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A dynamic contracting model for wages and employment in three European economies

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Abstract

We present a structural dynamic non-linear model for an efficient contracting between a firm facing adjustment costs on labour and a union having preferences which are subject to habit formation. The model's first-order necessary conditions are estimated for the French, the Dutch and the Belgian labour market. The estimation results turned out to be remarkably similar for the three countries. Two alternative hypotheses are also investigated: (i) a myopic behaviour of the union and (ii) a competitive labour market. The performance of the efficient contract model with a forward-looking union is found to be superior to that of the neo-classical model in explaining the dynamics of employment and wages in the three countries.

JEL classification: E24

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1. Introduction

The modelling of wage-setting and employment decisions under unionism is at the center of the debate about the unemployment dynamics in European countries.

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In particular, the debate on the role of unions is tightly linked to both the structure and the contents of the assumed bargaining process and to the union preferences (do unions put enough weight on employment decisions?). The empirical literature has tried to test whether observed wage–employment outcomes are consistent with non-cooperative bargaining (starting with Dunlop (1944)) or cooperative bargaining (efficient bargaining, Leontief (1946)). These tests basically amount to measuring alternative wages and other variables affecting the union utility function without directly affecting the firm's profits, and their explanatory power with respect to employment in addition to current market wages. When these variables have explanatory power, firms are assumed to stay no longer on their labour demand curves, giving some support to the efficient bargaining framework. Examples are given in Alogoskoufis and Manning (1991), Bean and Turnbull (1988), Brown and Ashenfelter (1986) and MaCurdy and Pencavel (1986). These studies rely on the estimation of one equation (a labour demand equation or a contract curve equation) derived from static (one-period) models of bargaining. In reality, of course, the sequence of bargains is not independent through time. Nickell and Wadhwani (1991), who derive a static bargaining model and add dynamics in an informal manner to account for the autocorrelation in the firm-level panel data they use, remark: "The theoretical analysis of such interconnected bargaining sequences is in its infancy" (Nickell and Wadhwani, 1991, p. 960).

A major criticism of static efficient bargaining models is that they are time-inconsistent. In the absence of a legal enforcement procedure, firms always have an incentive to deviate from the contractual employment level to return on their labour demand curves. When dynamic aspects are introduced, an opportunity exists for the agents to build a long-term relationship that may result in an efficient outcome. The conditions under which the efficient outcome emerges from a repeated bargaining game are derived in simple set-ups by Espinoza and Rhee (1989) and Strand (1989). Basically, if the time preference parameters of the agents are high enough, the future consequences of any deviation from the contract (punishment etc.) have more weight than the instantaneous benefit from deviating from cooperation. Cooperative outcomes are therefore time-consistent if the agents' discount rates are high enough.

The literature on wage formation in an intertemporal framework considers different ways of introducing dynamic aspects in wage formation. The most well-known assumes that the dynamics arise from endogenous union membership (see e.g. Lindbeck and Snower, 1988). Another interesting route is to make the link between explicit wage bargaining and the literature on staggered contracts (see Manning, 1989). Such a framework provides the foundations to the model of Taylor (1979) and is able to take into account the observed sluggishness of wage series.

In this paper we estimate and test a two-equation dynamic model describing the optimal paths for both wages and employment. The bivariate system is derived from an intertemporal structural model under uncertainty embedding the cooperative bargaining framework as well as the neo-classical labour demand framework. We model wage dynamics as follows: The fact that European wages display strong downward rigidity is explained in terms of habit formation. The utility of the union depends on the history of wages, making an income cut undesirable to the union. Stated differently, the unions' utility function depends on the growth of wages, i.e., the level of past wages is progressively included in the reservation wage. Habit formation relates to 'built-in' taste changes depending on past decisions (compare Boyer (1983) who assumes that taste changes depend on past real expenditure levels). [1] A related interesting problem in the context of habit formation is to try capture the degree of forward looking behaviour of the union (see Pashardes (1986)) for a similar discussion concerning consumption theory). The union will be called myopic if in each period it takes into account its wage history but does not recognise the impact of its present wage on its future tastes and employment decisions. In contrast, a 'rational' union refers to one which takes into account the effect of its current decision on its future tastes.

The fact that wages obey to a dynamic decision rule may affect the dynamics of employment. In standard labour demand models, the employment dynamics arise from adjustment costs of changes in the workforce. In order to get a more precise idea on whether introducing wage dynamics in the employment equation affects the estimation of the adjustment cost function, we will start with a fairly general function borrowed from Pfann and Palm (1993) allowing for asymmetric effects. [2]

The problem of testing the nature of the bargaining process (i.e. right-to-manage bargaining against efficient bargaining) in a dynamic framework is far more complex than in the static model since "in a dynamic model, in general all variables affecting profits, union utility and union power influence the employment equation, even though the employer has unilateral control over employment. This is because of the strategic aspects which become important in a dynamic model. When choosing current employment the employer must take account of the effect of future wages and this effect is influenced by variables in the union utility function and union power" (Lockwood and Manning, 1989). In general, there is no closed form solution for this effect, making the estimation of dynamic right-to-manage models almost impossible without strong assumptions (for instance, Machin et al. (1993) simply assume that the effect of current employment

[1] The assumption that "A once and for all increase tends after a period to be forgotten and assumed part of the accepted wage structure" is also present in Kotowitz and Portes (1974). Frank and Hutchens (1993) offer empirical evidence that people prefer jobs with rising wage profiles.

[2] An additional implication of adjustment costs in an efficient contracts model is that it makes any deviation from the cooperative outcome more costly. This is due to the reduction of the first-period firm's gain of returning to its labour demand curve. Hence, adjustment costs of labour make the cooperative model more plausible.

on future wages is a function of union presence). This explains why the literature concerned with testing dynamic bargaining models is so scarce. [3]

In an attempt to tackle the problems due to the dynamic features of the decision-making and the underlying identification problems, we make specific assumptions about the shape of technology and preferences. We jointly estimate the employment and the wage equation imposing adequate cross-equation restrictions, and test the model as a whole. The model includes the neo-classical labour market model as a special case. This implies that, like Osano and Inoue (1991) and Card (1986) we are able to test the efficient contract model against the neo-classical model.

The contribution of the paper is threefold. First, an intertemporal efficient bargaining model with asymmetric adjustment costs for labour and habit formation of the form of built-in taste changes in the union's utility function is developed. Second, the model is estimated for Belgium, France and the Netherlands. The model is found to perform remarkably well and yields very similar estimation results for the three different data sets. The asymmetry in the adjustment costs and habit formation on the side of the unions are highly significant. Third, the model is compared with the neo-classical model which can be seen as a special case of the efficient contract model with wages equal to the disutility of work in the case of unemployment. The performance of the efficient contract model is found to be superior to that of the neo-classical model. These remarkably robust findings for the three countries under consideration are interesting for their own sake, in particular for understanding the sluggish adjustment of wages and employment in response to changes in the economic conditions faced by firms. They are also useful as a guidance for future research on wage formation and employment decisions.

The structure of the paper is as follows: The dynamic contract model is derived in Section 2. Section 3 includes the presentation of the three data sets, the GMM estimates of the Euler equations of the model and a comparison with the neo-classical model. Section 4 concludes.

2. A dynamic model for wages and employment

The objective of the union-firm tandem is to maximize a weighted sum of the present value of utility of the union and real profits of the firm over an infinite

[3] An interesting alternative is to simulate a fully specified dynamic game and to analyse under which conditions it is optimal for the agents to stick to the cooperative outcome (or to return to the non-cooperative outcome). This is done for instance by Eberwein and Kollintzas (1995) in a framework with irreversible investment.

time horizon, given all currently available information. An optimal contract at time t over wages w_t and employment l_t is given by the solution of the following optimization problem:

$$\{w_t^*, l_t^*\} = \arg\max_{w_t, l_t} \mathrm{E}\left[\sum_{s=t}^{\infty} \mu U(l_s, w_s^{\mathrm{n}}, w_{s-1}^{\mathrm{n}})\theta_s^{s-t} + \sum_{s=t}^{\infty}(y_s(l_s) - w_s^{\mathrm{c}} l_s - \Psi_s(\Delta l_s))\tau_s^{s-t} | \Omega_t\right] \quad (1)$$

$$\text{with} \quad \mu > 0, \quad 0 < \theta_s < 1, \quad 0 < \tau_s < 1,$$

where $\Delta l_s = l_s - l_{s-1}$. μ is the parameter which weights the utility of the union in the objective function and is called 'union power'. U is the utility derived at time s from having l_s workers receiving a real net wage of w_s^{n}. θ_s is the discount factor of the union. The second term on the right-hand side of (1) is the profit made at time s by producing y_s using l_s workers, each of them costing w_s^{c}. Adjustment costs being a function of Δl_s are given by the function Ψ_s. τ_s is the discount factor of the firm. The discount factors vary through time. Ω_t is the information set at time t.

The relations between nominal wages w_s, net real wages w_s^{n} and real wage-cost w_s^{c} are given by:

$$w_s^{\mathrm{c}} = \frac{w_s(1 + c_s)}{p_s}, \quad w_s^{\mathrm{n}} = \frac{w_s(1 - t_s)}{p_s^{\mathrm{c}}}, \quad (2)$$

where c_s is the employer's social security contribution rate, p_s is the producer price, t_s is the income tax rate (including employee's social security contribution) and p_s^{c} is the consumer price index, which is the appropriate deflator for the union. The tax and price wedge z_s is given by

$$z_s = \frac{w_s^{\mathrm{c}}}{w_s^{\mathrm{n}}} = \frac{(1 + c_s)p_s^{\mathrm{c}}}{(1 - t_s)p_s}.$$

The utility of the union has the following two characteristics: First, following many others, we have chosen a Stone–Geary utility function of the form

$$U_s(l_s, w_s^{\mathrm{n}}, w_{s-1}^{\mathrm{n}}) = l_s \frac{1}{\nu}\left[w_s^{\mathrm{n}} - \overline{\omega}_s(w_{s-1}^{\mathrm{n}})\right]^{\nu}, \quad \nu < 1, \quad (3)$$

where ν is a measure of the concavity of the function with respect to the gap between net wages and the reservation wage $\overline{\omega}_s$. Notice that the model could be expanded by also including past employment levels in the utility function, allowing thereby for a more general habit formation process. This possibility will not be explored here.

Second, we introduce habit formation in the model through 'built-in' taste changes related to previous wages. This implies that at time s the utility function depends on wages, employment and previous wages: $U_s = U_s(l_s, w_s^n, w_{s-1}^n)$ with $\partial U_s / \partial w_{s-1}^n < 0$. More specifically, the reservation wage becomes a weighted average of previous and alternative wages:

$$\overline{\omega}_s = \phi w_{s-1}^n + (1-\phi)\tilde{u}_s, \quad 0 < \phi < 1. \tag{4}$$

The parameter ϕ measures the intensity of habit formation. If $\phi = 0$ there is no effect of previous wages on the tastes through the disutility of work. $\tilde{u}_s$ is a function of the alternative wage w_s^a (minimum wage or unemployment allowance) and of a deterministic trend T_s:

$$\tilde{u}_s = u_0 T_s + u_1 w_s^a.$$

Following Pfann and Palm (1993) we approximate the production function by a quadratic expression in labour and capital. The corresponding marginal productivity of labour can be written

$$\frac{\partial y_s}{\partial l_s} = \lambda_0 + \lambda_l l_s + \lambda_k k_s + \epsilon_s, \qquad \lambda_0 > 0, \quad \lambda_l < 0, \quad \lambda_k > 0. \tag{5}$$

The parameter λ_l is assumed to be negative (decreasing marginal productivity) and if λ_k is positive, capital and labour are substitutes. k_s denotes the capital stock and ϵ_s denotes the impact of random technological shocks on the production level.

Asymmetric adjustment costs functions in which hiring costs and firing costs are different have turned out to be appropriate to describe employment dynamics. We assume a fairly general function in which adjustment costs depend on the gross changes of employment, allowing for asymmetric effects and quit rates, which takes the following form:

$$\Psi_s(\Delta l_s) = -1 + \exp\{\beta(\Delta l_s + q_s)\} - \beta(\Delta l_s + q_s) + \frac{\gamma - \beta^2}{2}(\Delta l_s + q_s)^2, \tag{6}$$

where q_s denotes the quit rate. If the parameter β is negative, firing costs exceed hiring costs. If β is positive, this inequality is reversed. If β is zero, we retrieve the standard quadratic adjustment cost function, with $\gamma > 0$ measuring the magnitude of the costs. If the quit rate q_s is zero, the adjustment cost function has its minimum at zero net employment changes. More generally, it has its minimum at $\Delta l_s = -q_s$.

Wages and employment negotiated at time s should satisfy the Euler equations associated with the optimal program in (1):

$$\begin{cases} 0 = \lambda_0 + \lambda_l l_t + \lambda_k k_t + \epsilon_t + \dfrac{\mu}{\nu}\left[w_t^{\mathrm{n}} - \phi w_{t-1}^{\mathrm{n}} - (1-\phi)\tilde{u}_t \right]^{\nu} \\ \quad - w_t^{\mathrm{c}} - \Psi_s' + \tau_s \mathrm{E}\left[\Psi_{s+1}' | \Omega_t \right], \\ 0 = l_t\left[w_t^{\mathrm{n}} - \phi w_{t-1}^{\mathrm{n}} - (1-\phi)\tilde{u}_t \right]^{\nu-1} - \dfrac{l_t z_t}{\mu} \\ \quad - \phi\theta_s \mathrm{E}\left[l_{t+1}\left[w_{t+1}^{\mathrm{n}} - \phi w_t^{\mathrm{n}} - (1-\phi)\tilde{u}_{t+1} \right]^{\nu-1} \dfrac{(1-t_{t+1}) p_t^{\mathrm{c}}}{(1-t_t) p_{t+1}^{\mathrm{c}}} \Omega_t \right], \end{cases}$$

where

$$\Psi_s' = (\gamma - \beta^2)(\Delta l_t + q_t) + \beta - \beta \exp\{ \beta(\Delta l_t + q_t) \}.$$

After substitution of the realised values for the unobserved future expectations, the Euler equations become:

$$\begin{cases} 0 = \lambda_0 + \lambda_l l_t + \lambda_k k_t + \dfrac{\mu}{\nu}\left[w_t^{\mathrm{n}} - \phi w_{t-1}^{\mathrm{n}} - (1-\phi)\tilde{u}_t \right]^{\nu} \\ \quad - w_t^{\mathrm{c}} - \Psi_s' + \tau_s \Psi_{s+1}' + \eta_{t+1}^{l}, \\ 0 = l_t\left[w_t^{\mathrm{n}} - \phi w_{t-1}^{\mathrm{n}} - (1-\phi)\tilde{u}_t \right]^{\nu-1} - \dfrac{l_t z_t}{\mu} \\ \quad - \phi\theta_s \left[l_{t+1}\left[w_{t+1}^{\mathrm{n}} - \phi w_t^{\mathrm{n}} - (1-\phi)\tilde{u}_{t+1} \right]^{\nu-1} \dfrac{(1-t_{t+1}) p_t^{\mathrm{c}}}{(1-t_t) p_{t+1}^{\mathrm{c}}} \right] + \eta_{t+1}^{w}, \end{cases} \tag{7}$$

with

$$\eta_{t+1}^{l} = \epsilon_t + \tau_s\left[(\gamma - \beta^2)\Delta l_{t+1} + \beta \exp\{ \beta(\Delta l_{t+1} + q_{t+1}) \} \right] \\ - \tau_s \mathrm{E}\left[(\gamma - \beta^2)\Delta l_{t+1} + \beta \exp\{ (\Delta l_{t+1} + q_{t+1}) \} | \Omega_t \right],$$

$$\eta_{t+1}^{w} = \phi\theta_s \left[l_{t+1}\left[w_{t+1}^{\mathrm{n}} - \phi w_t^{\mathrm{n}} - (1-\phi)\tilde{u}_{t+1} \right]^{\nu-1} \dfrac{(1-t_{t-1}) p_t^{\mathrm{c}}}{(1-t_t) p_{t+1}^{\mathrm{c}}} \right] \\ - \phi\theta_s \mathrm{E}\left[l_{t+1}\left[w_{t+1}^{\mathrm{n}} - \phi w_t^{\mathrm{n}} - (1-\phi)\tilde{u}_{t+1} \right]^{\nu-1} \dfrac{(1-t_{t+1}) p_t^{\mathrm{c}}}{(1-t_t) p_{t+1}^{\mathrm{c}}} | \Omega_t \right].$$

Under the assumption of rational expectations, the conditional expectations of the errors are equal to zero:

$$\mathrm{E}\left[(\eta_{t+1}^{l}, \eta_{t-1}^{w})' | \Omega_t \right] = 0. \tag{8}$$

The first equation of (7) says that the marginal productivity of labour plus the marginal gain in utility of increasing employment weighted by union power should equal the wage cost plus the marginal adjustment cost. The marginal adjustment cost is equal to the cost of changing employment at time s minus the gain of the today's change on the cost in the next period. The dynamics of this equation comprises of two factors: (i) the presence of adjustment cost forces the firm to smooth the changes in employment; (ii) the presence of habit formation in union behaviour makes employment partly dependent on the growth of net wages in the past.

According to the second equation, the marginal gain in utility of increasing the wage today should be equal to the loss in profits today plus the marginal loss of utility tomorrow. The dynamics of this equation is both backward and forward-looking; it is backward-looking because of the presence of the habit formation. It is forward-looking because the union recognises the impact of its current decisions on decision variables in the future. For instance, wage increases today will make it claim higher wages in the next period as well.

Four interesting specifications are nested in system (7). The first one refers to the neo-classical model and can be found as a limit case when $\mu = 0$. In this case, system (7) becomes

$$\begin{cases} 0 = \lambda_0 + \lambda_l l_t + \lambda_k k_t - w_t^c - \Psi_s' + \tau_s \Psi_{s+1}' + \eta_{t+1}^l, \\ 0 = w_t^n - \phi w_{t-1}^n - (1-\phi)\tilde{u}_t + \eta_{t+1}^w. \end{cases}$$

The first equation is a standard dynamic labour demand Euler equation. The second one simply says that wages should equal the disutility of work in the case of unemployment. Note that, in this case, the parameter ν is no longer identified.

A second interesting restriction to test is $\theta_s = 0$, $\forall s$. In this case, the union is only interested in its contemporaneous utility and does not take into account the effect of its current decision on its future tastes. In the myopic union scenario, the first Euler equation of (7) remains unchanged and the second simply states that the marginal gain in instantaneous utility should be equal to the loss in profits (weighted by $1/\mu$):

$$0 = \left[w_t^n - \phi w_{t-1}^n - (1-\phi)\tilde{u}_t \right]^{\nu-1} - \frac{z_t}{\mu}.$$

A third interesting restriction is $\phi = 0$. In this case, the union is not subject to habit formation and the second equation of (7) is reduced to

$$0 = \left[w_t^n - \tilde{u}_t \right]^{\nu-1} - \frac{z_t}{\mu}.$$

In this case, the real wage is equal to the disutility of work plus a positive term related to union power and the wedge. It does not depend on the level of employment. Of course, such model generates much less persistence (in addition to the one of the shocks themselves) than the general model, as stressed in de la Croix and Fagnart (1995).

A last restriction to test is $\phi = 1$. If ϕ equals one, the union is only interested in wage growth. Its utility function becomes

$$U_s = l_s \frac{1}{\nu} [\Delta w_s^{\mathrm{n}}]^{\nu}, \quad \text{subject to} \quad \Delta w_s^{\mathrm{n}} \geq 0;$$

system (7) now becomes

$$\begin{cases} 0 = \lambda_0 + \lambda_l l_t + \lambda_k k_t + \dfrac{\mu}{\nu} [\Delta w_t^{\mathrm{n}}]^{\nu} - w_t^{\mathrm{c}} - \Psi_s' + \tau_s \Psi_{s+1}' + \eta_{t+1}^l, \\ 0 = l_t [\Delta w_t^{\mathrm{n}}]^{\nu-1} - \dfrac{l_t z_t}{\mu} - \theta_s \left[l_{t-1} [\Delta w_{t-1}^{\mathrm{n}}]^{\nu-1} \dfrac{(1-t_{t+1}) p_t^{\mathrm{c}}}{(1-t_t) p_{t+1}^{\mathrm{c}}} \right] + \eta_{t+1}^w. \end{cases} \tag{9}$$

In this case, any temporary shock will have permanent effects on the level of wages as the equation explains first differences of w_s^{n} instead of levels.

In the next section, the efficient contract model will be estimated from data for Belgium, France and the Netherlands. The special cases of the model described above will be empirically investigated as well.

3. Estimation of the model

For the empirical analysis we use three different data sets:

- French data are quarterly macroeconomic data from 1963.I to 1991.IV. Employment is measured in terms of hours worked. The chosen alternative wage is the legal minimum wage (SMIC) which is an important tool of the social and income policy of the government.
- Dutch data are quarterly sectoral data from 1971.I to 1989.IV covering the manufacturing sector. Employment is measured in terms of hours. The tax wedge and alternative wage data are annual data from Graafland (1991) and have been interpolated using an autonomic procedure. [4] The alternative wage is the government assistance to the long-term unemployed.
- Belgian data are annual macroeconomic data from 1953 to 1988. Employment is measured in terms of numbers of workers (corrected for part-time jobs). The alternative wage is the average unemployment allowance.

The sources and exact definitions of the variables are presented in an appendix. The employment series are plotted in Fig. 1. For the three countries, employment

[4] The subroutine in Matlab format is available upon request from the authors.

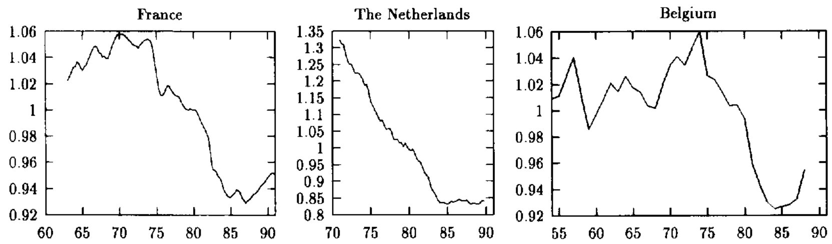

Fig. 1. Employment levels.

exhibits a steep decrease since the beginning of the seventies, followed by an increase in the second half of the eighties in Belgium and France and a stabilization in the Netherlands.

The heterogeneity of there three data sets has an important drawback. It limits the scope of relevant cross-country comparisons of the estimated parameters. However, the attractiveness of such an heterogeneity is to investigate the appropriateness and robustness of the model when it is applied to different economies. [5]

Two problems arise when estimating the system (7). First, there is a correlation between the endogenous variables at time $t+1$ like l_{t+1} and w_{t+1}^{n} and the error terms η_{t+1}^{w} and η_{t+1}^{l}. For this reason we need to instrument these variables to obtain consistent estimates of the parameters. Second, the error terms have a moving average representation of order one, implying that the nonlinear three-stage–least-squares estimation of the covariance matrix of the parameters is not appropriate. For these reasons, it is preferable to use the general method of moments proposed by Hansen (1982) which is based on the fact that the conditional expectation of the Euler equation error should be zero when evaluated at the true parameter value (see Eq. (8)). Writing β^* for the true values of the set of parameters β, Eq. (8) implies that

$$\mathrm{E}\left[\left(\eta_{t+1}^{l}(\beta^*), \eta_{t+1}^{w}(\beta^*)\right)' \otimes \Omega_t\right] = 0,$$

[5] The use of aggregate or sectoral data to analyze dynamic models of the (representative) firm has met severe critics recently (cf. Hamermesh, 1993). In the three countries that we consider, for the time period that we look at, however, negotiations took place at the sectoral or aggregate level. In this case, the empirical analysis of the dynamic processes of the decision variables l and w with firm-specific panel data requires not only many waves but also a structural model where decisions are made in two consecutive stages. The (first) bargaining stage models the contract negotiations at the aggregate level. The firm specific (second) decision stage models the impact of the outcomes from the first stage on the firm specific decision process of l and w. (see also Machin et al. (1993)). In this paper, because of a lack of sufficiently long time series on firm level data, we merge the two stages into one and analyze wage and employment decisions at the macroeconomic or sectoral level.

Table 1
The efficient contract model (estimates)

	France		Netherlands		Belgium	
λ_0	2.15	(0.25)	1.32	(0.26)	0.28	(0.31)
λ_l	−2.34	(0.23)	−0.77	(0.16)	−0.62	(0.29)
λ_k	0.63	(0.06)	0.22	(0.12)	0.74	(0.03)
β	−20.3	(2.14)	−20.0	(2.18)	−8.45	(0.50)
γ	84.4	(25.6)	116.	(37.6)	18.2	(2.83)
ϕ	0.74	(0.06)	0.81	(0.03)	0.58	(0.03)
u_0	0.26	(0.03)	0.09	(0.03)	1.12	(0.06)
u_1	0.60	(0.23)	1.25	(0.04)	0.46	(0.08)
ν	0.69	(0.12)	0.89	(0.03)	0.74	(0.04)
μ	2.38	(0.73)	4.70	(0.99)	1.40	(0.14)
ρ^l	0.14	(0.09)	0.55	(0.10)	0.49	(0.15)
ρ^w	0.61	(0.07)	0.40	(0.11)	0.33	(0.17)

where Ω_t is the vector of variables included in the information set. Defining $G(\beta)$ as the sample average of $(\eta^l_{t-1}(\beta), \eta^w_{t+1}(\beta))' \otimes \Omega_t$, GMM minimizes

$$G(\beta)'WG(\beta),$$

where W is the optimal weighting matrix computed using 3SLS estimates of β^*. When the model is overidentified, GMM can be seen as an application of instrumental variable estimation which uses the residuals from the non-linear 3SLS estimation to compute a consistent estimate of the covariance matrix of the parameters.

Given that the error term of the Euler equations follows a vector MA(1) process, two period lagged instrumental variables are, by assumption, orthogonal to the error process. The list of instruments is given in appendix together with the description of the data. Following Shapiro (1986), the discount rate τ_s varies over time, being the inverse of one plus the long-term real interest rate. We have no unbiased reason to assume a different discount rate for the union, so θ_s has been set equal to τ_s. Since there are no consistent data on q_s for the three countries under consideration, q_s has been assumed constant through time. The estimation of q_s turned out to be difficult because q_s is only weakly identified in (7). We have chosen q_s on the basis of a grid search by minimizing $G(\beta)' WG(\beta)$ under the constraint that the adjustment cost function should be convex. This gives the following values for the quit rates: 0.01 for France, 0.025 for the Netherlands and 0.03 for Belgium.

The estimation results are given in Table 1.[6] Table 3 reports various tests

[6] Standard-errors are between brackets. They are computed from the heteroscedastic and autocorrelation consistent covariance matrix of Newey and West (1987).

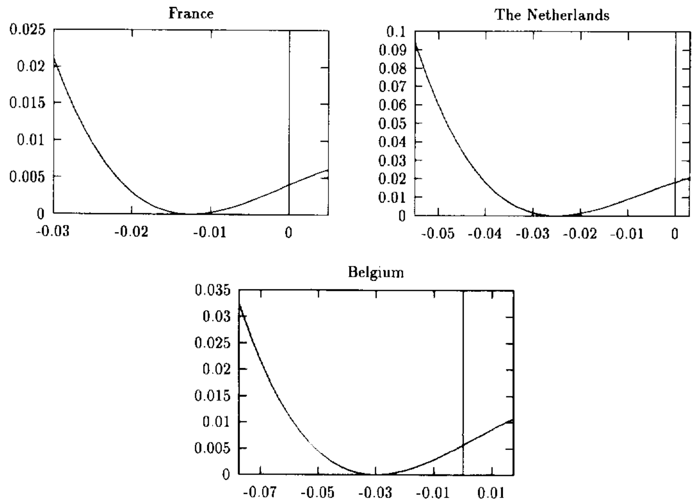

Fig. 2. Adjustment costs functions.

including Hansen's J-test for the overidentifying restrictions in the orthogonality conditions.

The estimation results show that all parameters are significantly different from zero (with the exception of λ_0 for Belgium) and have the expected sign. Moreover, despite the differences between the countries and the type of data used, the results exhibit remarkable cross-country similarities. As pointed out above, a negative estimate for β indicates that firing costs exceed hiring costs in all three countries. The parameter β is highly significant, a finding which stresses the importance of asymmetries in the three data sets. The adjustment costs functions using the point estimates of β and γ are shown in Fig. 2.

The parameter ϕ of habit formation is 0.74 and 0.81 for quarterly data of France and the Netherlands respectively and 0.58 for annual Belgian data. For the three data sets it is significantly different from one on the basis of a conventional t-test. Both the trend (u_0) and the alternative wage (u_1) have a significant impact on the reservation wage. The cross-country differences in u_1 partly reflect the differences in the alternative wage which we have chosen (minimum wage for France, long-term unemployment allowance for the Netherlands and average unemployment allowance for Belgium). The parameter ν is accurately estimated with values between 0.69 and 0.89. These values are not inconsistent with the previous studies on unions' objectives carried out with static models, as reported by Pencavel (1991). Indeed, Pencavel concludes that most studies find a greater weight attached to employment compared with what rent maximization would imply.

The size of μ, the parameter which weights the utility function of the union in

Table 2
Mark-up of wages over the reservation wage

Period	France	Netherlands	Belgium
70–75	4.0%	1.4%	6.6%
76–80	3.5%	0.3%	4.8%
81–85	2.3%	0.1%	1.1%
86–	1.2%	0.4%	0.6%

the objective function (i.e., which converts profits into utility), though significant, varies considerably across countries and seems to be very high for the Netherlands. However, a cross-country comparison of μ is not very insightful, since it's estimates depend on the scale of profits.

The estimation of ϕ, ν, u_0 and u_1 allows to compute the mark-up of wages over the reservation wage (including past wages). As the results in Table 2 show, this mark-up gives a good idea of the evolution of the union rent through time. This rent is steadily declining for France and Belgium, while for the Netherlands, it jumped near 0 in the mid seventies and tends to remain very low since then.

We also report in Table 1 the NLS estimates of the MA(1) process of the disturbances associated with the Euler equations:

$$\eta_{t+1}^{l} = \xi_{t+1}^{l} - \rho^{l}\xi_{t}^{l},$$

$$\eta_{t+1}^{w} = \xi_{t+1}^{w} - \rho^{w}\xi_{t}^{w}.$$

For the three countries, the ρ coefficients are significant, a finding which is in accordance with the assumptions underlying the model.

In Table 3, Ljung–Box autocorrelation tests (of order 4 for France and the Netherlands and of order 2 for Belgium) reveal that the residuals ξ display serial correlation in the wage equations for France and the Netherlands. This apparently significant autocorrelation is probably due to the presence of conditional heteroscedasticity (see Fig. 4) which we have accounted for when implementing GMM, but not when computing the Ljung–Box test.

Hansen's J-test measures the extent to which the residuals are effectively orthogonal to the instrument set. The number of degrees of freedom equals the number of restrictions imposed by the orthogonality conditions. These restrictions are not rejected at the 5% level for the three countries. Table 3 presents also the Wald tests corresponding to three interesting special cases of the model: risk neutral union ($\nu = 1$), competitive labour market ($\mu = 0$) and union interested in wage growth only ($\phi = 1$). All these hypotheses are strongly rejected for the three countries when the Wald statistic is compared to the χ^2 value with one degree of freedom.

The test $\theta_s = 0$ that the union has a myopic foresight behaviour may not be carried out in a standard way since θ_s is not estimated. We could however

Table 3
The efficient contract model (tests)

	France	Netherlands	Belgium
Sample	1963:1–1991:4	1971:1–1989:4	1953–1988
D.W. (l)	2.12	3.04	2.67
D.W. (w)	3.20	2.70	2.20
Ljung–Box (l)	5.59	4.71	0.17
p-value	[0.13]	[0.19]	[0.68]
Ljung–Box (w)	12.84	10.06	3.8
p-value	[0.01]	[0.02]	[0.05]
J-test	20.59	20.97	12.35
Degrees of freedom	20	26	20
p-value	[0.42]	[0.74]	[0.90]
H_0: $\nu = 1$	6.55	12.6	47.8
H_0: $\mu = 0$	10.7	22.6	96.3
H_0: $\phi = 1$	17.4	30.3	26.9

estimate the model imposing the restriction $\theta_s = 0$ and compare the value of the objective function with the one of the general model with a priori chosen value for θ. Note that the assumption of myopia on the side of the union does not imply any restriction on estimated parameters with respect to the above model but changes the structural form of the wage equation. The estimation of such model turned out to be very difficult for the Netherlands. Reliable estimates are obtained only for France and for Belgium. The corresponding J-tests are 31.47 and 14.78 respectively. Both are higher than in the general case. The overidentifying restrictions are rejected for France at the 5% level but are not rejected for Belgium. The fact that the J-test is higher for the same number of degrees of freedom in both countries is an indication that the general model performs better than the myopic union model for France and for Belgium. Also the findings for France that the difference between the value of the objective function of GMM of the general model and that for $\theta = 0$ is substantial is another indication that the model with forward looking union behaviour is preferred to the model assuming myopia.

The residuals of the Euler equations are plotted in Figs. 3 and 4. Concerning the employment equation, the two productivity shocks corresponding to the oil shocks are perceptible for the three countries. We interpret the impact of the oil shocks as being temporary (the real price of oil has now reverted to its 1972 level) and included in the productivity shock ϵ_y. Moreover, two other important shocks appear: one in 1982 in France (the sharp reduction in working hours decided by the Mauroy government) and in 1958 in Belgium (World exhibition?). Concerning wage equations, the residuals seem to display heteroscedasticity confirming the use of heteroscedastic-consistent estimators of the variance–covariance matrix of the orthogonality conditions. In addition, we have verified that there is no

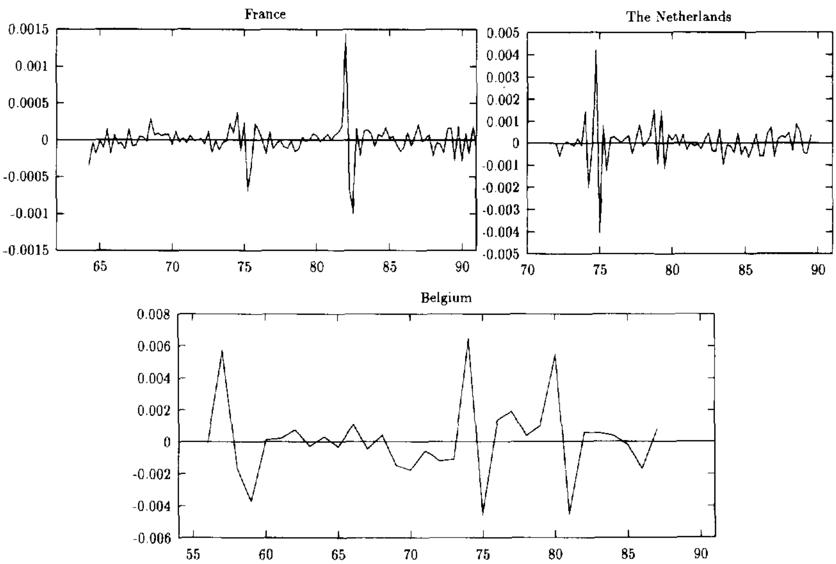

Fig. 3. Residuals from the employment equation.

stochastic trend present in the residuals using two tests proposed by Phillips (1987) and Phillips and Ouliaris (1990) ($\hat{Z}_\alpha$ and $\hat{Z}_t$). This amounts to test whether the I(1) variables are cointegrated in a nonlinear way in the Euler equations.

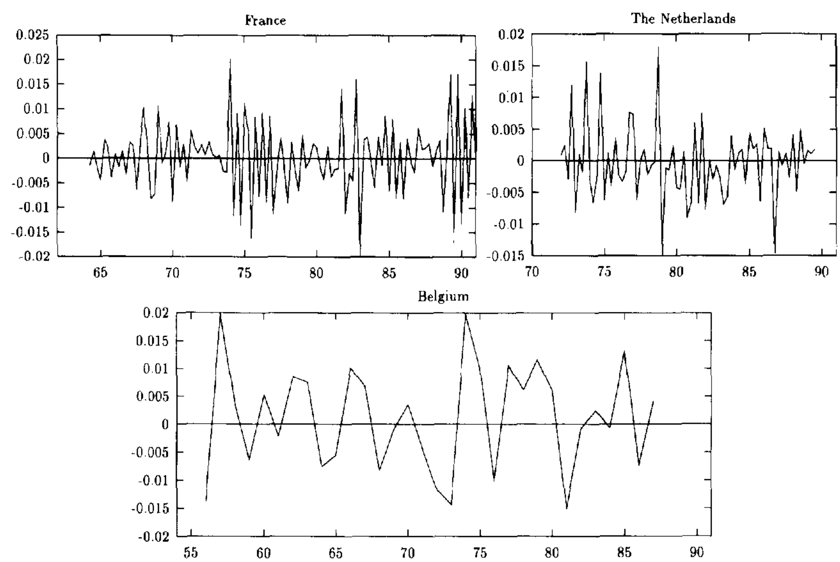

Fig. 4. Residuals from the wage equation.

Table 4
Cointegration tests

	France				Netherlands				Belgium	
	$\ell=1$	$\ell=4$	$\ell=7$	$\ell=10$	$\ell=1$	$\ell=4$	$\ell=7$	$\ell=10$	$\ell=1$	$\ell=2$
η^{l}_{t+1}										
$\hat{Z}_\alpha$	−117.7	−99.7	−90.9	−88.11	−102.4	−98.0	−98.7	−100.0	−40.44	−38.05
$\hat{Z}_t$	−11.4	−11.8	−12.4	−12.8	−15.7	−16.9	−16.6	−16.3	−8.0	−8.4
η^{w}_{t+1}										
$\hat{Z}_\alpha$	−169.7	−160.0	−160.2	−161.4	−93.5	−88.1	−89.7	−91.2	−36.4	−33.0
$\hat{Z}_t$	−21.9	−25.2	−25.0	−24.5	−12.2	−12.7	−12.6	−12.4	−6.8	−7.1

Unfortunately, the tables they provide are only valid for linear long-run relationships, so that they are not applicable here. However, since there is not much known for the nonlinear case, we use the critical values of Phillips and Ouliaris (1990) for indicative purposes. These values are -41.9 for the $\hat{Z}_\alpha$ test and -4.9 for the $\hat{Z}_t$ test. The results are presented in Table 4 for different truncation lag parameters (ℓ). Both tests reject the null hypothesis of no cointegration at any level for France and for the Netherlands. For Belgium, the $\hat{Z}_t$ test rejects the null hypothesis of no cointegration for both equations, while the $\hat{Z}_\alpha$ test rejects the null at 10% only for the employment equation and does not reject it for the wage equation.[7] Globally, using these tests and looking at Figs. 3 and 4, there is no reason for not rejecting the absence of nonlinear cointegration among the variables and therefore for suspecting spurious results. Notice that the rejection of the absence of cointegration in the employment equation is an indication that the technology shock ϵ_t affecting marginal labour productivity has been stationary.

Despite the fact that the estimate of μ in the efficient contract model is significant, we estimate the neo-classical model (with the same set of instruments) which is of interest for its own sake. The results are presented in Table 5.

The following differences with the efficient contract model are worth noting:

- The estimation of $|\lambda_l|$ is always significantly lower in the neo-classical model. This implies that, if the efficient bargaining model is appropriate, an estimation based on the neo-classical model underestimates the concavity of marginal productivity (and therefore, the elasticity of employment to wages along the labour demand curve).
- The estimation of the parameters of the adjustment cost function differs between the two models but these differences are not statistically significant. This implies that the introduction of additional dynamics in the employment

[7] The difference between the two tests could be due to their small sample properties (the sample size for Belgium is 31).

Table 5
The neo-classical model

	France		Netherlands		Belgium	
λ_0	1.59	(0.53)	0.68	(0.15)	−0.78	(0.11)
λ_l	−1.37	(0.47)	−0.28	(0.09)	0.80	(0.10)
λ_k	0.54	(0.06)	0.43	(0.07)	0.60	(0.02)
β	−31.10	(3.39)	−16.07	(1.24)	−8.11	(0.18)
γ	284.2	(86.7)	64.20	(14.6)	13.17	(1.07)
ϕ	1.03	(0.03)	0.99	(0.01)	1.07	(0.01)
u_0	0.13	(0.20)	−0.58	(1.00)	1.53	(0.29)
u_1	1.37	(1.04)	2.62	(2.12)	0.09	(0.30)
D.W. (l)	2.10		2.95		2.16	
D.W. (w)	2.48		2.05		1.12	
J-test [p-value]	23.19	[0.39]	24.98	[0.63]	15.19	[0.85]

equation through habit formation does not significantly affect the estimation of the adjustment cost function.

- The parameter ϕ is around one in the neo-classical model. This implies that the wage equation is reduced to the second equation of (9) which is expressed in terms of first differences of net wages.

Despite the fact that the overidentifying restrictions are not rejected for the neoclassical model, the empirical evidence favours the efficient bargaining model on the basis of the Wald test but also on the basis of the plausibility of the point estimates of the parameters.

4. Conclusion

We have presented a dynamic non-linear model of efficient contracting between a firm and a union interested in wages and employment. The firm faces adjustment costs on labour and the tastes of the union depend on past wages through an habit formation process. The parameters of the Euler equations of this model have been estimated with generalised method of moments under the assumption of rational expectations, imposing the overidentified restrictions implied by the theoretical model. The estimation has been carried out for French, Dutch and Belgian labour market data. The estimation results turned out to be remarkably similar for the three countries. The findings have allowed us to compute estimates of the non-linear adjustment cost function, of the union's relative risk aversion and of the gap between the contract wage and the reservation wage, which can be interpreted using the dynamic theory on efficient contract and labour demand.

The model was then estimated under two alternate assumptions: (i) a myopic union and (ii) a competitive labour market. Although the overidentifying restrictions implied by these two cases are not rejected, the parameter estimates seem less plausible for the competitive labour market than for those of the efficient contract model with forward-looking union. Therefore, we conclude that inertia in the adjustment of employment and wages in the three countries can been explained in terms of the effect of habit formation by the unions and asymmetric adjustment costs faced by firms.

In view of the similarities and the performance of the efficient contract model for three countries, the development and the estimation of a dynamic non-cooperative bargaining set-up and the treatment of the related time-consistency problems in the case of labour adjustment costs seems to us a natural priority for future work in this field of research.

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Appendix A. Data sources and definitions

A.1. General comments

The variable k is always measured as the capital stock times the degree of utilisation of capacities (*duc*). Additional variables used as instruments are p^{i}/p (real price of investment), p^{m}/p (real price of imports), x^{w} (world demand), d (union density), w^{g} (wages in the public sector), y (output), ur (unemployment rate), h hours of work, i (nominal long-term interest rate).

A.2. Belgium

y (GDP), w^{n}, w^{c}, p, p^{c}, p^{m}, x^{w} have been taken from Mehta and Sneessens (1990). p^{i}, τ (discount rate), w^{a} (unemployment allowance), l (employment in equivalent full-time) and k have been provided by the Central Planning Bureau. d has been computed by Vincent Vannetelbosch (Louvain).

Instruments are a constant term, trend, Δw^{c}_{s-2}, Δl_{s-1}, Δk_{s-1}, $\Delta(p_{i}/p)_{s-2}$, Δy_{s-2}, Δx^{w}_{s-2}, $\Delta(p_{m}/p)_{s-2}$, z_{s-2}, d_{s-2}, Δw^{a}_{s-1}, duc_{s-1}, τ_{s-2}, Δw^{g}_{s-2}.

A.3. France

y (GDP), w^{n}, w^{c}, p, p^{c}, l (number of workers times number of hours), k, p^{m}, i and ur have been taken from the databank built under the supervision of Guy Laroque at INSEE. w^{a} (minimum wage) is a series computed by Michel Lubrano (Marseille).

Instruments are a constant term, trend, Δw^{c}_{s-4}, Δl_{s-4}, Δk_{s-4}, $\Delta(p_{i}/p)_{s-4}$, Δy_{s-4}, Δx^{w}_{s-4}, $\Delta(p_{m}/p)_{s-4}$, Δw^{a}_{s-4}, i_{s-4}, duc_{s-4}, ur_{s-4}, h_{s-4}.

A.4. Netherlands

y (industrial production), w^{c}, p, p^{c}, l, k, duc, ur and h have been taken from Pfann and Palm (1993). w^{a} (minimum wage), d and z from Graafland (1991).

Instruments are a constant term, trend, Δw^{c}_{s-2}, Δw^{c}_{s-3}, Δl_{s-1}, Δk_{s-1}, $\Delta(p^{i}/p)_{s-2}$, Δy_{s-2}, Δw^{a}_{s}, Δ^{a}_{s-1}, Δw^{a}_{s-2}, i_{s-2}, duc_{s-1}, ur_{s-2}, h_{s-1}, z_{s-2}, d_{s-2}, $(p/p^{c})_{s-2}$.

References

Alogoskoufis, G. and A. Manning, 1991, Tests of alternative wage employment bargaining models with an application to the U.K. aggregate labour market, European Economic Review 35, 23–37.

Bean, C. and P. Turnbull, 1988, Employment in British coal industry: A test of the labour market demand model, Economic Journal 98, 1092–1104.

Boyer, M., 1983, Rational demand and expenditures patterns under habit formation, Journal of Economic Theory 31, 27–53.

Brown, J. and O. Ashenfelter, 1986, Testing the efficiency of employment contracts, Journal of Political Economy 94, 41–87.

Card, D., 1986, Efficient contracts with costly adjustment: Short-run employment determination for airline mechanics, American Economic Review 76, 1045–1071.

de la Croix, D. and J.-F. Fagnart, 1995, Underemployment of production factors in a forward-looking model, Labour Economics 58, 109–130.

Dunlop, J., 1944, Wage determination under trade unions (Macmillan, New-York).

Eberwein, C. and T. Kollintzas, 1995, A dynamic bargaining model in a unionized firm with irreversible investment, Annales d'Economie et de Statistique 37/38, 91–116.

Espinoza, P. and C. Rhee, 1989, Efficient wage bargaining as a repeated game, Quarterly Journal of Economics 104, 565–588.

Frank, R. and R. Hutchens, 1993, Wages, seniority, and the demand for rising consumption profiles, Journal of Economic Behaviour and Organization 21, 251–276.

Graafland, J., 1991, On the causes of hysteresis in long-term unemployment in the Netherlands, Oxford Bulletin of Economics and Statistics 53, 155–170.

Hamermesh, D., 1993, Spatial and temporal aggregation in the dynamics of labour demand, in: J. van Ours, G. Pfann and G. Ridder, eds., Labor demand and equilibrium wage formation (North-Holland, Amsterdam).

Hansen, L., 1982, Large sample properties of generalized method of moments estimation, Econometrica 50, 1029–1054.

Kotowitz, Y. and R. Portes, 1974, The tax on wage increases, Journal of Public Economics 3, 113–132.

Leontief, W., 1946, The pure theory of the guaranteed annual wage contract, Journal of Political Economy 54, 76–79.

Lindbeck, A. and D. Snower, 1988, The insider–outsider theory (MIT Press, Cambridge, MA).

Lockwood, B. and A. Manning, 1989, Dynamic wage–employment bargaining with employment adjustment costs, Economic Journal 99, 1143–1158.

Machin, S., A. Manning and C. Meghir, 1993, Dynamic models of employment based on firm-level panel data, in: J. van Ours, G. Pfann and G. Ridder, eds., Labor demand and equilibrium wage formation (North-Holland, Amsterdam).

MaCurdy, T. and J. Pencavel, 1986, Testing between competing models of wage and employment determination in unionized markets, Journal of Political Economy 94, 3–40.

Manning, A., 1989, Dynamic wage bargaining and staggered contracts, Mimeo. (LSE, London).

Mehta, F. and H. Sneessens, 1990, Belgian unemployment: The story of a small open economy caught in a worldwide recession in: J. Drèze et al., eds., Europe's unemployment problem (MIT Press, Cambridge, MA).

Newey, W. and K. West, 1987, A simple positive semi-definite heteroscedasticity and autocorrelation consistent covariance matrix, Econometrica 55, 703–708.

Nickell, S. and S. Wadhwani, 1991, Employment Determination of British industry: Investigations using micro data, Review of Economic Studies 58, 955–969.

Osano, H. and T. Inoue, 1991, Testing between competing models of real business cycles, International Economic Review 32, 669–688.

Pashardes, P., 1986, Myopic and forward looking behavior in a dynamic demand system, International Economic Review 27, 387–397.

Pencavel, J., 1991, Labor markets under trace unionism (Basil Blackwell, Oxford).

Pfann, G. and F. Palm, 1993, Asymmetric adjustment costs in non-linear labour demand models for the Netherlands and UK manufacturing sectors, Review of Economic Studies 60, 397–412.

Phillips, P.C.B., 1987, Time series regression with a unit root, Econometrica 55, 277–301.

Phillips, P.C.B. and S. Ouliaris, 1990, Asymptotic properties of residual based tests for cointegration, Econometrica 58, 165–193.

Shapiro, M., 1986, Dynamic demand for capital and labour, Quarterly Journal of Economics 101, 513–542.

Strand, J., 1989, Monopoly union versus efficient bargaining: A repeated game approach, European Journal of Political Economy 5, 473–486.

Taylor, J., 1979, Staggered price setting in a macro model, American Economic Review 69, 108–113.