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Keskusteluaiheita – Discussion papers

No. 839

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THE EQUILIBRIUM RATE OF UNEMPLOYMENT AND POLICIES TO LOWER IT: THE CASE OF FINLAND*

* This paper was originally written as a part of the project *Growth and European Labour Markets*, financed by the EU's 5th Framework and coordinated by the Kiel Institute of World Economics, but has undergone several additions and amendments since that. The author is indebted to Professor Markku Rahiala of Oulu University for his assistance with the problems of estimation and testing carried out in the paper and to Hannu Kaseva of ETLA for supplying the data on taxes and benefits. The author also thanks participants of conferences and seminars in Jyväskylä, Mikkeli, ETLA, EALE in Paris and the project team in a seminar at the CPB in The Hague, and Professor Pentti Vartia at ETLA for comments on earlier versions and inspiration. The usual disclaimer applies.

ISSN 0781-6847 31.12.2002

ALHO, Kari E.O., **THE EQUILIBRIUM RATE OF UNEMPLOYMENT AND POLICIES TO LOWER IT: THE CASE OF FINLAND.** Helsinki: ETLA, Elinkeinoelämän Tutkimuslaitos, The Research Institute of the Finnish Economy, 2002, 26 p. (Keskusteluaiheita, Discussion Papers, ISSN, 0781-6847; no. 839).

ABSTRACT: The paper combines the short-run link between increases in aggregate demand and growth of GDP, which leads to a reduction in unemployment, with a definition of the equilibrium rate of unemployment that is independent of the growth rate. We first present evidence from the EU and the US that expected changes in the growth rate of GDP do not have, while unexpected shocks do have, an effect on the change in unemployment, in line with the equilibrium rate model. A novel structural model, allowing for this distinction, is then constructed and estimated for the Finnish labour market. We solve for the equilibrium rate of unemployment and the standard error of this estimate, and evaluate policies to lower the still quite high equilibrium rate or to accelerate adjustment towards it. Reducing the replacement rate is a feasible policy option to lower unemployment permanently, although its effects will be felt only slowly. A more competitive product market and a permanent moderation in wage claims also lead to a lower equilibrium level of unemployment. Expansionary demand management policies, even though their effect is neutralised in the medium run, can, if properly designed, accelerate adjustment towards the equilibrium rate. Due to slow adjustment in the labour market, temporary wage restraint and a reduction in payroll taxes are also effective tools over the medium run, although they do not have an effect on the long-run steady state.

KEY WORDS: Equilibrium rate of unemployment, GDP growth, economic policies

JEL Code: E24, E64

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TIIVISTELMÄ: Tässä tutkimuksessa yhdistetään kokonaiskysynnän ja BKT:n kasvu, joka johtaa työttömyysasteen laskuun, tasapainotyöttömyysasteen määritelmään, joka on riippumaton talouden kasvunopeudesta. Ensiksi esitetään evidenssiä EU:n ja USA:n osalta, joka osoittaa, että tasapainotyöttömyysasteen mallin mukaisesti odotetuilla muutoksilla BKT:ssä ei ole, mutta odottamattomilla muutoksilla on vaikutusta työttömyysasteen muutokseen. Uudenlainen työmarkkinoiden rakenteellinen malli, joka sallii yo. erotuksen, rakennetaan ja estimoidaan Suomen työmarkkinoita koskien. Mallin perusteella ratkaistaan tasapainotyöttömyysasteen arvio ja tähän arvioon liittyvä epävarmuus. Sen jälkeen tutkitaan mallin avulla politiikkoja, joilla voidaan alentaa vielä varsin korkeaa tasapianotyöttömyyttä tai nopeuttaa sopeutumista sitä kohti. Työttömyyden pysyväksi alentamiseksi voidaan alentaa työttömyyskorvausastetta, vaikkakin sen vaikutukset tulevat esiin vain hitaasti. Kilpailullisemmat hyödykemarkkinat ja pysyvästi maltilliset palkkaratkaisut johtavat myös tasapainotyöttömyysasteen alenemiseen. Ekspansiivinen kysynnän säätelypolitiikka, vaikkakin sen vaikutus häipyy keskipitkällä ajalla, voi nopeuttaa sopeutumista kohti tasapainotyöttömyysastetta, jos politiikka mitoitetaan sopivalla tavalla. Työmarkkinoiden hitaan sopeutumisen vuoksi tilapäinen palkkamaltti ja välillisten työvoimakustannusten alentaminen ovat tehokkaita keinoja keskipitkällä ajalla, vaikkakaan ne eivät muuta pitkän ajan tasapainotyöttömyysastetta.

AVAINSANAT: Tasapainotyöttömyysaste, BKT:n kasvu, talouspolitiikka

1 INTRODUCTION

Growth is conceived by politicians to be the standard key recipe to improve the difficult unemployment situation in Europe. On the other hand, the basic notion used by economists to explain the persistent high unemployment is the hypothesis of the NAIRU or the equilibrium rate of unemployment, the model of which does not, however, usually allow any explicit role for aggregate demand in the goods market, and the growth rate of output, to have an impact on unemployment.

The standard tool in macroeconomics to link growth and unemployment is the classical Okun relation, which has been incorporated into a model of the labour market and equilibrium unemployment in the seminal work by Layard et al. (1991), see also Nickell (1998). On the basis of this inclusion Nickell states that aggregate demand and unemployment are not independent, but should be cointegrated with each other. However, there is some sort of a puzzle here as both variables have trended upward in Europe and therefore the long-run relationship should evolve in a perverse way from such a straightforward estimation. But, when equations of price and wage setting are taken into consideration in the model, this link vanishes in the long run. Accordingly, Nickell shows that under rational expectations expected changes in total demand, and thereby in the growth rate of GDP, do not have an impact on unemployment. This outcome depends on the fact that the equilibrium rate is supply determined, and therefore aggregate demand impulses to unemployment will be neutralised over time. Only unexpected changes in total demand, leading to a change in the growth rate of GDP, have an impact on the rate of unemployment.

This distinction is not much discussed by Nickell (1998), but we may add that it is based on the following basic mechanism. An unexpected shock to GDP growth is reflected solely in the demand for labour, without a change in the wage claims by the unions, which are based on expected growth of GDP, so that the effects of expected growth will be neutralised with respect to unemployment through a rise in wage pressure. This distinction is the basic starting point of our paper. By including this constraint we suggest a specification for a structural model of unemployment that differs somewhat from those earlier in the literature. In contrast to this neutrality, expected changes in mark ups in price setting in the goods market and wage setting in the labour market do have a permanent effect on the natural rate of unemployment.

In the early 1990s the Finnish economy experienced a depression of an exceptional magnitude on an international comparison and the rate of unemployment skyrocketed from 3.5 to 18 per cent (see Figure 6 below). In the following vigorous boom, unemployment has declined to around 9 per cent, which is still high. Therefore, it is of interest to study the Finnish case in more depth and try to evaluate policies to lower the unemployment rate further.

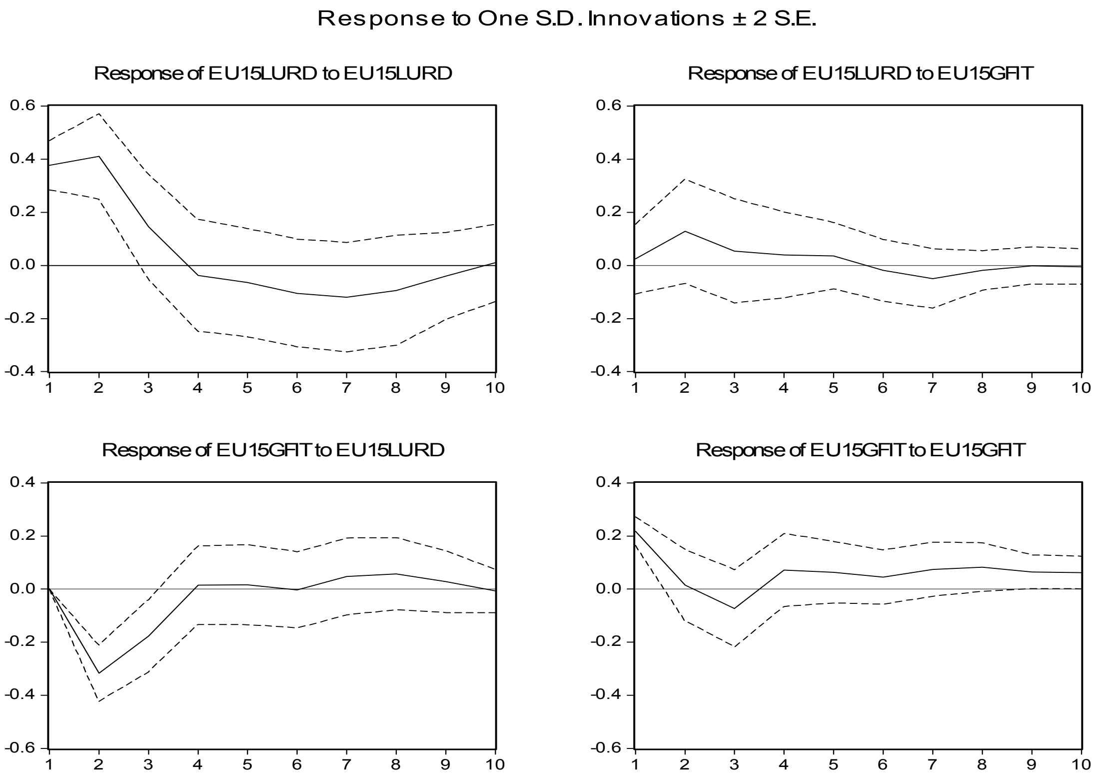
The methodological aim of this paper is to present a model that allows for the short-run impulse from growth to unemployment and which at the same time tests the long-run neutrality of the rate of unemployment with respect to the growth of GDP. First, to get some rough evidence on the above two mechanisms, i.e., the impact of the expected and unexpected impulses of growth on unemployment, we have estimated basic VAR models between the change in the rate of unemployment and the expected and unexpected growth of GDP. This is done in Section 2 for the aggregate EU 15 and US. The results basically confirm the above-mentioned distinction as to the effects of the various components of GDP growth on unemployment. Section 3 then proceeds to specify a structural model of the labour market, comprising equations for labour demand and wage setting, which tests the idea that over time wage setting by the unions neutralises the short-run expansionary effect of growth on unemployment. Section 4 presents estimation results for the model using Finnish data. Section 5 solves for the equilibrium rate of unemployment and the uncertainty related to its estimate, simulates the pass-through of a growth impulse, and evaluates a wide range of policies to reduce the unemployment rate either on a permanent basis or to accelerate adjustment towards the equilibrium rate, if the economy is initially out of equilibrium. Section 6 concludes.

2 EVIDENCE PRODUCED BY VAR MODELS

Let us first estimate basic VAR models between the change in unemployment and the “expected” and “unexpected” component of output growth for the EU 15 and the US. We have simply estimated the expected component of GDP growth to be the fit of a univariate autoregressive model of output growth and the unexpected component to be the residual of this equation. For the EU 15, we still had to include a linear time trend, as otherwise the cumulative impulse responses would grow unbounded. This is due to the fact that there is a secular deceleration in the GDP growth rate of the EU 15. So, the autoregressive equation for the GDP growth of the EU comprises, after testing for the suitable number of lags, a constant, one-year lag and a time trend, while that for the US includes a constant and two lags of the GDP growth rate.

We then estimated two-variable VAR models for GDP growth and the change in unemployment rate using annual data for the period 1965-99. The impulse responses were identified using a Cholesky decomposition so that the impulse to the growth rate of GDP precedes the shock to the change in unemployment. The results of the impulse responses appear in Figures 1-4.

Figure 1. The impulse responses of the expected component (GFIT) and the change in unemployment (LURD) in the EU15



The empirical evidence produced by the VARs is quite definitively in favour of the hypothesis that only an unexpected acceleration of the GDP growth is able to depress the rate of unemployment, while the response to the shock in expected growth rate does not differ from zero on any of the lags. The situation seems to be the same and of similar magnitude for the EU and the US, which is interesting and an important observation in itself. The impulse from growth to unemployment is neutralised in four years in Europe, while, somewhat surprisingly, in the US this takes place in a shorter time, less than three years.

Figure 2. The impulse responses of the unexpected component (GRES) and the change in unemployment rate (LURD) in the EU15

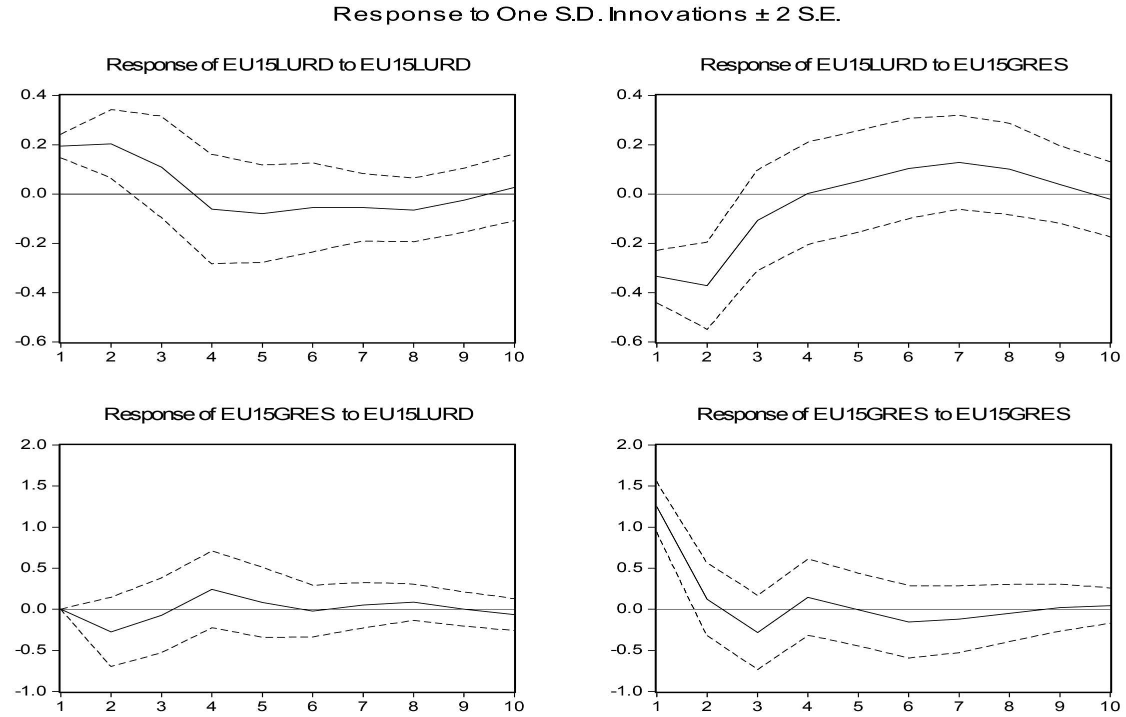


Figure 3. The impulse responses of the expected component (GFIT) and the change in unemployment (LURD) in the USA

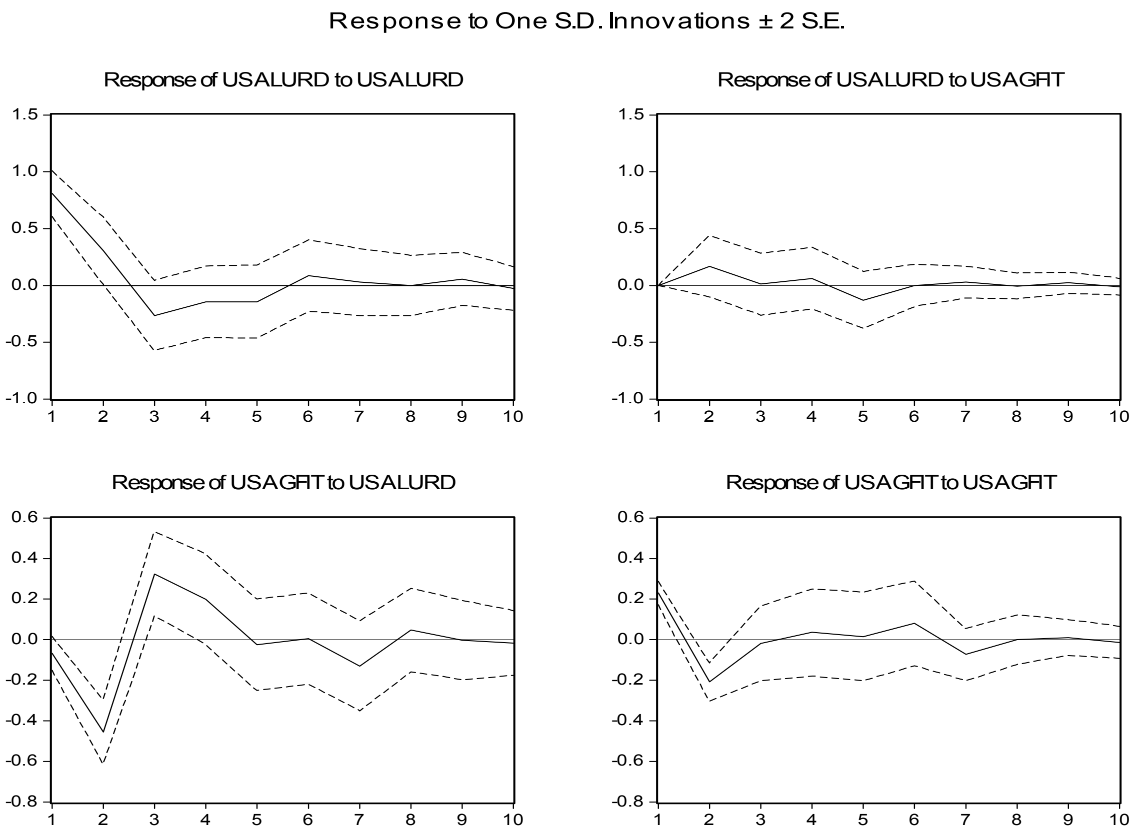
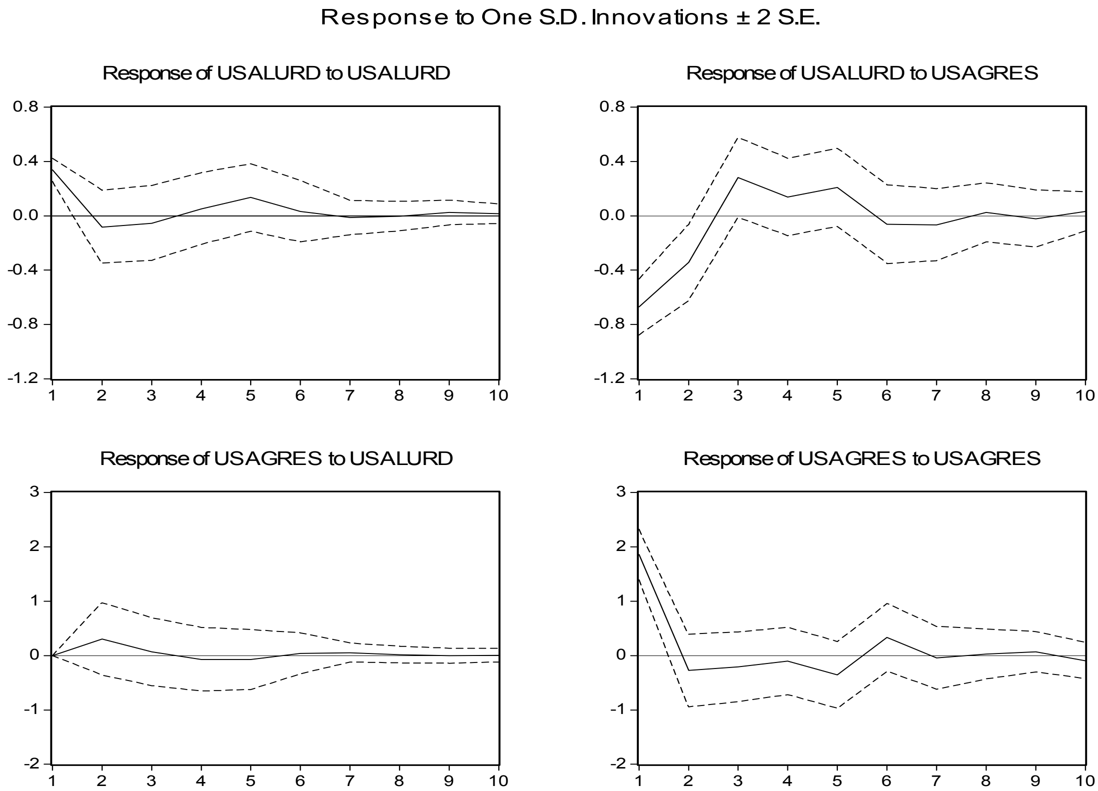


Figure 4. The impulse responses of the unexpected component (GRES) and the change in unemployment (LURD) in the USA

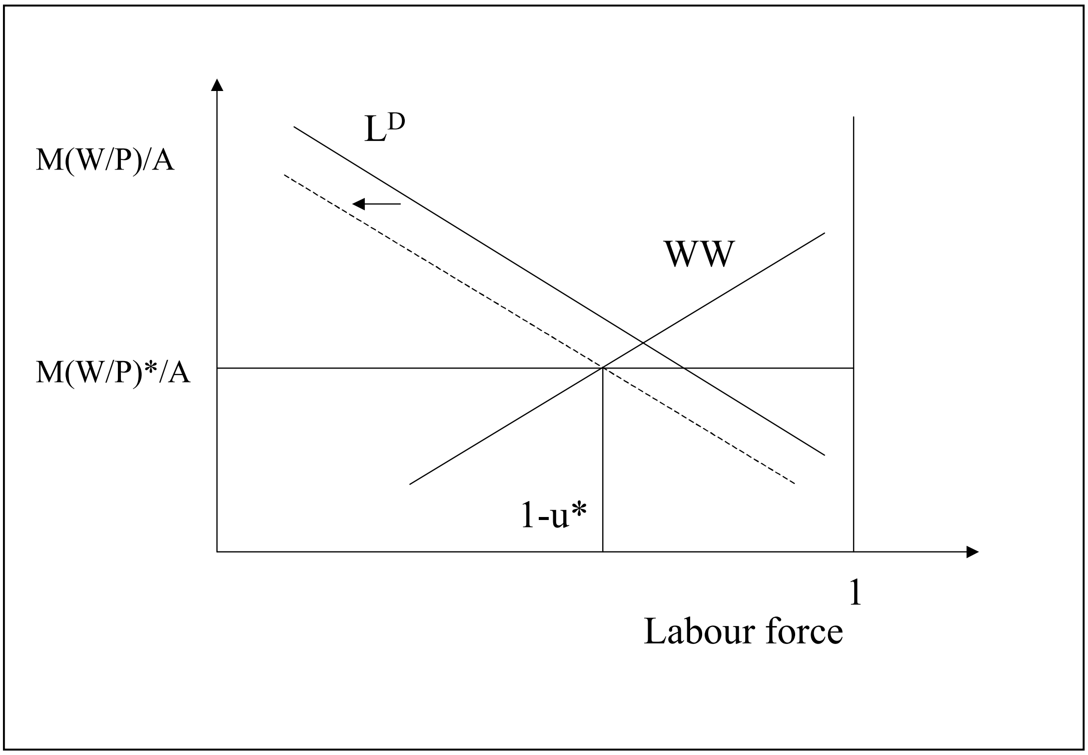


3 A STRUCTURAL MODEL OF THE EQUILIBRIUM RATE OF UNEMPLOYMENT

Let us now specify a structural aggregative model of the labour market. This model determines the equilibrium rate of unemployment, but allows, at least in the short to medium run, for the rate of growth of GDP to have an impact on unemployment. To that end, we specify a model for three variables: the rate of unemployment, the real wage and output. The idea is to incorporate short-run fluctuations in output, caused primarily by aggregate demand impulses, in a standard model of the determination of the equilibrium rate of unemployment based on the interplay between union wage setting and labour demand (price setting) by the firms.

Let us start with an illustration on how the equilibrium rate of unemployment is determined in the framework used in this paper. Assume that the constant returns to scale production function is $Q = F(K,AL)=ALf(k)$, where Q is production, K the capital stock, L the labour input, A the labour augmenting technical change, and $k = K/AL$. In the short run the capital stock is fixed and we have the downward sloping demand for labour curve L^D, determined by the marginal productivity condition $F_L(K,AL) = M(W/P)/A$, where M (≥ 1) is the mark-up factor in price setting over unit costs. The situation is as depicted in Figure 5. Along the short-run labour demand curve, however, the rate of return on capital varies as the labour input varies, but in the long-run equilibrium this rate is given by r, the real rate of interest, or, more generally, by the cost of capital: we have $F_K(K,AL) = Mr$ in the long run. This condition determines the optimal capital-labour ratio. Inserting this then into the labour demand equation yields a unique real wage $(W/P)^*$, in relation to the productivity index A, which is consistent with profit maximisation by the firms.

Figure 5. Determination of the equilibrium rate of unemployment



Wage setting (WW curve in Fig. 5), derived, e.g., from a bargaining framework between the labour unions and employers, is then the other part of the model, see below. Real wage claims in relation to productivity depend, i.a., negatively on the rate of unemployment. This relation then determines the equilibrium rate of unemployment, which is consistent with the long-run real wage given by the firms' optimisation problem.

We now turn to specify the model in a more structured and detailed way.[1] We also want to give a role to the short-run impact from GDP growth to unemployment. The first equation is the labour demand equation. Let the production function be of the CES type,

$$Q = (a_K K^{\mu} + a_L (AL)^{\mu})^{1/\mu},\ \mu \leq 1, \tag{1}$$

where 1/(1−μ) is the elasticity of substitution between capital and labour. Let us solve from this the short-run labour demand equation, as often, in the form of the labour share in total income,

$$\frac{WL}{PQ} = (1+m)^{-1} a_L (\frac{Q}{AL})^{-\mu}, \tag{2}$$

where m is the mark up of prices over unit cost in the price setting of the firms, 1+m = M. The long-run labour productivity is determined by the capital intensity K/AL, which again can be derived from the marginal condition for the productivity of the stock of capital,

$$F_K = (1+m)^{-1} g(\frac{K}{AL}) = r, \tag{3}$$

where g is a homogeneous of degree zero and an increasing function of K/AL and r is the real capital cost. From (3) we can solve for the capital intensity, and inserting this into (2) we can solve the equilibrium share of wage income in GDP as a function of the cost of capital. Let us also note that the equilibrium capital-labour ratio k at the same time determines the equilibrium labour share in output WL/PQ, as a function of the interest rate, unless the elasticity of substitution between capital and labour in production is unity (when μ = 0).

The empirical model is specified in an error correction form. We now write directly the labour demand equation in terms of change in unemployment[2], denoted by U,

$$\Delta U = \alpha_0 + \alpha_1(\frac{WL}{PQ})_{-1} - \alpha_2 U_{-1} - \alpha_3 g + \alpha_4 x_1 . \tag{4}$$

Here Δ is the difference operator, W is the labour cost per hour, including the indirect labour cost, P is the price level, g is the growth rate of GDP, and x_1 is the impact of other variables affecting labour demand or supply, especially the capital cost (the real

[1] For an explicit derivation of the wage setting equation and the labour demand in the case of the Netherlands, see Broer et al. (2000), and a more general presentation by Bean (1994). For a derivation and an empirical application of the equilibrium rate of unemployment in six OECD countries, see van der Horst (2002).

[2] We may also start, in addition to the labour demand L^D equation, from the labour supply L^S equation (in log form), depending on the wage rate and on variables x^D and x^S, respectively, and combine these equations. Using the (approximative) identity U = log L^S–log L^D, we reach an equation of the form (4), where x_1 includes both the variables x^D and x^S.

interest rate). α_1 (multiplied by the share of labour income) is the short-run elasticity of labour demand with respect to the real wage. The parameter α_2 is zero, if the specification above is correct with respect to a fixed real wage or share of labour income, determined, in the long run, by the ability to pay by the firms. Unemployment is positively related to the real wage and a higher growth rate decreases unemployment, through the Okun effect. Equation (4) can also be interpreted as a "modified" Okun curve. The mark-up factor is included in the constant term of the equation. The long-run solution of (4) is the same as given by (2) combined with (3).

Turn then to the second equation in Fig. 5, the wage setting curve. This is normally derived from a Nash bargaining model of the wage negotiations. Let the fall-back situation of the firms' profits be the capital cost, –rK, while that of the labour union be the unemployment benefits, bN, where N is the number of the members in the union. The union members may also put value on the public expenditure G, the amount of which depends on the taxes collected from the wage earners and the firms. However, if the consumption of public goods does not depend on whether the person is employed or unemployed, the solution in the wage negotiations does not depend on this item. So, the wage rate is solved from the following Nash bargaining problem,

$$\left[\frac{PQ - WL}{P_C}\right]^{\theta}\left[\frac{(W(1+s)^{-1}(1-t)L}{P_C} - bL\right]^{1-\theta}, \tag{5}$$

where θ (1−θ) is the power in the negotiations of the employers (trade unions), s is the payroll tax rate and t the income tax rate and the social security contributions paid by the employees, and P_C is the consumer price. Expression (5) is maximised under the condition that employers choose employment, once the wage rate has been agreed upon between the parties. Let us first note that if the outside option, b, is also taxed at the same rate as the wage income, then the income tax rate t does not play any role in wage setting, and in the determination of the equilibrium rate, either. But normally, leisure is not taxed, and thereby taxes play a role, see below.

The solution to the negotiated wage is in the long-run situation

$$\frac{W}{P} = H(\theta, \varepsilon_L, rp)\frac{Q}{L}, \quad H_1 < 0,\ H_2 < 0,\ H_3 > 0\ , \tag{6}$$

and where ε_L is (the absolute value of) the elasticity of the labour demand and the replacement rate rp is defined as,

$$rp = \frac{P_C b}{W(1+s)^{-1}(1-t)} = b*\frac{P_C / P}{(1+s)^{-1}(1-t)} \quad .$$

Here b* is defined as the replacement rate in ratio to the product wage (W/P). The outside option depends on the value of leisure, on the after-tax unemployment benefit b_U and the possibility of finding another job, if unemployed. The latter is influenced by the rate of unemployment, so that b = $b(b_U,U)$, see Broer et al. (2000) and van der Horst (2002) for details.

Let us now write the second equation, the wage setting curve in the following error-correction form, which satisfies (6) as a long-run equilibrium,

$$\Delta(W/P) = \beta_0 - \beta_1 U + \beta_2 g - \beta_3 \left(\frac{WL}{PQ}\right)_{-1} + \beta_4 x_2 . \tag{7}$$

The real wage demands of the labour unions depend negatively on unemployment. We also specify the real wage to depend positively on the growth of GDP. This term reflects the fact that the rent to be divided by the unions and the firms rises if the growth rate picks up and causes, through an insider effect, an increase in wage claims.[3] The coefficient β_0 represents the autonomous trend rise in productivity. The other variables x_2 include the structural characteristics of the labour market institutions, such as the replacement rate, union density, and the tax wedge with its different components, i.e., the indirect tax rate, the income tax rate and the value added tax rate.

The third equation of the model is the output equation,

$$g = -\chi_1 \Delta U + \chi_2 x_3 . \tag{8}$$

In (8) the first term describes the temporary supply side effect coming from the change in unemployment to growth, so that a reduction in unemployment, achieved through reforms in the functioning of the labour market, also leads to a pick-up in the growth rate as the labour input increases. The term x_3 presents the influence of aggregate demand factors such as government expenditure, taxes, and monetary policy measures, including the exchange rate, see below.

Now, the equilibrium rate of unemployment, denoted by U_e, derived as a long-run steady-state equilibrium of equations (4) and (7), given the current level of variables x_1 and x_2, is as follows[4],

$$U_e = \gamma_0 + \frac{1}{\gamma_1}\left(\frac{\alpha_1 \beta_2}{\beta_3} - \alpha_3\right) g + \gamma_2 x_1 + \gamma_3 x_2 . \tag{9}$$

The γ parameters here are combinations of α's and β's in (4) and (7) and are all positive. Equation (8) does not have an independent role in (9), as is plausible, and thus the supply side measures included in (8) have to be taken into account directly by including them in (4), if they are assumed to have an influence on the equilibrium rate of unemployment, too.

The equilibrium unemployment rate (9) does not depend on the growth rate of GDP, if the term in brackets is zero. The interpretation of this condition is straightforward, namely, that the short-run positive effect of a demand expansion on employment will be lost through the consequent long-run rise in wage pressure and its adverse effect on the rate of unemployment. This constraint will be explicitly tested below. However, in the short to medium run an expansion in output, created by a pick-up in total demand, will cause either a reduction in unemployment (if α_3 is large), as is plausible, or a rise in unemployment (if β_2 is large), which is not so plausible.

This specification of the equilibrium rate closes the model here in a way which differs from that presented by Layard et al. (1991) and in the Finnish case by both Honkapohja and Koskela (2000), and Kiander and Pehkonen (1999). They all close the model by

3 Note that for simplicity nominal wage flexibility has not been considered in the model yet. We add this feature in Section 4.

4 For various definitions of the structural rate of unemployment, see Turner et al. (2001).

specifying that aggregate demand, driving unemployment in the short run as explained above, will be constrained in the long run by the balance in foreign trade or foreign borrowing of the economy. This is acceptable in itself, but specifying this constraint in exact empirical terms may be somewhat arbitrary. Here we specify the stronger neutrality result that demand expansion, without paying attention to the possibilities of a continued boom, will be neutralised through the consequent higher wage pressure. We consider our method to close the model and solve for the equilibrium rate of unemployment to be more robust and an alternative to the standard procedure.[5]

[5] It should be noted, however, that Layard et al. (1991) basically need the external constraint to tie the effect of the price wedge (i.e. real exchange rate) in the long run. In our estimation, the price wedge does not work in a meaningful way, so we can skip this extension.

4 AN EMPIRICAL ESTIMATION OF THE MODEL

We now turn to estimating the model using Finnish annual data for the period 1965 to 1999. As the explanatory variable x_1 in equation (4) we identified the real interest rate (rrl), as discussed above and included in a number of equilibrium rate models, for example in Kiander and Pehkonen (1999) and in Honkapohja and Koskela (1999). In equation (7) we included as variables x_2 the tax wedge, its three components (the indirect labour costs, income tax and the VAT) plus the price wedge (ratio of import price to output price), the replacement rate after tax (brate)[6] and the union density.

We also want to allow for a potential asymmetry as regards the effects of the growth of GDP so that the effect of a positive growth rate (g^+) can be different from that of a contraction in output (g^-). The justification for this is that it is likely that the real wage resistance is stronger during a downturn so that the unions are not willing to cut their wage claims in a symmetric way as they are willing to raise them during a boom. The same issue can also be raised in relation to the Okun coefficient, i.e., the parameter α_3. Firms may hire and fire differently in booms and depressions. As mentioned in the Introduction, the Finnish economy experienced an exceptionally deep depression in the early 1990s, when the cumulative loss in real GDP was 13 per cent in 1991-93 and the rate of unemployment skyrocketed from 3.5 per cent to 18 per cent in a few years (see Figure 6 below). Therefore, this separation may be a vital element in the analysis of the labour market and the Finnish case also gives an interesting possibility to empirically analyse the two effects.[7] Note that we have the identity $g = g^+ + g^-$ and we can in a straightforward way test whether the real wage and employment adjustment are symmetric or asymmetric in booms and recessions.

The empirical model is formulated, as mentioned above, so that the equations are specified in an error correction form. The variable to be explained in (7) was specified so that it is the (percentage change) in the total real labour cost per hour. We also allowed for nominal rigidity and, accordingly, included in the wage equation the change in the inflation rate measured by producer prices. Construction of the variables and graphs of the main data series are presented in the Appendix.

The model (the two equations (4) and (7)) was estimated by the full information maximum likelihood method. Estimation results of the labour demand equation are presented in Table 1.

The coefficient of the lagged unemployment rate in Table 1 was not significant, implying that the equilibrium level of the labour share in GDP is solely determined by the long-run competition in the goods market, in consistency with the theoretical model presented above. The real interest rate is not here a significant explanatory variable, in contrast to Pehkonen and Kiander (1999). Nor does inclusion of the growth rate in the equation make the interest rate variable insignificant. So, a puzzle is apparent in this equation with respect to the interest rate variable. In the popular debate of the Finnish depression it has been common to refer to the abnormal rise of the interest rate prior to

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6 In Finland unemployment benefits were tax exempt before 1983, after which they were raised markedly and made taxable. Our variable ‘brate’ captures this change, and displays throughout the average after-tax replacement rate.

7 See the VAR analysis of the US and Canadian labour markets allowing for a similar distinction by Dibooglu and Enders (2001).

the devaluation of the Finnish markka in 1991-92, see graphs in the Appendix. Accordingly, if we interact the real interest rate with a dummy variable for the depression of the 1990s (the variable depr being unity after 1991 and zero before), we get a somewhat significant effect from the interaction variable on unemployment, see Model 4 in Table 1. In this case, however, the solution for the equilibrium rate (see Section 5) is not so successful as in our preferred specification. As argued above in Section 3, the long-run labour demand schedule is independent from the interest rate, if the elasticity of substitution is unity, which seems to be the case according to our basic estimation result.[8] So, the above estimation result gives evidence that the aggregate long-run production function is of the Cobb-Douglas type in Finland, although in the 1990s there seems to be a divergence from it, as analysed thoroughly by Ripatti and Vilmunen (2001).[9]

Table 1. Estimation results for the labour demand equation, the variable to be explained is the change in the rate of unemployment (ΔU)*

Explanatory variable	Model 1 Coeff.	t-value	Model 2 Coeff.	t-value	Model 3 Coeff.	t-value	Model 4 Coeff.	t-value
Constant	–21.114	4.95	–21.236	5.64	–21.571	6.18	–22.461	6.44
Labour share $(WL/PQ)_{-1}$	0.418	5.31	0.417	6.33	0.426	7.05	0.421	6.79
g	–0.237	4.45			–0.235	4.01	–0.176	3.71
g^+			–0.245	3.72				
g–			–0.234	1.85				
Real interest rate, rrl	0.005	0.10	0.074	1.21				
rrl*depr							0.229	2.10
AR (1)	0.728	4.39	0.78	4.85	0.744	4.36	0.847	6.83
R_C^2 D-W	0.81	2.11	0.83	1.96	0.81	2.11	0.88	2.48

* All variables, except the constant, have been multiplied by 100 and are therefore percentage changes or percentage shares.

There is also some lagged effect from growth to unemployment (which is not present in Table 1), but this change in the specification lowered markedly the significance of the

8 If the capital cost rises, this will lead to a lower capital-labour ratio, and this will lead a lower productivity and, further, to a lower real wage so that the income shares and the equilibrium rate of unemployment remain unchanged. See a discussion on the role of the elasticity of substitution by van der Horst (2002).

9 However, according to our estimation result, the short-run elasticity of substitution (based on parameter α_1 in eq. (4)) is only 0.2, and rises gradually so that it will take as long as almost ten years, before it is close to unity.

effect from the wage push on the rate of unemployment. The effect of the positive and negative growth rates on the change in unemployment is very symmetric (the probability of the χ^2-test statistic for the equality of these coefficients is 0.937).[10] We also tested whether the specification of the equation remains unchanged in the Finnish crisis of the early 1990s by including the dummy variable 'depr' in the equation. It turned out to be non-significant and to be a substitute for the negative growth rate variable, as is plausible. Therefore, we retained the basic specification in Table 1.

Table 2. Estimation result of the wage setting equation, the variable to be explained is the percentage change in the real wage cost per hour*

Explanatory variable	Model 1 Coeff.	Model 1 t-value	Model 2 Coeff.	Model 2 t-value	Model 3 Coeff.	Model 3 t-value
Constant	22.519	1.80	22.009	1.69	14.998	2.41
Δ Inflation rate	–0.358	3.06	–0.360	2.97	–0.274	3.60
Unemployment rate U	–0.596	2.64	–0.577	2.30	–0.698	3.61
Labour share $(WL/PQ)_{-1}$	–0.314	0.88	–0.165	0.65	–0.252	2.74
Replacement rate $(brate)_{-1}$	0.315	2.52	0.366	2.07	0.148	1.74
Tax $wedge_{-1}$	–0.233	1.51	–0.285	1.32		
GDP growth g_{-1}	0.279	0.95			0.141**	..
$(g^{+})_{-1}$			0.258	0.86		
$(g^{-})_{-1}$			0.628	0.29		
R_C^2 D-W	0.72	1.62	0.72	1.65	0.636	1.38

* All variables, except the constant, have been multiplied by 100 and are so percentage changes or shares.

** The coefficient was constrained to this value by condition (4).

Let us then turn to the first estimation of the wage setting equation, see Table 2. As can be seen from Model 1 in Table 2, other variables are significant and of the right sign, only the tax wedge variable is of the wrong sign and not significant. There are opinions that the tax wedge should not have an influence on wage setting, see e.g. Blanchard and Wolfers (2000), as (many of) its components should have an equal effect on the real disposable income of the employed and unemployed and should therefore be irrelevant

[10] Virén (2001) has studied whether the Okun relation is non-linear using a sophisticated threshold model estimator. The outcome is that, in general, growth has a big effect on unemployment when it is vigorous and the reverse holds in a depression. However, in the case of Finland, this asymmetry is rejected.

with respect to wage setting, a point mentioned above in connection with expression (5). We study this issue in more detail below in Table 3.

There is evidence in Table 2 that wage setting does not react strongly to output growth. Using different lag specifications, we were not able to find strong evidence that the growth rate would have a marked effect on wage formation as such. This might be a sign of the lack of insider power in the Finnish labour market. Let us next split the variable into two parts in the manner explained above. We see from Model 2 that the effect of negative growth of GDP on wage rises is very weak. We then imposed the long-run neutrality constraint as regards the relationship between growth and unemployment, specified above in (9). This constraint is accepted by the χ^2 -test, the test statistic being 0.11 with a probability of 0.74. The estimation result, when this constraint is imposed upon the system, is presented in Models 3 in Tables 1 and 2.

The hypothesis of hysteresis is clearly rejected. The constraint that the coefficient of the level of unemployment in Table 2 is zero is rejected by a wide margin indeed (the probability of the test is 0.0009).

Above we only paid attention to taxes from the point of view of the total tax wedge. Let us now turn to consider this important policy tool in more detail. Nickell and Layard (1999) (see also Nickell, 1999) included both the level of taxes and the change in taxes in their cross-country wage equation and concluded that the former is not significant while the latter variable is. We followed this route and reached the outcome in the Finnish case, presented in Model 1 in Table 3, that neither effect works in a meaningful way.

Here we come to a similar conclusion as Nickell and Layard (1999) that the equilibrium rate of unemployment is unaffected by taxes, suggesting that labour bears all of the burden of taxes in the long run. Moreover, it is only the change in the indirect labour cost, the payroll tax, which has an impact on wage setting, see Model 2 in Table 3. However, in the simulation of the model, the impact from a reduction in these taxes will be spread over quite a long time span so that it is anyway quite an effective policy tool in lowering unemployment at least in the Finnish case over the medium-run, see Section 5. Similarly, also Daveri and Tabellini (2000) came to the conclusion that there is not a strong case to argue that increased labour taxes in the Nordic countries would have contributed to a higher rate of unemployment, while, in contrast, in the continental European countries they have quite clearly done so. Recently, Böckerman and Kiander (2002) also concluded that the tax wedge does not have an influence on sectoral labour demand in Finland, in contrast to what was obtained by Kiander and Pehkonen (1999) using an aggregate model.[11]

Model 1 in Table 3 reveals that the coefficients on the tax and price wedge variables are not meaningful as a whole. In Model 2 we have split the change in the wedge into its four components, and in Model 3 only retained the indirect labour cost variable, which seems to work in a sensible way. Model 3 is our preferred wage setting equation. Of the additional variables tested in estimation, it should be noted that the union density variable was not at all significant in the wage equation.

[11] See Koskela (2001) and Aronsson et al. (2002) on a general analysis of the relations between unemployment and taxation.

Table 3. Testing the impact of taxes on wage setting

Explanatory variable	Model 1 Coeff.	Model 1 t-value	Model 2 Coeff.	Model 2 t-value	Model 3 Coeff.	Model 3 t-value
Constant	25.280	4.02	18.628	0.82	19.328	4.79
Δ Inflation rate	–0.274	2.27	–0.192	1.04	–0.254	2.03
Unemployment rate U	–0.710	3.30	–0.686	1.66	–0.618	3.35
Labour share $(WL/PQ)_{-1}$	–0.454	3.26	–0.406	1.47	–0.333	4.87
Replacement rate $(brate)_{-1}$	0.473	4.57	0.377	3.82	0.121	1.74
GDP growth g_{-1}	0.187**	..	0.167**	..	0.183**	2.96***
Tax wedge	–0.270	2.50				
Δ Tax wedge	0.110	0.70				
Indtax			–0.136	0.58		
Δ Indtax			0.867	2.07	0.740	1.50
Inctax			–0.344	1.20		
Δ Inctax			–0.172	0.65		
Valatax			–0.097	0.21		
Δ Valaddtax			–0.207	0.49		
Price wedge	0.072	2.04	0.088	1.88		
Δ Price wedge	–0.128	1.99	–0.164	2.57		
R_C^2 D-W	0.815	2.47	0.844	2.49	0.778	1.73

* All variables, except the constant, have been multiplied by 100 and are so percentage changes or shares.

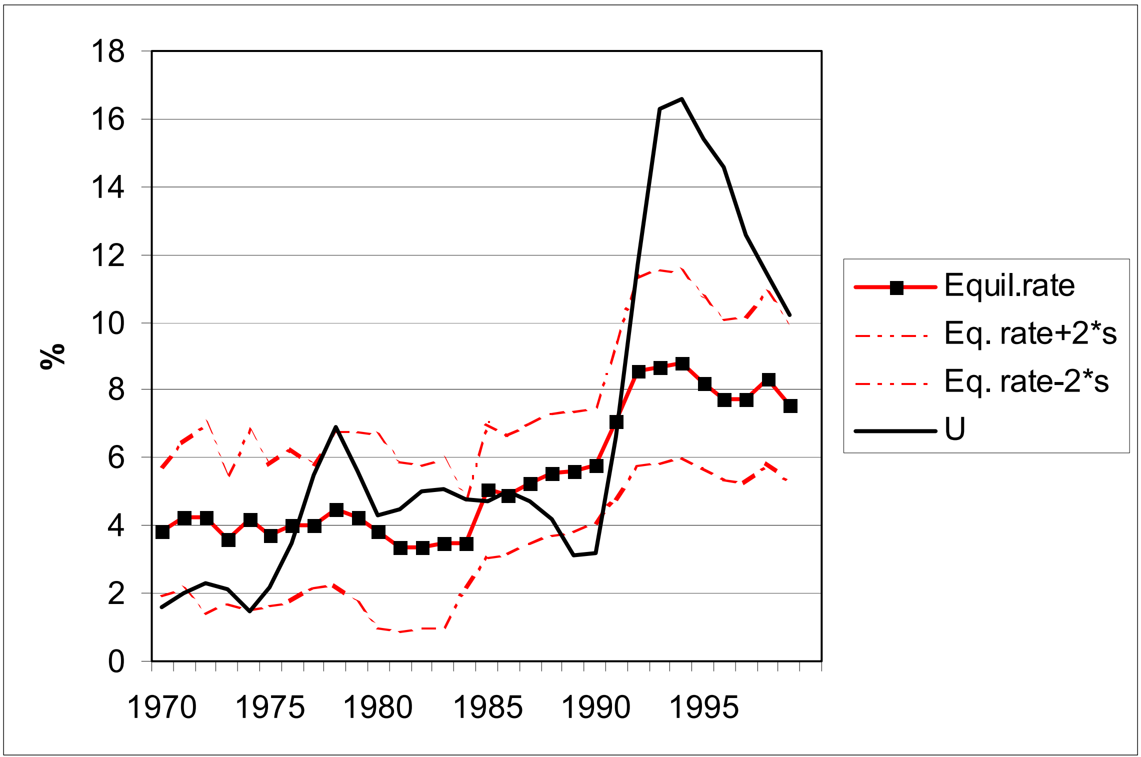
** The coefficient was constrained to this value by condition (9).

*** For estimation of the t-value, see footnote 12.

4 ANALYSIS OF POLICIES TO LOWER THE EQUILIBRIUM RATE OF UNEMPLOYMENT OR TO ACCELERATE ADJUSTMENT TOWARDS IT

The equilibrium rate of unemployment produced by the model, see (9), given the current levels of the exogenous variables explaining the mark ups, assuming in the standard manner that the inflation rate remains stable, is displayed in Figure 6. We have also calculated an asymptotic standard error (s) of the estimate of the equilibrium rate, which gives us a confidence interval for the estimate of the equilibrium rate, also shown in the Figure.[12]

Figure 6. Estimate of the equilibrium rate of unemployment in Finland (based on Model 3 in Table 1 combined with Model 3 in Table 3, s = standard error of the estimate of the equilibrium rate)



The equilibrium rate is driven here solely by the replacement rate, which was the only significant variable in level form in the wage setting equation, and the average mark ups in the two equations. The equilibrium rate, has risen to a level somewhat less than 8 per cent currently, while the actual rate exceeded this by a wide margin during the crisis of the early 1990s. Unemployment has declined from that abnormal level but the rate in 1999 was still at the upper end of the confidence interval. The actual rate has subsequently continued to decline so that its current level of 9 per cent is closer to our estimate of the equilibrium rate.

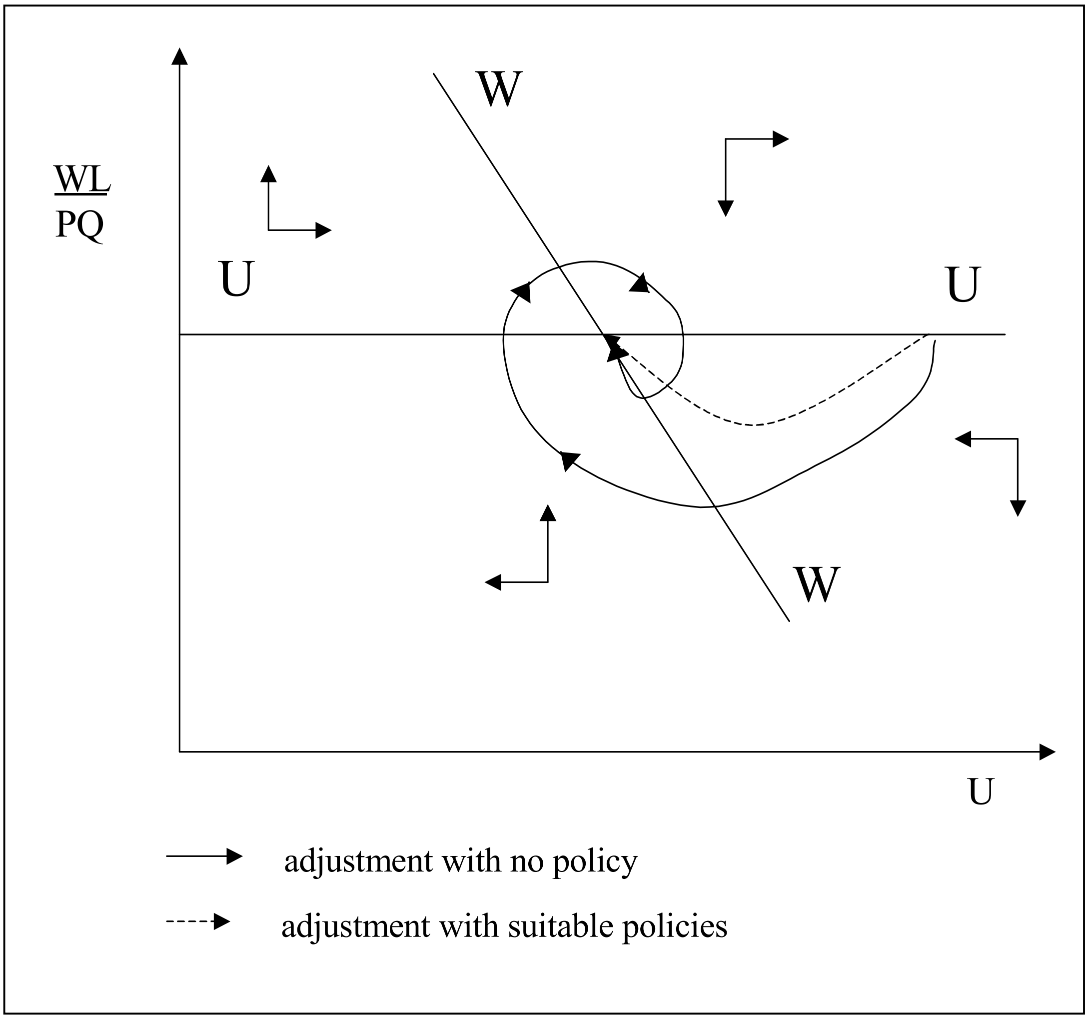
---

[12] This was estimated with the aid of the Wald test on a constraint imposed on the coefficients, conditional on the values of the exogenous variables. If W is the value of the test χ^2 -statistic that U_e, the equilibrium rate, is zero, we can solve the standard error s of the estimate of U_e from the definition of W, which gives $s^2 = (U_e)^2/W$.

Let us then turn to simulation of various policies with the aid of the model. We distinguish *two types of simulations*: first, we can find out, whether a change in a policy variable is able to *lower the equilibrium rate* of unemployment. In order this to hold the coefficient of the variable concerned has to have a non-zero (long-run) coefficient in the level form in either the labour demand or wage setting equation. If the variable concerned is only present in a difference form in the model, or its long-run coefficient is zero, it does not have an impact on the equilibrium rate of unemployment. However, when the current rate of unemployment is out of equilibrium, such temporary policies can be used to *accelerate adjustment towards equilibrium*, but only if applied temporarily. In this specific sense, we can in a way also discern a permanent effect of such policies on the current rate of unemployment.

The situation is illustrated with Figure 7. The identity for the share of labour income in GDP (WS) was plugged into the wage setting equation and thereby the system was transformed into a dynamic two-variable equation system in the unemployment rate and the labour income share. The long-run relations are the ability to pay (the UU-curve) and the wage setting (WW). The adjustment pattern outside equilibrium is also depicted in the Figure. As the empirical dynamic model has two imaginary roots, the adjustment towards the equilibrium involves cycles, see also below Figure 14.

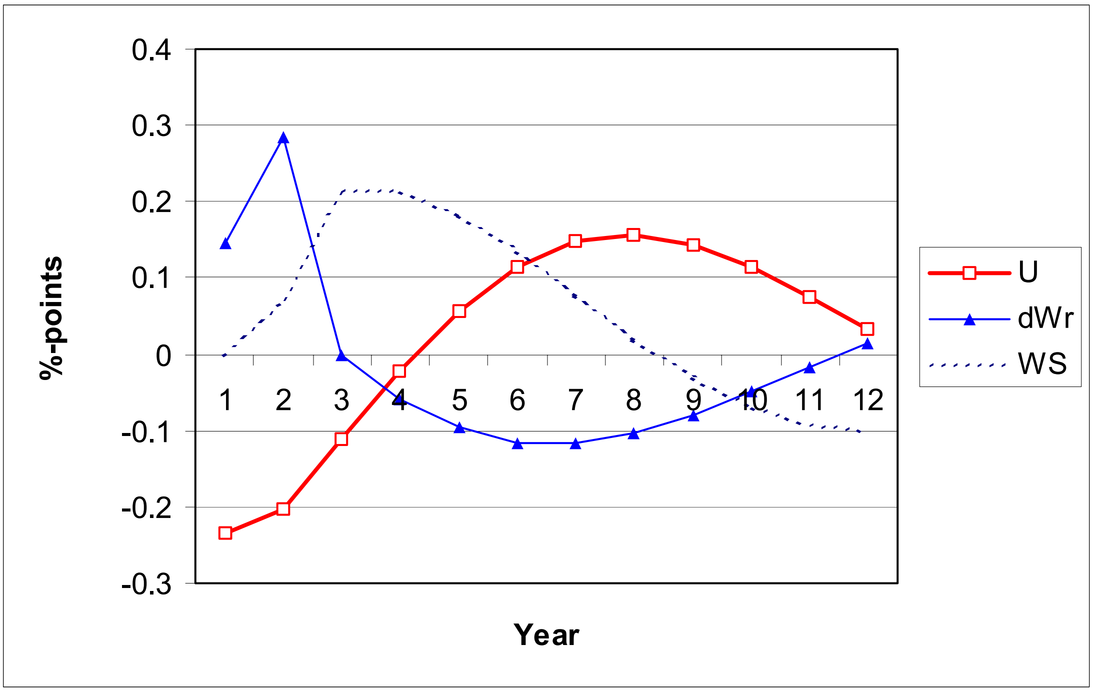
Figure 7. Adjustment to the equilibrium according to the empirical model



Policies that have an effect on the long-run equilibrium rate of unemployment have to shift permanently the UU or the WW curve. With a suitable selection of fiscal and incomes policies the cyclical adjustment can be skipped and a more rapid approach to the equilibrium reached, see below subsection 5.2.

Let us first see how the shock to the growth rate in GDP will be transmitted to the rate of unemployment. A simulation of Models 3 in Table 1 and 3, combined with an identity for the dynamics of the labour income share variable[13] to an impulse of 1 percentage point increase in the growth rate of GDP is presented in Figure 7. (The growth rate returns to the baseline from year 2 onwards.) The reaction of the wage rate is quite strong in year 1 (when the shock occurs) and even bigger in the next year. The wage rate reacts first positively, but from year 4 onwards its rate of increase declines below the baseline path. The positive reaction from growth to the level of unemployment fades away in four years according to this estimation result, similarly as in the VAR estimations in Section 2.

Figure 7. Simulation of the model to an increase of the growth rate of GDP by 1 percentage point in year 1 (U = rate of unemployment, dWr = change in the real wage cost per hour, WS = share of labour income)



5.1 Policies that lower the equilibrium rate

In order to achieve a permanent effect on unemployment, a permanent shift in the UU and WW curves in Figure 7 are necessary, as mentioned above. The latter can, i.a., be achieved by a *permanent lowering of the replacement rate*. The results of this simulation, in relation to the baseline, are presented in Figure 8. The effects of such a policy are felt only gradually. Using this policy is, however, quite difficult in practice, due to the many political constraints related to it.

13 The exogenous growth in labour productivity was fixed to 2.5 per cent per annum.

Figure 8. The effect of a permanent lowering by 5 percentage points of the replacement rate (U = rate of unemployment, dWr = change in the real wage cost per hour, WS = share of labour income)

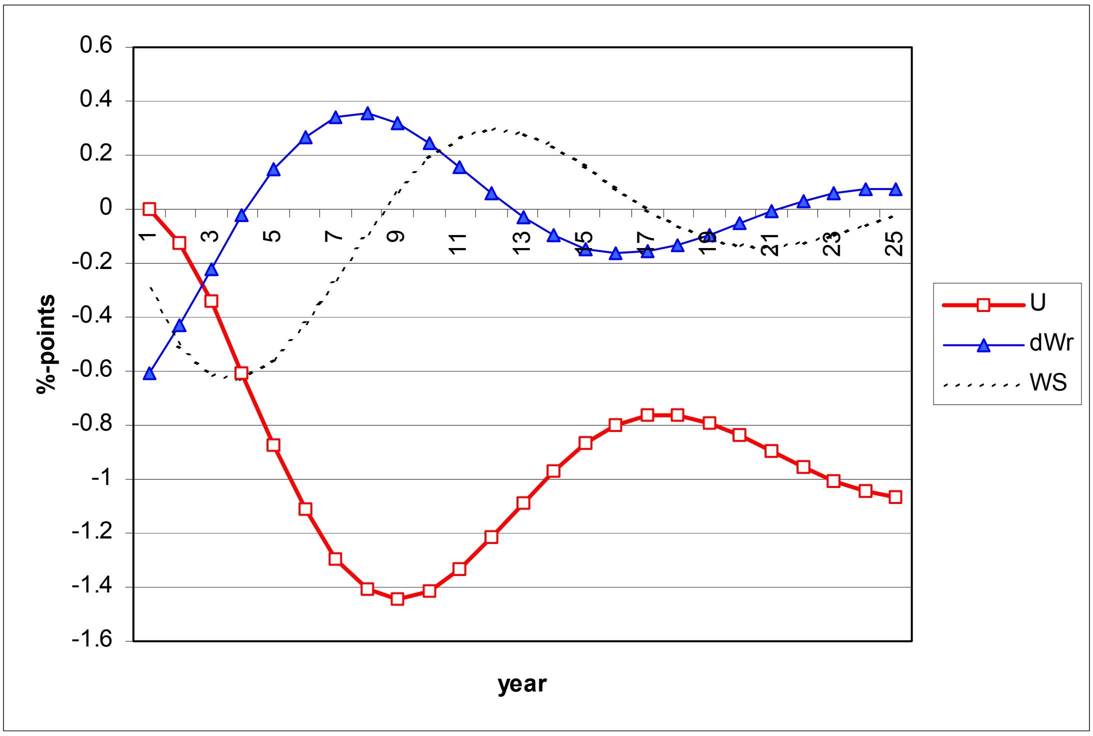
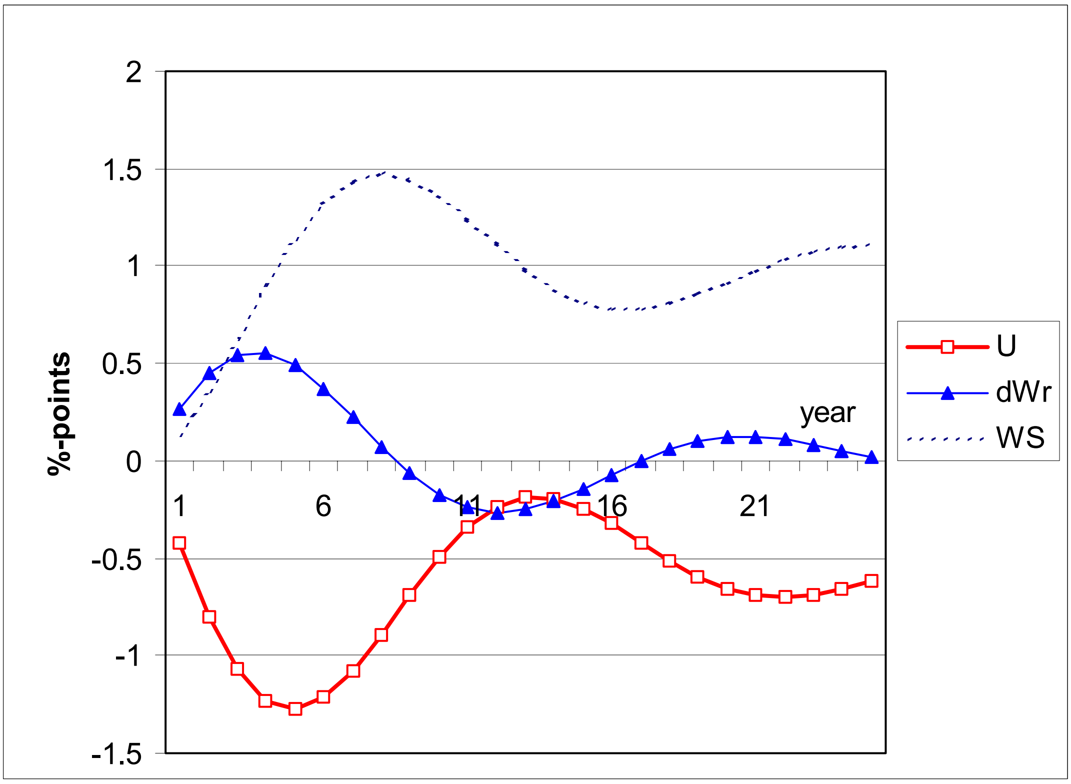


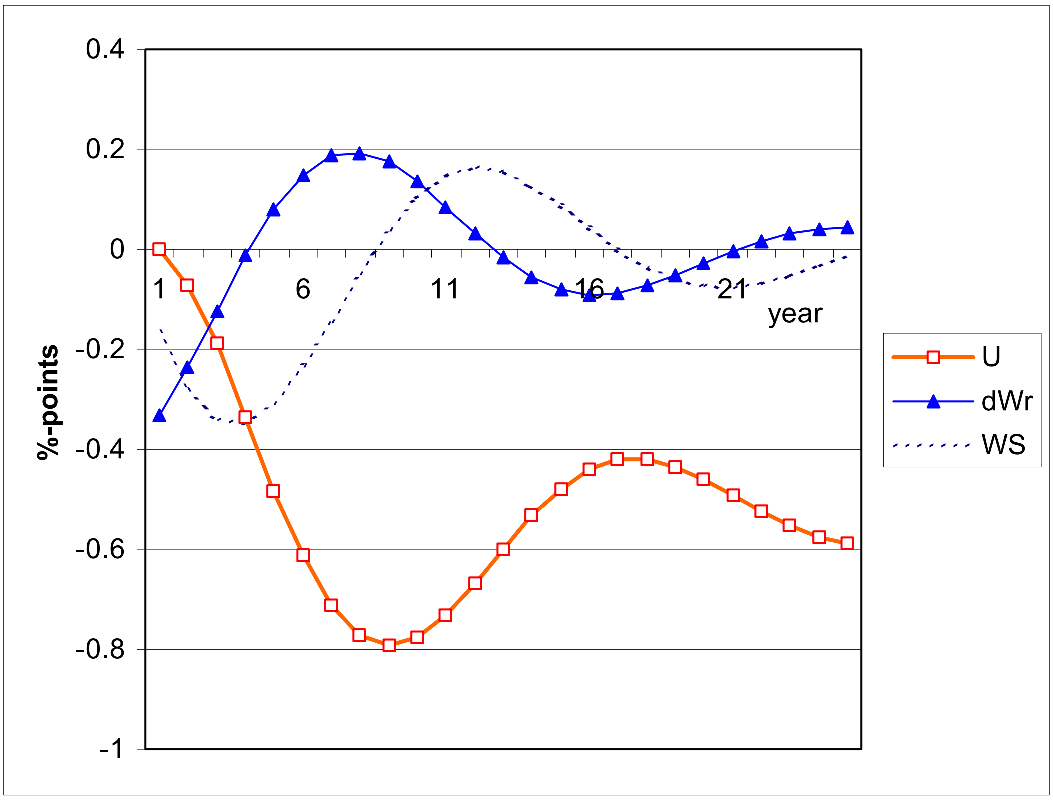
Figure 9. The effects of a permanent reduction in the mark of prices over wage cost, i.e. lowering in the equilibrium profit rate (share of non-wage income in GDP) by one percentage point (U = rate of unemployment, dWr = change in the real wage cost per hour, WS = share of labour income)



Policies which *lower the mark-ups in price setting in the goods market* and lead to a *permanent moderation in the wage setting policies* of the unions are also able to bring down the rate of unemployment on a permanent basis. In Fig. 7 the former change means a shift upwards of the UU curve. In Figure 9 we, accordingly, depict the effects of lowering of the profit rate (share of non-wage income in GDP) through a shift in the mark up in the price setting (labour demand) behaviour downward so that the share of labour income in GDP rises by one percentage point in the long run.

Figure 10 presents a similar simulation for permanently more moderate wage behaviour which leads to a shift downwards in the wage setting equation, i.e., a shift downward of the WW curve in Fig. 7. Accordingly, the share of the wage income in GDP, at a given the rate of unemployment, goes down by one percentage point. However, as is evident from Fig. 7, the share WS of labour income in GDP does not change in the long run as it is solely determined by the equilibrium prevailing in the competition in the goods market.

Figure 10. The effects of a permanent moderation in wage setting which lowers, given the rate of unemployment, the share of wage income in GDP by one percentage point in the long run (U = rate of unemployment, dWr = change in the real wage cost per hour, WS = share of labour income)



Deregulation of the product markets (Fig. 9) would produce a more rapid leverage as to unemployment than moderation in wage setting (Fig. 10), although a drawback in our analysis of the former policies is that it is not identified in the model, how and by what measures this change could be achieved in practice. The model of equilibrium unemployment is not specified in this respect.[14]

[14] As an additional policy able to drive permanently the rate of unemployment down, we could also think about acceleration of the growth rate in productivity, coupled with maintaining the previous wage setting curve.

Figure 11. Combination of the three policies analysed in Figures 8, 9, and 10

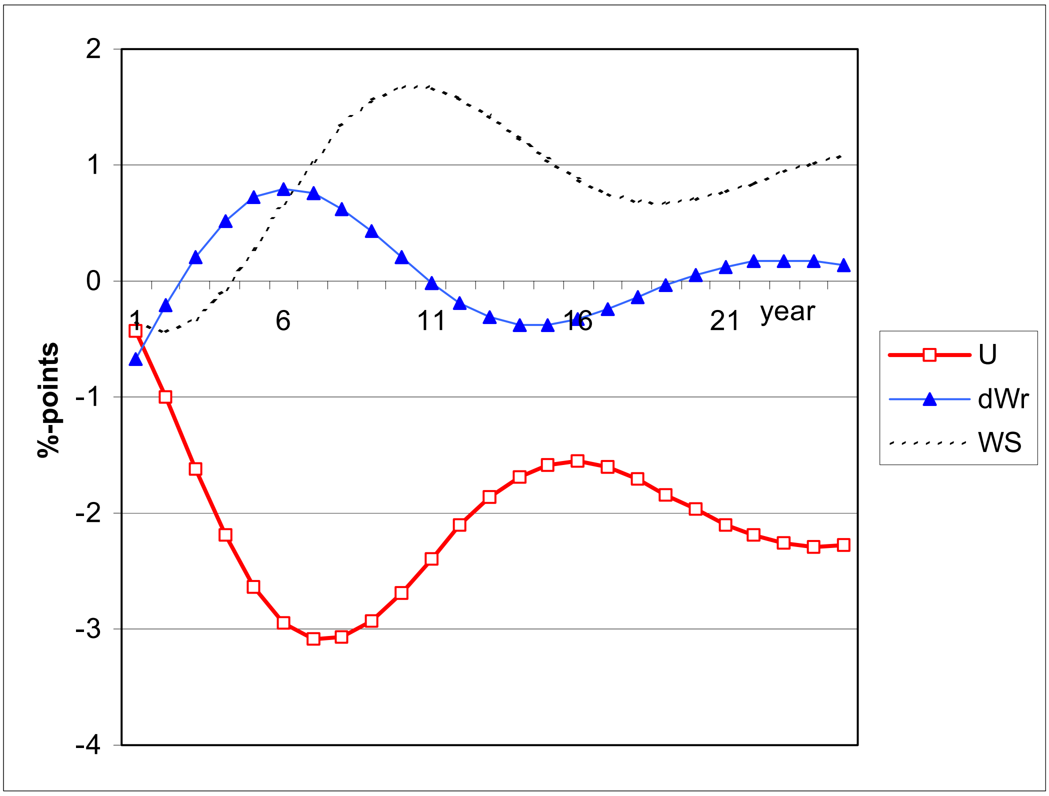
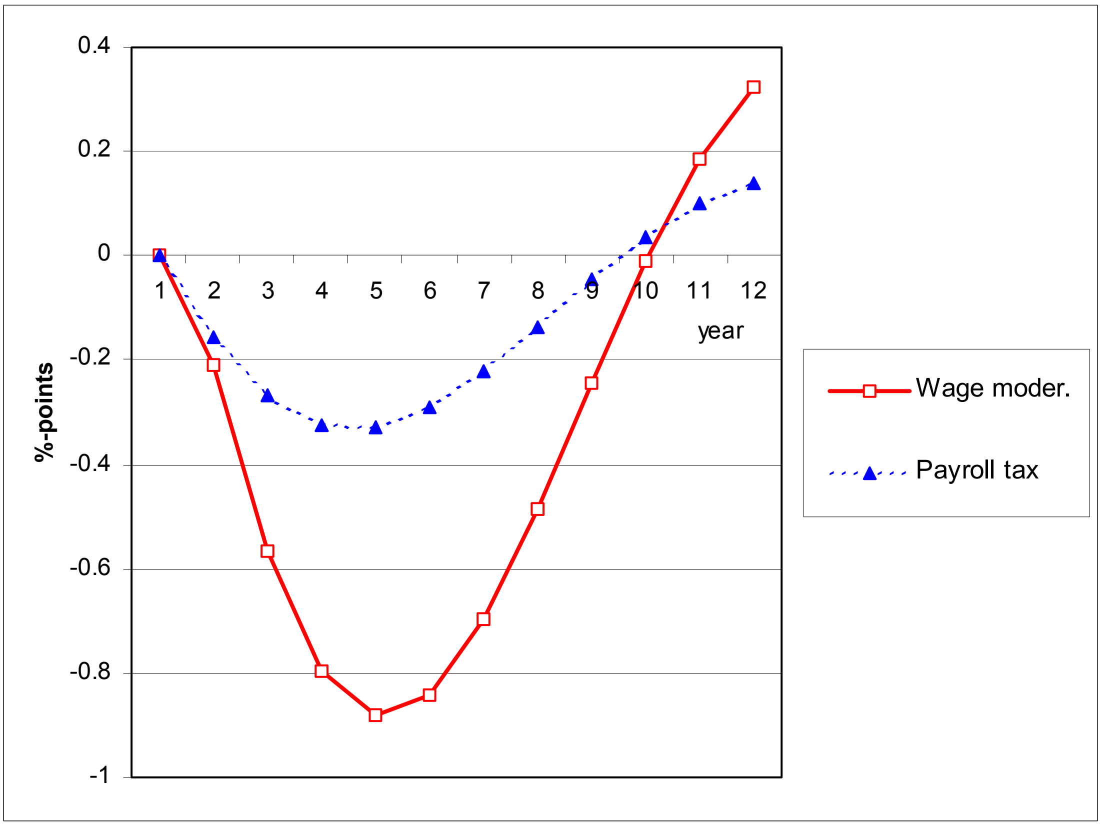


Figure 12. The effects on the rate of unemployment of a temporary wage restraint where the real labour cost per hour is reduced by one percentage point in years 1 and 2, and a permanent reduction in the payroll tax by one percentage point



It has recently been suggested in Finland that the country should take as a goal to drive the unemployment rate back to 5 per cent by the end of the current decade. Through means of combining the above three policies, Figure 11 shows that the present level of equilibrium unemployment (7.5 per cent, see Fig. 6) could indeed be driven down to the desired level over the desired time period. The overall required real wage adjustment is, however, quite negligible and of a temporary character, based largely on the reaction seen in Fig. 9.

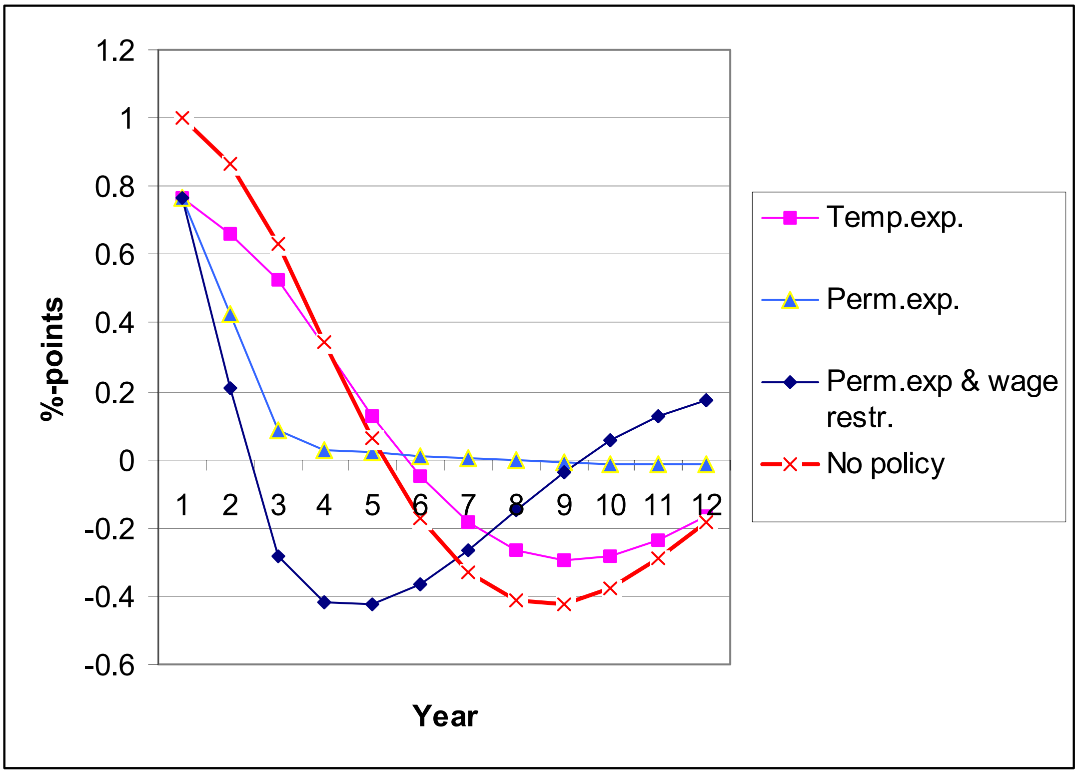
Let us close this subsection by making a note on the role of taxes and incomes policy. Due to the dynamic properties of the model policies, which are neutral in the long-run, like lowering of the payroll tax paid by the employers and a temporary wage restraint, are nevertheless quite effective tools, especially the latter, in lowering unemployment in the medium run, see Figure 12.

5.2 Policies that accelerate adjustment to the equilibrium rate

Consider then policies to accelerate adjustment towards the equilibrium rate after an adverse shock to unemployment in a situation where the economy is out of the long-run equilibrium. In all the cases above, there is room for policy intervention in order to avoid cyclical adjustment around the equilibrium, as shown in Fig. 7.

In Figure 13 we have simulated expansionary demand management policies in the case where there is a rise by one percentage point in unemployment rate in year 1 and com-

Figure 13. Reaction to an adverse shock in unemployment of 1 percentage point by expansionary policies, the difference in the rate of unemployment from the equilibrium rate of unemployment *

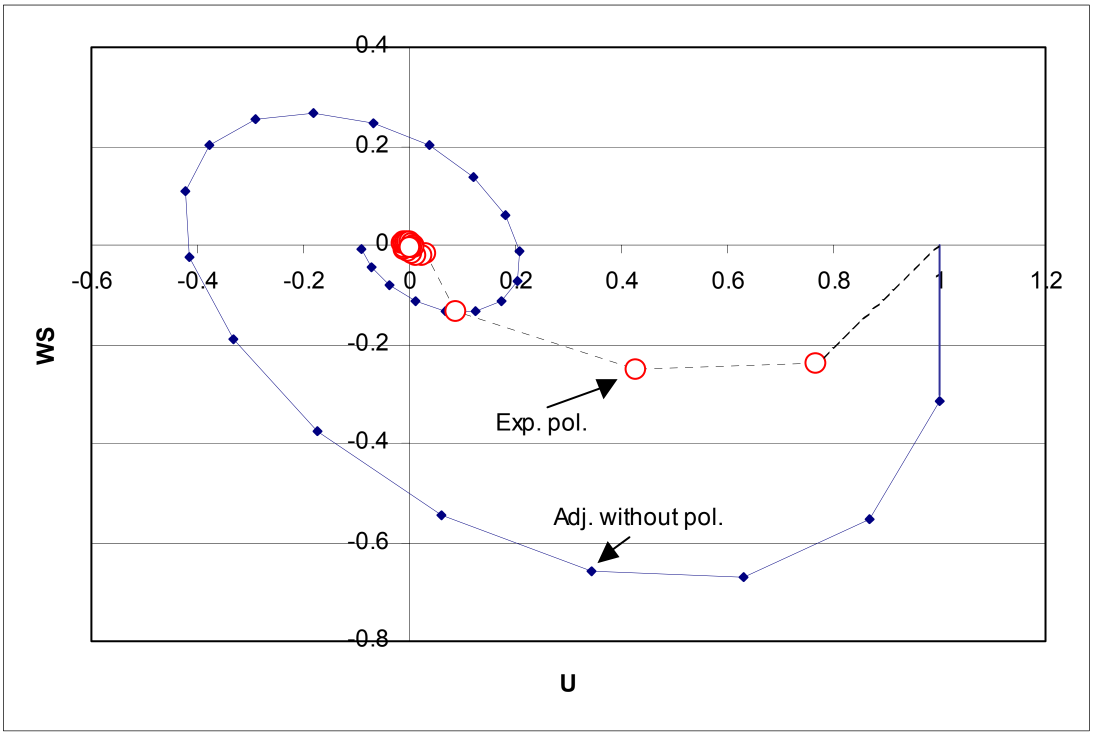


* For explanations, see the text.

pared various policies to the case of autonomous adjustment of the economy without any change in policies. In the first two scenarios, respectively, demand policies boost the growth rate of GDP by one percentage point for one year (a temporary expansion) or for three consecutive years (a permanent expansion in Figure 13), but is then abandoned. In the third alternative, the permanent demand expansion is combined with wage restraint, lowering the rise in real wages by one percentage point in year one.

We see that a temporary demand expansion of one year is not a very effective tool in speeding up adjustment towards the steady state. A demand expansion, which is extended over three years, and then abandoned, however, brings the economy just back to the equilibrium. It is clear from what could be seen already in Figure 12 that a wage restraint combined with demand expansion accelerates the adjustment and can eliminate the initial shock in less than three years, but may show an overshooting type of reaction. In the unemployment-labour income share (U, WS) –plane the situation is as depicted in Figure 14, where expansionary policies just mean the three year-long expansion in GDP growth leading to the rapid adjustment in Figure 13. We infer that expansionary demand management policies will be a substitute for wage moderation, which corresponds to the situation in practice, where unions normally call for an increase in government expenditure to alleviate a rise in unemployment, rather than they are willing to undergo a sizeable wage moderation.

Figure 14. Adjustment with and without expansionary demand management policies after an adverse shock of one percentage point in unemployment (U), deviations from the steady state equilibrium, %-points*



* For explanations, see the text, WS = share of labour income in GDP.

As is clear from Figure 13, a policy, which accelerates adjustment towards the equilibrium can produce a permanent effect on unemployment as evidenced by the actual rate of unemployment, although this policy cannot change the equilibrium rate itself.

4 CONCLUDING REMARKS

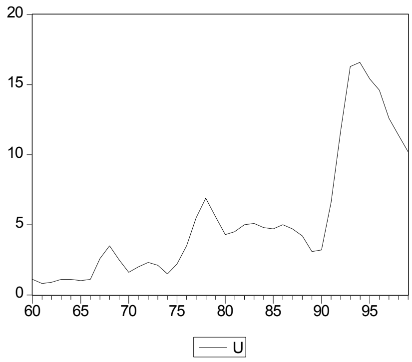
The short-run determination of output through aggregate demand (equation (8)) is not an integral part of the determination of the equilibrium rate of unemployment in our model. Hence, we can embed the system of the labour market (consisting of equations (4) and (7)) into any macroeconomic model of the economy with the usual short-run demand-determined output and, thus also, change in unemployment.

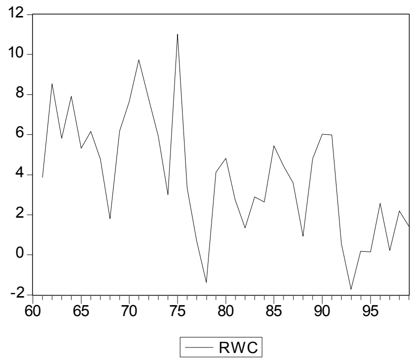
Growth only has a temporary, albeit slowly vanishing effect on unemployment according to our model specification and estimations. The real interest rate can bring, although, according to our estimation result, not a direct effect on the equilibrium rate of unemployment, anyway an indirect one through its effect on the aggregate demand. The study showed that policies to fight unemployment have to be far-sighted as many of their effects will be felt only slowly over a long period of time. As future tasks in the research in this field remain, i.a., the detailed specification of the formation of the mark-ups in the goods and labour market and how they can be influenced by economic policies.

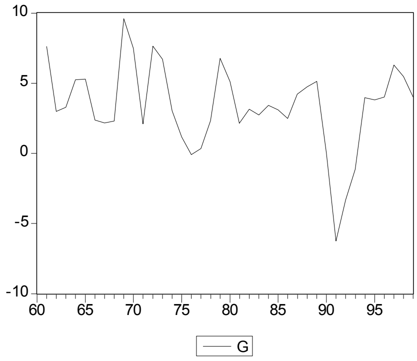
Appendix. Construction and series of the variables used in estimation

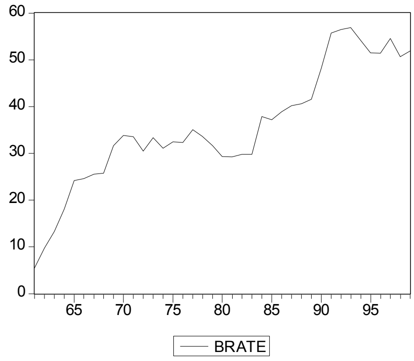
W nominal labour cost per working hour in the total economy
W_r Real labour cost per working hour
ΔW_r Percentage change of W_r
P Price of GDP
Q GDP (volume)
L Labour input in working hours
WSHARE (WS) Share of labour in total income, per cent (= 100*WL/PQ)
U Rate of unemployment, per cent
g Percentage growth of GDP
g^+ max(g,0)
g^- min(g,0)
rrl Real lending rate of banks on new loans, per cent, deflated by the rise in P
depr Dummy for the depression of the 1990s, = 1 from 1991 onwards, otherwise 0
brate replacement rate after tax, per cent, calculated based on data on unemployment and UI benefits as a three-year moving average. The benefits were made taxable in 1983, which has been taken into account by using the average tax rate on wage income
wedge Sum of the payroll taxes by employers, income tax and the value added tax revenues in relation to total labour cost by employers
valatax The value added tax revenues in relation to total labour costs by employers
inctax Income tax revenues in relation to total labour costs by employers
indax Payroll taxes by employers and employees in relation to total labour costs by employers
price wedge Ratio of import price to price on GDP
unioncov Share of employees belonging to a labour union

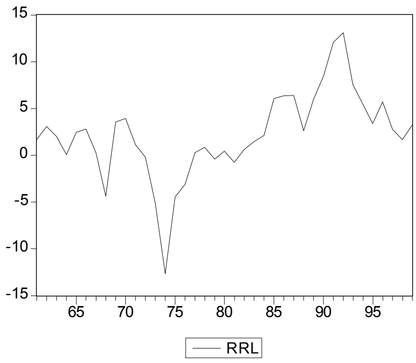
Graphs of the main data series (all in per cent or percentage change form)

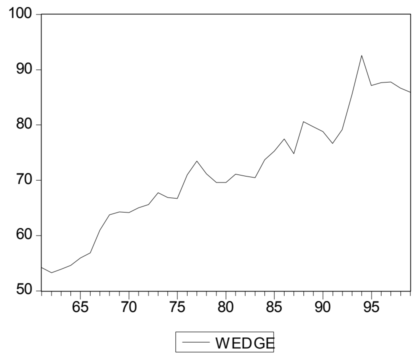


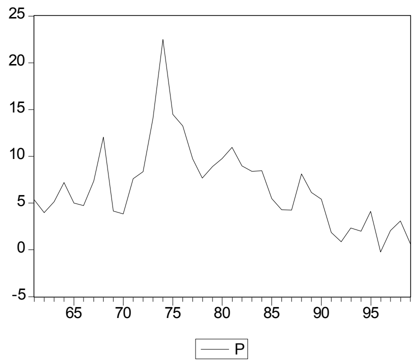


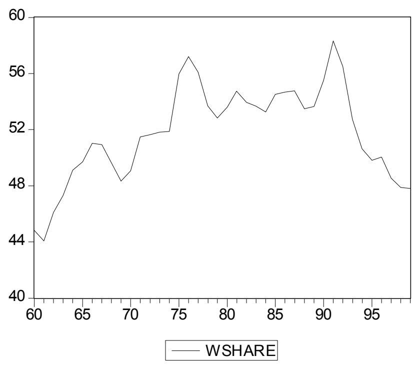












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