cope with this problem, several approaches have been followed. One possibility is to adopt an agnostic view of the natural rate and uses statistical procedures such as time-varying parameters (Gordon (1997)), to capture the shifts in the natural rate. Research along these lines is primarily useful to determine the current level of the natural rate, and hence predict the direction of inflation. It does not shed much light on the causes of the increased unemployment or on its future development. In spirit, the time-varying natural rate is closely related to the concept of hysteresis, in which the equilibrium rate of unemployment depends on the past unemployment path of the economy (Blanchard (1986)). In essence, hysteresis implies that the natural rate follows a random walk.

Another approach attempts to find the structural causes of the increased unemployment by explicitly modeling labor market imperfections. The models that were formulated in the first half of the eighties may be subdivided into efficiency wage models, union wage bargaining models, and search models of unemployment. Katz (1988) provides a nice overview. All these models predict that there is a relationship between the *levels* of wages and unemployment, leading in effect to an upward sloping labor supply curve, also called a wage curve (Layard, Nickell, and Jackman (1991), Blanchard (1997)). Moreover, a strengthening of the position of workers, caused for instance by an increase in the replacement rate, will shift the curve up, leading to higher unemployment. Increases in the wedge between the product wage and the consumption wage also contribute to unemployment if it increases the replacement rate (Pissarides (1998)). Empirical support for the existence of such a stable long-run relation between the level of wages and unemployment is provided by Blanchflower and Oswald (1994) and Blanchard and Katz (1996).

While the new labor market theories have been successful in tracking down the causes of the upswing of unemployment in the seventies to an inward shift of effective labor supply, they have so far not been able to explain the European unemployment persistence of the nineties. Following the substantial cut backs in social security in the eighties, unemployment should have returned to its previous low levels within a few years. This however has not happened.

In recent years, a number of authors have attempted to reconcile the empirical evidence in favor of a wage curve with the observed unemployment persistence in Europe, by adding elements that affect labor demand. In these studies the return to capital plays an important role. Phelps (1994) and Phelps and Zoega (1998) point to the close correspondence that exists between the real rate of interest and unemployment in Europe since the eighties. In Phelps (1994) the rate of interest is an important determinant of labor demand. Hiring costs, costs of investment in job-specific capital, and the costs of creating stable customer markets are all affected by the real interest rate. A rising real interest rate depresses the creation of new jobs and the demand for new products. The result is an inward shift of the labor demand curve. Madsen (1998) also finds empirical support for Phelps's model in a panel of OECD countries.

Caballero and Hammour (1996) also claim that the labor demand curve has shifted in. In their view, this happened because the rise in bargaining power of labor enabled it to appropriate a larger share of the rent. This has led firms to adopt technologies that are labor saving. Due to the putty-clay nature of capital, this process is slow to develop, and Europe still experiences the adverse effects of the welfare state of the seventies. Blanchard (1997) lends further support to this story by showing how it can also explain the observed gradual fall followed by a gradual rise of the capital income share in many OECD countries.

From this summary of the literature, we can identify a number of issues that are important in relation to the European unemployment problem, *viz.* the existence of a wage curve and its properties, the effects of the return to capital and of the interest rate on labor demand, and the speed of adjustment towards the long-run equilibrium. In this paper we attempt to shed additional light on these issues by specifying and estimating a structural model of wage bargaining, price setting and labor demand for the Netherlands. The case of the Netherlands has a separate interest since it was one of the countries hit hardest by the supply shocks of the seventies, when the term ‘Dutch disease’ was introduced by *The Economist* in 1977, and it is now one of the few European countries showing a clear improvement in unemployment (OECD (1997)).

Our bargaining model is of the ‘right-to-manage’ variety (Nickell and Andrews (1983)). It provides a role for the effects of product prices, the markup, unemployment, the replacement rate, labor productivity, and the wedge. On the production side, we specify a fairly standard model of labor demand and price formation, but with a substitution elasticity that is not a priori fixed at unity. This provides for an explicit role of capital costs not just in the demand for labor, but also, most importantly, in the wage bargaining solution, through its effect on labor productivity.

Our empirical results about the dynamic adjustment show that hysteresis is not a major issue. We find that the wedge, the replacement and the user costs of capital are important determinants of unemployment. The importance of the user cost of capital originates from the low estimated value of the elasticity of substitution. This effect distinguishes our approach from the contributions by Phelps (1994) and Blanchard (1997), that also seek the main determinant of unemployment persistence in the shifts in the labor demand curve, but through different channels. Our main conclusion is that in the period 1985-1996 unemployment remained high because of an increase in the relative user costs of capital that neutralized the beneficial effects of the cut-backs in social security payments.

The remaining part of the paper is organized as follows. In Section 2 we discuss the model, Section 3 presents our estimation results as well as the estimate and decomposition of the natural rate of unemployment. Section 4 offers some conclusions.

2 The model

The model we estimate consists of three equations, determining wages, employment and prices. We first present the equations for the steady state. Dynamics will be added later on in the form of an error correction specification. The wage equation is a linearized version of an equation that can be derived from a bargaining model, namely

$$\ln w \;=\; \ln p_y \;+\; \ln h \;+\; \chi_1 \ln \Lambda \;+\; \chi_2 \ln rp \;-\; \chi_3 u \;+\; \chi_0 \;, \qquad \textbf{(1)}$$

where w denotes annual total wage costs per worker (inclusive of employer social security and pension premium payments), p_y the price of value added, h labor productivity, Λ the wedge (defined as the ratio of the real wage costs to the real after tax consumption wage), *rp* the replacement rate, and *u* the unemployment rate. The unit coefficient for labor productivity follows if we assume that the fallback position rises proportionally with labor productivity. A positive coefficient on the wedge may be derived by assuming that the fallback position involves informal or underground activities that are not taxed.[1] The wage equation can also be seen as an equation determining the labor income share, $\ln w - \ln p_y - \ln h$. The labor income share resulting from the bargaining process, denoted lis^b, rises with the wedge and the replacement rate and falls with the unemployment rate.

The equations for the value added price and employment are derived from a model of firm optimization. We assume that the production structure may be characterized by a CES unit cost function with labor augmenting technological progress and possible non-constant returns to scale, written as

$$
\begin{aligned}
C &= \beta\, y^{\frac{1}{\xi}}\, c \\
c &= \left[\theta\, p_l^{1-\sigma} + (1-\theta) p_k^{1-\sigma}\right]^{\frac{1}{1-\sigma}} \\
p_l &= \frac{w}{p_{l0}\; g\; e^{\gamma_1 t + \gamma_2 t^2}} \\
p_k &= \frac{p_i}{p_{k0}}\; \frac{1 - t_b (c_i + d_i)}{1 - t_b} \left(1 - \frac{(1-\delta)(1+\dot{p}_i^e)}{1 + (1-t_g) r}\right),
\end{aligned}
\qquad (2)
$$

where C denotes total cost, β an efficiency parameter, y the output of value added, ξ the returns to scale parameter, p_l the efficiency corrected price of labor, p_k the user cost of capital, and c a CES weighted average of p_l and p_k. The efficiency corrected price of labor equals the annual wage cost w divided by the effective working time g and the degree of labor augmenting technological progress, which is modeled by a quadratic time trend. This quadratic time trend is meant to capture locally the actual technological progress. Following Jorgenson (1986) the user cost of capital is a function of the

[1] A formal derivation of this equation may be found in Graafland and Huizinga (1999).

investment price p_i, the corporate tax rate t_b, the investment tax credit c_i ,[2] the present value of depreciation rights of one guilder of investment expenditures d_i, the depreciation rate δ, the expected inflation rate $\hat{p}_i^e$, the overall income tax rate t_g, and the interest rate r,. The expected inflation rate, $\hat{p}_i^e$, is computed from an optimal MA(1) forecast of investment prices. To turn p_l and p_k into indices, their expressions are divided by their values in the base year p_{l0} and p_{k0}.

Shephard's lemma implies that the demand for labor equals

$$\ln l = \ln\beta + \ln\theta + \frac{1}{\xi}\ln y - \sigma\ln\left(\frac{p_l}{c}\right) - \ln p_{l_0} g - \gamma_1 t - \gamma_2 t^2 . \qquad \textbf{(3)}$$

The price equation is based on profit maximization in an imperfectly competitive market. The price is set as a markup over marginal cost

$$\ln p_y = \ln M + \ln\left(\frac{\partial C}{\partial y}\right) , \qquad \textbf{(4)}$$

where M denotes the markup. The markup depends on the price elasticity of demand, which under homothetic utility depends on the own price p_y and the foreign competitor price $p_{fc,}$ After linearization, the expression for the value added price becomes:

$$\ln p_y = \ln\mu_0 + (1-\mu_1)\left[\ln\beta + \ln c - \ln\xi + \frac{1-\xi}{\xi}\ln y\right] + \mu_1 \ln p_{fc} \qquad \textbf{(5)}$$

The term between square brackets equals marginal cost. If μ_1 is zero (foreign competitor prices do not matter in the long run), μ_0 equals the markup. The firms' price setting and labor demand equations imply another relationship for the labor income share denoted lis^f

[2] In the Netherlands from 1977 - 1988 a variety of the investment tax credit existed (called the WIR), whereby a percentage of the investment expenditure was simply re-imbursed, rather than deducted before taxes. The net effect of this change on Equation 2 is simply to replace c_i by c_i/t_b in the computation of the tax credit.

$$\ln lis^{f} = \ln \xi - \ln M + \ln\left(1 - (1-\theta)\left(\frac{p_k}{c}\right)^{1-\sigma}\right). \qquad \textbf{(6)}$$

The labor income share resulting from profit maximization falls with the markup and with the relative price of capital if the elasticity of substitution is less than one.

In equilibrium, the two expressions for the labor income share have to be consistent, that is $lis^b = lis^f$. This implies that in equilibrium, unemployment must equal

$$u^{*} = \frac{1}{\chi_3}\left[\chi_1 \ln \Lambda + \chi_2 \ln rp + \chi_0 + \ln M - \ln\xi - \ln\left(1 - (1-\theta)\left(\frac{p_k}{c}\right)^{1-\sigma}\right)\right] \qquad \textbf{(7)}$$

where a star denotes equilibrium unemployment. This expression shows four determinants of equilibrium rate of unemployment: the wedge, the replacement rate, the markup and the relative cost of capital. The wedge may shift as a result of changes in tax rates or because of a change in the terms of trade. An increase in the wedge and the replacement rate push up wage demands and, ceteris paribus, lead to an increase in the bargaining labor income share lis^b. However, the labor income share consistent with firm price and employment setting has not changed. To maintain equilibrium, the unemployment rate has to rise. An increase in the markup and the relative user cost of capital reduce the labor income share consistent with firm price and employment setting. So, the bargaining labor income share has to fall as well. To bring this about, the unemployment rate has to rise.

Note that the degree to which the relative capital costs affects equilibrium unemployment depends on the elasticity of substitution σ. A rise in the relative cost of capital always reduces the real wage the firm can pay and still maintain its level of profitability as measured by the markup. This follows directly from the factor price frontier. The issue is how the unions will be induced to accept this wage cut. Without substitution, we get the standard mechanism of layoffs and unemployment. If there is scope for substitution, firms will also respond by reducing the capital labor ratio, which over time reduces labor productivity. Since lower productivity directly reduces union wage demands, there is less need for unemployment to rise in this case. In the case of Cobb Douglas technology, the reduction in labor productivity exactly matches the reduction in the real wage the firm can pay. Unions wage demands then also exactly match this wage reduction, and there is no need for increased unemployment at all.

3 Estimation

All data used in estimation is given in the data appendix. Before estimation, we make two additions to the set of equations above. First, we add two dummy variables. In 1981 Statistics Netherlands changed its method of calculating real value added. Until 1981 deflation was carried out with fixed weigh price indices, while as of 1981 chained year-to-year indices were used. The change in method is elaborated in CBS (1984), Al et al. (1985) and de Boer et al. (1997). An important reason is that fixed weight indices may lead to serious bias in the price-quantity decomposition of nominal value added. After an increase in the price of raw material the old method leads to a downward bias in calculated quantity changes and a corresponding upward bias in price changes (see Bruno and Sachs, 1985). Because the base year for the price index is 1990 (that is, the price is 1 in 1990), there is a downward bias in the observed price level before 1981. We attempt to capture this bias by including a dummy variable in the price and labor demand equations for the period up to 1981.[3]

In addition, we introduce a dummy for their possible productivity effects of the oil price shocks (see again Bruno and Sachs, 1985). Because the three different shocks (1974, 1979-1981, and a reverse shock in 1986) have roughly the same size, the oil dummy (dum_{oil}) has the value 0 before 1974, 1 in the period 1974-1978, 2 in the period 1979-1985, and 1 afterwards. Since the oil shock is thought of as an additional productivity shock, we see it as affecting the efficiency parameter β in the cost function. We implement this by replacing β by $\beta+\delta_{oil}dum_{oil}$ in the cost function, and thus also in the price and labor demand equations. If μ_1 is zero, neither dummy affects the labor income share resulting from profit maximization, and the expressions for lis^f and equilibrium unemployment remain unaltered.

The second addition is dynamics. For this we use the error correction formulation. We impose that the equilibrium derived in the previous section will eventually be reached, which amounts to imposing the restriction that the dynamic equation is homogeneous in growth rates.

The dynamic wage we estimate is

[3] More specifically, we write ln(observed price) = ln(actual price) + ln(1+ $\delta_{66}^{81} dum_{66}^{88}$) and ln(observed quantity) = ln(actual quantity) - ln(1+ $\delta_{66}^{81} dum_{66}^{88}$) , where $\delta_{66}^{81} < 0$ is the average percentage bias. Substituting this into the price and labor demand equations leads to both equations having the additional term ln(1+ $\delta_{66}^{81} dum_{66}^{88}$) on the right hand side.

$$\Delta \ln w = \alpha_{11} \Delta \ln w_{-1} + (1 - \alpha_{11}) \Delta \ln w^{*}$$
$$+ \sum \beta_{1j} \Delta^{2} x_{1j} + \lambda_{1} (\ln w^{*} - \ln w)_{-1} \qquad \textbf{(8)}$$
$$\ln w^{*} = \ln p_{y} + \ln h + \chi_{1} \ln \Lambda + \chi_{2} \ln rp - \chi_{3} u + \chi_{0}$$

where a star(*) denotes long run and $\Sigma\beta_{1j}\Delta^{2}x_{1j}$ is the sum of second differences of explanatory variables. The parameter restrictions imposed on the first line insure that the equation is homogeneous in growth rates of ln$w$ and ln$w$*. This insures on a steady state growth path ln$w$ will eventually reach ln$w$*. The dynamic labor demand equation is

$$\Delta \ln l = \alpha_{21} \Delta \ln l_{-1} + (1 - \alpha_{21}) \Delta \ln l^{*}$$
$$+ \alpha_{23} \Delta dum_{oil} + \alpha_{24} \Delta dum_{66}^{81} + \sum \beta_{2j} \Delta^{2} x_{2j} + \lambda_{2} (\ln l^{*} - \ln l)_{-1}$$
$$\ln l^{*} = \ln(\beta + \delta_{oil} dum_{oil}) + \ln \theta + \frac{1}{\xi} \ln y - \sigma \ln\left(\frac{p_{l}}{c}\right) - \ln w_{0} g \qquad \textbf{(9)}$$
$$- \gamma_{l} t - \gamma_{2} t^{2} + \ln(1 + \delta_{66}^{81} dum_{66}^{81})$$

The restriction on the parameters for the short run is the same as for the wage equation. Note that the dummies for the oil shocks and the measurement error in prices and quantities have been implemented in the long run labor demand equation. The dynamic price equation is

$$\Delta \ln p_y = \alpha_{31} \Delta \ln p_{y-1} + \alpha_{32} \Delta \ln p_y^{*} + (1 - \alpha_{31} - \alpha_{32}) \Delta \ln p_m$$

$$+ \alpha_{34} \Delta dum_{oil} + \alpha_{35} \Delta dum_{66}^{81} + \sum \beta_{3j} \Delta^2 x_{3j} + \lambda_3 (\ln p_y^{*} - \ln p_y)_{-1}$$

$$\ln p_y^{*} = \ln \mu_0 + (1 - \mu_1) \left[\ln(\beta + \delta_{oil} dum_{oil}) + \ln c - \ln \xi + \frac{1-\xi}{\xi} \ln y \right] \qquad \textbf{(10)}$$

$$+ \mu_1 \ln p_{fc} + \ln(1 + \delta_{66}^{81} dum_{66}^{81})$$

where p_m is the import price.[4] The restriction on short run dynamics is again implemented in a similar way, except that now we impose homogeneity with respect to the growth rates of domestic and foreign prices. However, under the assumption that in a steady state domestic and foreign prices grow at the same rate, we still have that ln*p* will eventually reach ln*p**.

So, in a steady state with constant growth rate it will hold that

$$\ln w = \ln w^{*} \quad ; \quad \ln l = \ln l^{*} \quad ; \quad \ln p_y = \ln p_y^{*} \qquad \textbf{(11)}$$

implying that the steady state unemployment level does not depend on the inflation rate and other short run dynamics. So, our dynamic specification is consistent with the non accelerating inflation rate of unemployment (NAIRU) hypotheses. Moreover our model gives an explanation of structural changes in the non accelerating inflation rate of unemployment.

We investigated the empirical relevance for the years 1966-1995 of the above system in several ways. First, we determined the level of integration of the individual series and checked whether the individual long run equations form cointegrating vectors. The data did not reject this hypothesis. Then we estimated the static long run equations simultaneously applying the proper cross equation restrictions. This hardly changed the results. Then we estimated the dynamic system conditional on the long run static results

[4] We tried both the import price p_m and the price of foreign competitors on the foreign markets p_{fc} as indicators of foreign competition. For the short run the data seemed to favor p_m but it does not matter much which one is taken.

just obtained, using non-linear 3SLS. This amounts to the Engle Granger two step procedure. Next, we estimated the whole system in one step. Finally, because all estimation results strongly pointed towards constant returns to scale, we imposed that restriction in our final estimation round.[5]

It was not possible to estimate the measurement error in prices and volumes in the dynamic equations, because lagged mis-measured variables are part of the explanatory variables. This leads to biased estimates because of dependency of the error term and the explanatory variables. So we fix the long run coefficient for dum_{66}^{81} at the value obtained from the static equation estimates (the first part of the Engle two step procedure).

Tables 1, 2 and 3 present the results of the three estimation rounds of the whole dynamic system. The first set, labeled ‘2step’, is the result of the Engle Granger two step procedure. The second set, labeled ‘joint’, is the result of the one step overall estimation. The last set, labeled ‘CRS’, is the result imposing constant returns to scale. For each set we present the point estimates on one line and the standard errors in italics on the line below. No t-statistics should be computed for the coefficients of the level variables with these standard errors because the distribution of the estimates is non-standard. However, the t-statistics for the coefficients of the variables in first differences and of the error correction terms have a standard distribution.

For all equations we find a good fit. The LM test statistics do not point to autocorrelation in the wage and labor demand equation. In the price equation, there is also no indication of autocorrelation when estimated with the Engle Granger two step method, but negative autocorrelation in the one step estimation. However, estimation with autocorrelation correction using the GMM procedure gives nearly the same results. In the wage equation, we find significant long run effects of the wedge, the replacement rate and the unemployment rate on the wage level, confirming the existence of the wage curve. The point estimates indicate that the elasticities of a wage with respect to the wedge and the replacement rate are 0.22 and 0.35, which is also quantitatively not unimportant. The semi-elasticity with respect to the unemployment rate is -1.51, which is in line with results found elsewhere (see for instance Graafland and Huizinga (1999) and references contained therein).

[5] Some authors claim that the wage equation cannot be identified because it is derived based on the firm’s profit function and the union utility and fallback functions, and therefore no exclusion restrictions should be applicable that allow identification. However, in practice, equations like our wage equation perform reasonably well. This may be because there is only a small contemporaneous feedback of wages on employment and only little correlation between the error terms, so that the system is almost recursive. See Bean (1994) for a discussion.

The labor demand and price equations indicate that the substitution elasticity σ is around 0.3, quite significantly below unity. Thus we may expect that the relative cost of capital will play a role in determining equilibrium unemployment. The dummies for the oil shocks dum_{oil} and for the measurement errors in prices and quantities dum_{66}^{81} turn out quite significant. The oil shock reduced overall productivity by about 3%, and the effect of the measurement error on prices and quantities is about 4.5%. The effect of competitor prices on domestic prices is important for the short run, but the effect in the long run is negligible, as μ_1 is around zero . We find, therefore that the markup of prices over costs is constant in the long run, at about 25%, as μ_0 is around 1.25. The return to scale parameter ξ is close to 1 in all estimates, and has been set to 1 in the last round.

A prediction test is used to check whether the model estimated with 1966-1995 data also fits the post-sample years 1996 and 1997. For this purpose, the model is estimated for the extended period with addition of dummy variables for both years in all equations. The Gallant Jorgenson (1979) test was used to test the hypotheses that the coefficients of the dummy variables are insignificant. The test statistic was constructed with application of the Anderson correction factor for degrees of freedom (Kiviet, 1986). This is a straightforward extension of the Chow prediction test in the classical linear regression model to the nonlinear simultaneous regression model estimated with three-stage least squares. The test statistic is not significant. So, our model passes the extended sample test.

Substituting the estimation results in the last estimation round into equation (7), we find the following relationship for the equilibrium rate of unemployment

$$u = 0.15\ln\Lambda + 0.23\ln rp - 0.66\ln\left(1 - 0.22\left(\frac{p_k}{c}\right)^{0.75}\right) - 0.10 \qquad \textbf{(12)}$$

With this equation we have constructed Figure 1, using a confidence interval of two standard errors around the point estimate. The standard errors have been calculated with the TSP analyze command and are conditional on the values for the exogenous variables in each period. The two standard error interval does not correspond to a standard 95% confidence interval because the distribution of some of the estimates is non-standard.

The equilibrium rate deviates significantly from the actual rate over a large period due to large and multiple shocks. However, the adjustment speed is rather high. The adjustment speed is determined by the largest (real part of the) eigenvalues, which are

0.64, 0.73 and 0.74.[6] This implies that a (static) change in equilibrium is absorbed for more than 90 percent in a period of 8 years. The long standing deviations between the actual and equilibrium rate have to be attributed to structural changes and are not due to slow adjustment. The relatively fast adjustment speed also implies that our results do not favor hysteresis as an explanation for the unemployment persistence.

Figure 1 *Actual unemployment rate and estimated equilibrium unemployment rate (in %)*

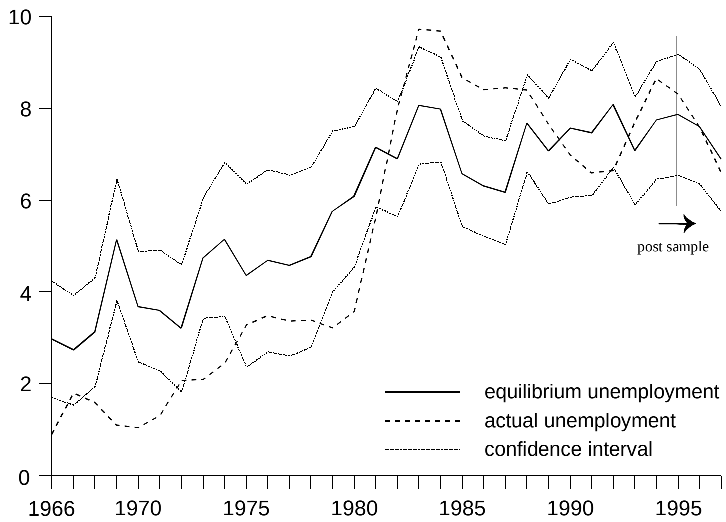

Figure 2 and tables 4 and 5 give a decomposition of the equilibrium rate for the years 1966-1995. The period 1966-1975 shows some increase of the equilibrium rate. The wedge and the replacement rate are rising but this is largely compensated by the fall in

[6]These are the eigenvalues of the companion matrix (the matrix of the feedback coefficients) of the estimated system, that is, they indicate the adjustment speed towards a static equilibrium in which w^*, l^* and p_y^* are exogenous. A full analysis of the adjustment speed would, of course, take account of the fact that the equilibrium also moves in response to a shock, and would additionally require, for instance, the dynamic modelling of equilibrium output since output is a major determinant of equilibrium employment l^*. Indeed, a proper analysis of the overall adjustment speed woud require a fully determined macro model. This is beyond the scope of this paper, although some information on this topic may be found in CPB, 1997.

the user costs of capital. The equilibrium rate increases in the 1975-1984 period. The replacement rate is starting to fall, but the wedge and the cost of capital rise steadily. The equilibrium rate stays at the high level in the last period in our sample 1984-1995. The wedge remains on its high 1984 level but the replacement rate falls. The unemployment rate does not decrease because of the further increase in the relative user costs of capital in that period. The markup has no effect on equilibrium unemployment since in our estimates it is constant in the long run.

Figure 2 *Decomposition of the change in the equilibrium rate of unemployment (in %)*

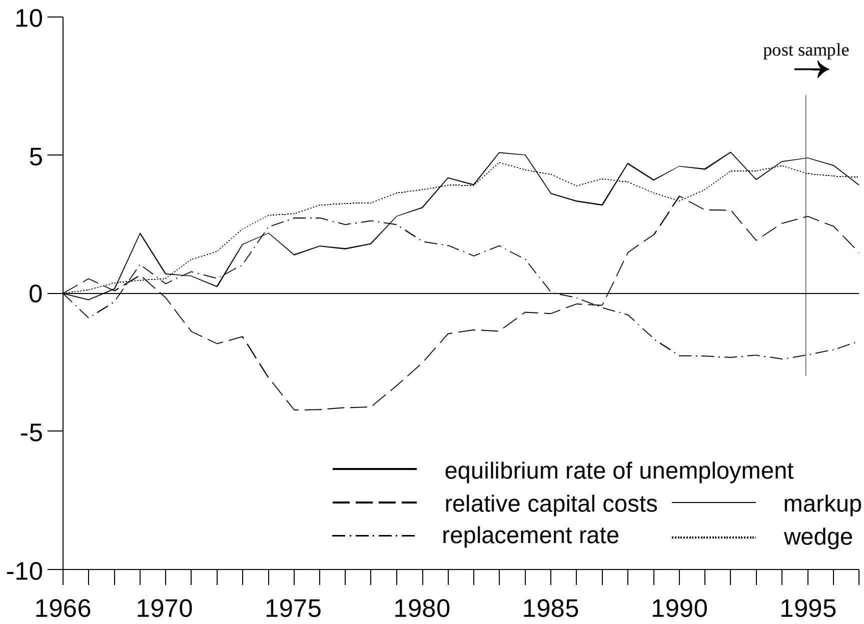

Table 5 gives a further decomposition of the influence of the user costs of capital and of the wedge. The fluctuations in the user cost of capital are driven mostly by the real interest rate. The increase in the wedge is mainly due to the increase in taxes and social security premiums, with only small effects of the terms of trade. In comparison with Madsen (1998), our results point to an even more important role of the real interest rate in the explanation of the development of unemployment in the eighties.

4 Conclusions

In this paper we show that the development of unemployment in the Netherlands over the period 1966-95 can be explained by a structural model of wage bargaining, labor demand and price setting. Care has been taken to impose homogeneity restrictions on the adjustment dynamics that make the model consistent with a long-run NAIRU concept. The individual equations of this model show satisfactory explanatory power. Conspicuous results are a low estimated elasticity of substitution, at 0.25, a significant influence of the oil price shock through its effect on productivity and a strong feedback of unemployment on wage formation. Although the feedback to the static equilibrium is fairly fast, it nevertheless appears that the actual rate of unemployment can deviate from the natural rate for a considerable length of time.

The structural form of the model allows for a decomposition of the natural rate into its composing factors. It appears that the rise of unemployment in the seventies can be attributed to increases in the wedge between the real product wage and the real consumption wage, and to an increasing replacement rate. The persistence of high unemployment in the eighties, despite a falling replacement rate, appears to be due to rising capital costs. Our analysis shows that the impact of capital costs on unemployment hinges crucially on a low elasticity of substitution. With an elasticity of substitution equal to unity, a long-run effect of capital costs on unemployment would not exist in our model.

Our results are in line with other recent studies, *e.g.* Blanchard (1997) and Phelps (1998), in that they all point to a substantial effect of capital costs on unemployment. We deviate from these studies by identifying the elasticity of substitution as the main parameter that regulates the importance of this effect. A desirable future extension of our work would be to repeat this analysis in a panel of countries, to see whether the difference in unemployment performance between countries can be related to differences in the capital-labor substitution. A second important extension is to include a description of capital formation into the model, both to provide a more complete description of the dynamics of employment, and to be able to integrate the dynamic arguments of Phelps (1994) and Caballero and Hammour (1996) into the analysis.

Table 1 Dynamic wage equation

$$\Delta \ln w = \zeta_{11}\Delta \ln w_{-1} + \zeta_{12}\Delta \ln w^{*} + \zeta_{13}\Delta \ln w^{*}_{-1} + \zeta_{14}\Delta^2 \ln h + \zeta_{15}\Delta^2 \ln p_y + \zeta_{16}\Delta^2 \ln rp + \zeta_{17}\Delta^2 \ln \Lambda + \zeta_{18}\Delta^2 \ln u_{-1} + \lambda_1(\ln w^{*} - \ln w)_{-1}$$

$$\ln w^{*} = \ln p_y + \ln h + \chi_1 \ln \Lambda + \chi_2 \ln rp - \chi_3 u + \chi_0$$

	ζ_{11}	ζ_{12}	ζ_{13}	ζ_{14}	ζ_{15}	ζ_{16}	ζ_{17}	ζ_{18}	λ_1	χ_1	χ_2	χ_3	χ_0	$\bar{R}^2$	se	LM1[a)]	LM2[a)]
2step	0.38	0.35	0.27	0.12	0.51	0.10	0.09	0.97	0.60	0.22	0.38	1.34	-0.39	0.97	0.0077	0.1	0.3
	0.11	*0.12*	*0.17*	*0.16*	*0.14*	*0.07*	*0.07*	*0.28*	*0.13*	*0.06*	*0.05*	*0.21*	*0.04*				
joint	0.42	0.53	0.05	0.05	0.26	0.10		1.05	0.76	0.22	0.35	1.53	-0.39	0.98	0.0067	1.7	1.0
	0.09	*0.08*	*0.11*	*0.11*	*0.10*	*0.06*		*0.23*	*0.10*	*0.04*	*0.03*	*0.13*	*0.02*				
CRS	0.40	0.51	0.09	0.09	0.28	0.10		1.06	0.76	0.22	0.35	1.51	-0.39	0.98	0.0065	1.7	0.9
	0.09	*0.08*	*0.11*	*0.11*	*0.10*	*0.06*		*0.23*	*0.10*	*0.03*	*0.03*	*0.13*	*0.02*				

Estimation sample period: 1966 - 1995

[a)]For convenience we present the Lagrange Multiplier tests against auto-correlation as absolute t-values: LM1 tests against significant first order auto-correlation; LM2 against significant second order auto-correlation.

Table 2 Dynamic labour demand equation[a)].

$$\Delta lnl = \zeta_{21}\Delta \ln l_{-1} + \zeta_{22}\Delta lnl^{*} + \zeta_{23}\Delta^2 \ln t_b(c_i + d_i) + \zeta_{24}\Delta^2 \ln w + \zeta_{25}\Delta dum_{oil} + \zeta_{26}\Delta dum_{66}^{81} + \lambda_2(lnl^{*} - \ln l)_{-1}$$

$$\ln l^{*} = \ln(\beta + \delta_{oil} dum_{oil}) + \ln\theta + \frac{1}{\xi}\ln y - \sigma \ln\left(\frac{p_l}{c}\right) - \ln w_0 g - \gamma_l t - \gamma_2 t^2 + \ln(1 + \delta_{66}^{81} dum_{66}^{81})$$

	ζ_{21}	ζ_{22}	ζ_{23}	ζ_{24}	ζ_{25}	ζ_{26}	λ_2	β	θ	ξ	σ	γ_1	γ_2	$\bar{R}^2$	se	LM1	LM2
2step	0.56	0.44	0.05	−0.09	−0.007	0.014	0.23	0.86	0.71	1.00	0.39	0.019	−0.0009	0.88	0.0052	0.5	0.2
	0.04	*0.04*	*0.03*	*0.07*	*0.003*	*0.005*	*0.06*	*0.03*	*0.02*	*0.08*	*0.08*	*0.003*	*0.00009*				
jont	0.56	0.44	0.04		−0.01	0.018	0.22	0.76	0.78	1.05	0.21	0.013	−0.001	0.89	0.0048	0.7	0.9
	0.05	*0.05*	*0.03*		*0.006*	*0.007*	*0.07*	*0.03*	*0.03*	*0.07*	*0.14*	*0.002*	*0.0001*				
CRS	0.55	0.45	0.04		−0.01	0.017	0.25	0.76	0.78	1	0.25	0.014	−0.001	0.90	0.0046	0.7	1.0
	0.04	*0.04*	*0.02*		*0.005*	*0.006*	*0.06*	*0.03*	*0.03*	−	*0.11*	*0.002*	*0.0001*				

Estimation sample period: 1966 - 1995

[a)]The long run dummy coefficients are presented in the price equation table

Table 3 Dynamic price equation

$$\Delta \ln p_y = \zeta_{31}\Delta\ln p_{y-1} + \zeta_{32}\Delta\ln p_y^{*} + \zeta_{33}\Delta\ln p_{y-1}^{*} + \zeta_{34}\Delta\ln p_m + \zeta_{35}\Delta\ln p_{m-1} + \zeta_{36}\Delta^2 lny + \zeta_{37}\Delta dum_{oil} + \zeta_{38}\Delta dum_{66}^{81} + \lambda_3(lnp_y^{*} - \ln p_y)_{-1}$$

$$\ln p_y^{*} = \ln\mu_0 - \ln\xi + (1-\mu_1)\left[\ln(\beta + \delta_{oil} dum_{oil}) + \ln c + \frac{1-\xi}{\xi}\ln y\right] + \mu_1 \ln p_{fc} + \ln(1 + \delta_{66}^{81}\, dum_{66}^{81})$$

verg	ζ_{31}	ζ_{32}	ζ_{33}	ζ_{34}	ζ_{35}	ζ_{36}	ζ_{37}	ζ_{38}	λ_3	μ_0	ξ	β	μ_1	δ_{oil}	δ_{66}^{81}	$\bar{R}^2$	se	LM1	LM2
2step	0.26	0.58	−0.05	0.14	0.08	-0.0002	-0.02	0.005	0.39	1.15	1.00	0.86	0.00	0.03	−0.05	0.93	0.0084	1.0	0.5
	0.12	*0.07*	*0.09*	*0.05*	*0.06*	*0.00006*	*0.005*	*0.008*	*0.09*	*0.09*	*0.08*	*0.03*	–	*0.006*	*0.01*				
joint		0.67	−0.008	0.19	0.14	0.03	−0.03	0.01	0.30	1.33	1.05	0.76		0.03	−0.05	0.94	0.0074	1.3	2.6
		0.06	*0.07*	*0.04*	*0.05*	*0.04*	*0.008*	*0.008*	*0.08*	*0.10*	*0.07*	*0.03*		*0.008*	–				
CRS		0.65	0.01	0.19	0.15		−0.03	0.01	0.27	1.27	1	0.76		0.03	−0.05	0.95	0.0067	1.5	2.6
		0.06	*0.08*	*0.05*	*0.06*		*0.008*	*0.009*	*0.08*	*0.04*	–	*0.03*		*0.007*	–				

Estimation sample period: 1966 - 1995

Table 4 *Decomposition of the cumulative change in the equilibrium rate of unemployment from 1966 (in %)*

	1975	1984	1995
change in equilibrium rate of unemployment	1.4	5.0	4.9
– relative capital costs	–4.2	–0.7	2.8
– wedge	2.9	4.5	4.3
– replacement rate	2.7	1.2	–2.2
– markup	0.0	0.0	0.0

Table 5 *Decomposition of the cumulative change in the equilibrium rate of unemployment from 1966; the contribution of the relative capital costs and the wedge (in %)*

	1975	1984	1995
relative capital costs	–4.2	–0.7	2.8
– real interest rate	–2.4	0.7	4.1
– fiscal instruments	–0.3	–1.1	0.1
– overall income tax rate	–0.9	–1.1	–1.1
– terms of trade indicator	–0.6	0.8	0.3
wedge	2.9	4.5	4.3
– terms of trade	–0.2	–0.1	0.3
– taxes and social premiums	3.1	4.6	4.0

Data appendix[7]

year	w	g	p_i	$\frac{1-t_b(c_i+d_i)}{1-t_b}$	t_b	r	Λ
1960	5.865	2189	0.275	1.146	0.292	0.044	1.459
1961	6.281	2156	0.279	1.165	0.304	0.041	1.477
1962	6.642	2126	0.282	1.165	0.300	0.043	1.466
1963	7.242	2123	0.295	1.162	0.309	0.043	1.480
1964	8.330	2105	0.312	1.233	0.314	0.051	1.522
1965	9.249	2097	0.327	1.243	0.328	0.055	1.523
1966	10.259	2086	0.343	1.274	0.345	0.066	1.568
1967	11.187	2077	0.347	1.263	0.358	0.062	1.582
1968	12.193	2042	0.350	1.216	0.366	0.065	1.608
1969	13.807	2045	0.364	1.287	0.370	0.075	1.619
1970	15.590	2015	0.393	1.307	0.379	0.080	1.625
1971	17.733	2004	0.431	1.310	0.396	0.076	1.705
1972	19.987	1965	0.461	1.307	0.407	0.074	1.740
1973	23.211	1938	0.480	1.322	0.419	0.079	1.839
1974	26.872	1902	0.532	1.253	0.424	0.098	1.904
1975	30.426	1859	0.593	1.214	0.436	0.088	1.911
1976	33.740	1881	0.644	1.205	0.435	0.090	1.953
1977	36.756	1871	0.680	1.174	0.444	0.081	1.960
1978	39.336	1847	0.711	1.166	0.451	0.077	1.964
1979	41.578	1835	0.746	1.109	0.456	0.088	2.013
1980	44.031	1835	0.793	1.115	0.460	0.101	2.029
1981	45.827	1833	0.852	1.103	0.455	0.115	2.052
1982	48.822	1836	0.893	1.143	0.461	0.099	2.049
1983	50.577	1826	0.910	1.141	0.472	0.082	2.172
1984	50.927	1811	0.920	1.094	0.456	0.081	2.131
1985	51.808	1760	0.937	1.089	0.453	0.073	2.108
1986	53.101	1740	0.934	1.075	0.454	0.064	2.049
1987	53.893	1741	0.950	1.096	0.479	0.064	2.084
1988	54.499	1749	0.964	1.218	0.481	0.064	2.068
1989	54.915	1731	0.983	1.216	0.453	0.072	2.013
1990	56.644	1724	1.000	1.221	0.450	0.089	1.973
1991	59.149	1718	1.018	1.228	0.476	0.087	2.028
1992	61.598	1733	1.031	1.233	0.472	0.081	2.124
1993	63.573	1733	1.045	1.232	0.480	0.064	2.127
1994	65.017	1732	1.053	1.224	0.461	0.069	2.153
1995	65.915	1722	1.050	1.221	0.452	0.069	2.111
1996	66.346	1718	1.053	1.218	0.446	0.062	2.099
1997	67.931	1700	1.080	1.217	0.451	0.056	2.093

[7] For convenience, this appendix contains both original data and data calculated during estimation such as the cost variable c. The parameters used to calculate these variables are the ones estimated in the third joint dynamic estimation round, labelled CRS in tables 1,2 and 3. The source for the original data is CPB .

year	rp	u	y	p_y	l	p_{fc}	p_m
1960	0.657	0.008	146.562	0.258	3.807	0.415	0.499
1961	0.667	0.005	150.972	0.262	3.863	0.404	0.490
1962	0.698	0.005	157.347	0.269	3.942	0.407	0.482
1963	0.711	0.006	162.443	0.281	3.999	0.415	0.488
1964	0.715	0.005	178.527	0.299	4.075	0.423	0.503
1965	0.744	0.006	187.356	0.316	4.110	0.431	0.507
1966	0.750	0.009	193.355	0.330	4.134	0.449	0.509
1967	0.721	0.018	202.484	0.344	4.110	0.451	0.501
1968	0.740	0.016	215.958	0.356	4.146	0.447	0.480
1969	0.784	0.011	229.003	0.383	4.210	0.473	0.502
1970	0.761	0.010	244.330	0.401	4.260	0.500	0.537
1971	0.776	0.013	254.605	0.429	4.269	0.503	0.538
1972	0.767	0.021	262.888	0.466	4.206	0.511	0.544
1973	0.783	0.021	278.339	0.508	4.204	0.570	0.586
1974	0.831	0.024	290.287	0.552	4.197	0.682	0.745
1975	0.843	0.033	290.177	0.602	4.152	0.689	0.761
1976	0.843	0.035	303.486	0.658	4.135	0.723	0.793
1977	0.835	0.034	311.340	0.693	4.129	0.742	0.827
1978	0.839	0.034	318.923	0.730	4.154	0.737	0.807
1979	0.834	0.032	327.695	0.756	4.215	0.788	0.864
1980	0.812	0.036	331.999	0.803	4.238	0.868	0.937
1981	0.808	0.056	329.556	0.853	4.158	0.987	1.021
1982	0.794	0.080	323.205	0.908	4.025	0.989	1.050
1983	0.807	0.097	329.323	0.931	3.940	1.019	1.050
1984	0.790	0.097	342.239	0.945	3.948	1.104	1.131
1985	0.751	0.087	355.156	0.961	4.027	1.131	1.116
1986	0.744	0.084	363.432	0.963	4.122	0.999	1.008
1987	0.733	0.084	371.045	0.949	4.199	0.937	0.977
1988	0.725	0.084	380.880	0.963	4.283	0.983	0.998
1989	0.698	0.077	399.569	0.980	4.381	1.045	1.034
1990	0.680	0.070	417.125	1.000	4.503	1.000	1.000
1991	0.680	0.066	428.719	1.025	4.581	1.008	1.000
1992	0.679	0.066	436.270	1.043	4.642	0.976	0.987
1993	0.681	0.077	438.065	1.061	4.639	0.948	0.959
1994	0.677	0.087	453.680	1.080	4.657	0.969	0.967
1995	0.682	0.083	463.805	1.084	4.774	0.958	0.984
1996	0.687	0.076	477.340	1.092	4.886	0.968	0.973
1997	0.696	0.066	492.886	1.118	4.986	1.032	0.999

year	p_k	p_l	c	C	$\hat{p}_i^e$	u^*
1966	0.279	0.401	0.374	52.229	0.039	0.030
1967	0.304	0.411	0.387	56.617	0.029	0.028
1968	0.301	0.427	0.398	62.186	0.029	0.032
1969	0.340	0.453	0.428	70.842	0.032	0.052
1970	0.334	0.489	0.454	80.170	0.045	0.037
1971	0.310	0.528	0.478	87.931	0.053	0.036
1972	0.319	0.574	0.515	97.828	0.054	0.032
1973	0.368	0.640	0.578	116.208	0.050	0.048
1974	0.336	0.717	0.628	131.800	0.070	0.052
1975	0.308	0.791	0.676	148.245	0.072	0.044
1976	0.322	0.828	0.708	162.176	0.075	0.047
1977	0.342	0.867	0.742	174.557	0.068	0.046
1978	0.356	0.901	0.772	185.906	0.065	0.048
1979	0.413	0.921	0.802	206.942	0.062	0.058
1980	0.475	0.939	0.831	217.402	0.064	0.061
1981	0.550	0.945	0.854	221.668	0.066	0.072
1982	0.576	0.972	0.881	234.838	0.059	0.069
1983	0.578	0.982	0.889	241.395	0.050	0.081
1984	0.622	0.969	0.890	251.058	0.043	0.080
1985	0.630	0.988	0.906	265.383	0.039	0.066
1986	0.666	1.000	0.924	265.489	0.028	0.063
1987	0.657	0.992	0.916	268.708	0.030	0.062
1988	0.800	0.979	0.939	282.889	0.024	0.077
1989	0.855	0.980	0.953	300.934	0.026	0.071
1990	1.000	1.000	1.000	329.814	0.023	0.076
1991	0.987	1.035	1.024	347.219	0.023	0.075
1992	1.008	1.057	1.046	360.913	0.020	0.081
1993	0.925	1.082	1.047	362.736	0.019	0.071
1994	1.003	1.101	1.079	387.159	0.016	0.078
1995	1.045	1.119	1.103	404.331	0.012	0.079
1996	1.016	1.127	1.103	397.522	0.011	0.076
1997	0.954	1.167	1.120	416.875	0.016	0.069

Abstract

The rise in unemployment in the 1970's and its subsequent persistence have challenged the conventional wisdom embodied in the standard Phillips curve, namely that equilibrium unemployment is fairly constant over time. This paper attempts to explain the apparent non-constancy of equilibrium unemployment by developing and estimating a structural model in which equilibrium unemployment is endogenous and results from the interactions of wage bargaining and the price and employment determination of firms. We find that the three major determinants of equilibrium unemployment are tax rates, the replacement rate and the real interest rate. The rise in unemployment in the 1970's and early 1980's was mainly due to a rise in the first two factors. That equilibrium unemployment remained high when tax rates and the replacement rate were reduced in the 1980's and early 1990's is attributed to the rise in real interest rates during this period.

Key words: equilibrium unemployment, wage bargaining, labor demand, price setting

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