UNEMPLOYMENT BENEFITS, CONTRACT LENGTH AND NOMINAL WAGE FLEXIBILITY*

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April 23, 2003

Abstract

We show in a bargaining model that a decrease in the unemployment benefit level increases not only equilibrium employment, but also nominal wage flexibility, and thus reduces employment variations in the case of nominal shocks. Long-term wage contracts lead to higher expected real wages and hence higher expected unemployment than short-term contracts. Therefore, a decrease in the benefit level reduces the expected utility gross of contract costs of a union member more with long-term than with short-term contracts and thus creates an incentive for shorter contracts. Incentives for employers are shown to change in the same direction.

JEL Classification code: E24, E32, J64, J65

Key words: nominal wage flexibility, contract length, macroeconomic fluctuations, unemployment benefits.

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I. Introduction

There exists a large literature on how various labour-market institutions influence the equilibrium rate of unemployment, i.e. the average rate of unemployment around which there are cyclical variations (e.g. Layard et al., 1991; Elmeskov et al. 1998; or Nickell and Layard, 1999). Much less is known about how various institutions affect the *sensitivity* of the economy to macroeconomic shocks. Our aim is to analyse how one specific labour-market institution, unemployment benefits, affect money-wage flexibility and thus cyclical sensitivity.

It is often taken for granted that the same labour-market reforms both lower equilibrium unemployment and stabilise employment in the case of shocks (e.g. OECD, 1994). The basic presumption is that reforms make labour markets more competitive (Calmfors, 2001). However, it remains to be modelled exactly how various reforms, such as a reduction of unemployment benefits, affect, for example, the length of wage contracts and thus macroeconomic variability.

The models of how unemployment benefits affect real wages and equilibrium unemployment usually have firm microeconomic underpinnings. There is a multitude of approaches (union and bargaining models, insider-outsider models, efficiency-wage models, search and matching models) that all predict that higher unemployment compensation leads to higher real wages and higher equilibrium unemployment (see e.g. Layard et al., 1991; Holmlund, 1998; or Pissarides, 2000).

A standard way to analyse money-wage rigidity is to view the optimal contract length as the outcome of a trade-off between contract costs and costs of output variability (see e.g. Gray, 1978; Ball, 1987; Ball et al., 1988; or Groth and Johansson, 2002). Long contract periods hold down contract costs, but also imply that money wages cannot change in response to unanticipated events. The optimal contract length is chosen so that the sum of these costs is minimised. The costs to be minimised are usually modelled through ad hoc quadratic loss functions, which are analytically convenient. This suffices to derive results such that contract length is reduced if nominal shocks become more prevalent. But the ad hoc objective functions make it difficult to analyse the effects of such labour-market reforms as, for example, changes in unemployment benefit levels. Nor is it clear to what extent the choice of contract length reflects incentives on the employee side and on the employer side, respectively.We use a simple bargaining model to explain how both the average real wage over the cycle and the extent of money-wage flexibility depend on the unemployment benefit level. To convey the basic intuition as clearly as possible, we assume a small open economy with an irrevocably fixed exchange rate. One can think of the economy as being either a member state in the EMU or a country that has opted for dollarisation. In our model both nominal wages and contract length are determined. There is unemployment because unions aim for a higher real wage than the market-clearing level.

There are two standard ways of modelling unemployment benefits, which correspond to the systems that exist in the OECD countries (Layard et al., 1991; Pissarides, 1998). The first is to assume that governments set unemployment benefits in real terms, thus determining a minimum standard of living. Benefits then act as a floor for wages, which in bargaining models are set as a mark-up over benefits. The second way is to assume that unemployment compensation replaces a fixed proportion of the wage. With the latter type of benefits, it is obvious that an increase in the replacement ratio could create incentives for more rigid nominal wages by providing more insurance against employment variations. But it is less obvious how the first type of benefits should affect wage flexibility. This motivates why we focus on such a benefit system.[1]

Our conclusion is that higher unemployment benefits, apart from increasing equilibrium unemployment, also lead to more rigid money wages and hence to larger macroeconomic variability. The result can be seen as an application of the general principle that real rigidities reinforce nominal rigidities (Romer, 1996, Ch. 6). The intuition in our model is as follows. Wage setters choose contract length by comparing the higher costs of short-term contracts with the utility gain that follows from the possibility to adjust wages to unforeseen shocks. We show that wage setters aim for higher real wages with long-term than with short-term contracts. This can be seen as reflecting a *risk premium* for the larger uncertainty associated with long-term contracts. Hence, unemployment is larger with long-term than with short-term contracts. As a consequence, an increase in the unemployment benefit level raises the expected utility of a representative union member more if contracts are long-term than if they are short-term. So a higher benefit reduces the utility gain from short-term contracts for unions and thus makes long-term contracts more favourable for them. We also show that higher benefits enhance the incentives for long-term contracts on the employer side as well. The reason is that the wage increases associated with a rise in the benefit level reduce expected profits more with short-term than long-term contracts.

[1] It would seem to correspond to the way that unemployment benefits are set in the UK (see e.g. Minford, 1994). In many other countries, unemployment insurance are a mixture of the two systems discussed. In, for example, Sweden there is a fixed replacement rate for medium-income earners, but this does not apply to low-income earners, who instead receive a minimum benefit that is unrelated to the earlier wage, and not to high-income earners, for whom there is a benefit ceiling. In most European countries the long-term unemployed that have lost their eligibility for ordinary unemployment benefits also receive minimum unemployment (social) assistance levels (OECD, 1994; Elmeskov et al. 1998).

Our results do not follow because higher unemployment compensation reduces the welfare cost of employment variability per se. Such a mechanism cannot work in models where wages are set as a mark-up over benefits. Instead, the results are the consequence of the fact that *certainty equivalence* does not hold in our model: the expected wage and employment levels differ between wage contracts of different length and changes in the degree of macroeconomic variability are associated with changes in the expected wage and employment levels. These features follow from the explicit modelling of union and employer objectives and are in stark contrast to the features of earlier models of nominal wage flexibility based on ad hoc quadratic preference functions. Our paper relates to other recent work stressing how lack of certainty equivalence can "compound or offset the more obvious welfare effects of uncertainty" (Obstfeld and Rogoff, 2000). Other papers where uncertainty affects expected real wage and employment levels are Bacchetta and van Wincoop (1998), Devereaux and Engel (1998, 1999), Obstfeld and Rogoff (1998), and Rankin (1998). But none of these papers explore the issue we focus on: the determination of the degree of nominal rigidity.

The structure of the paper is as follows. Section 2 shows how wages, employment, union utility and profits depend on contract length. Section 3 contains the basic analysis of the incentives for wage contracts of different duration. Section 4 discusses various modifications of the analysis. Section 5 concludes.

II. The basic model

We assume a small open economy with an irrevocably fixed exchange rate or using the same currency as larger trading partners (the euro or the dollar). A large number of perfectly competitive firms in the economy produce a homogenous tradable good. As is conventional in small-open economy models, there is an infinitely elastic foreign excess demand (supply) of the tradable good. Its price is thus determined in the world market and is exogenous to the economy. There is a fixed pool of workers attached to each firm, so there is no labor mobility between firms, and workers are organised in firm-specific unions. The firms are identical in all respects except that contract length may differ.

The economy is exposed to two types of shocks: nominal price shocks and real supply shocks. The two shocks are independent of each other. The nominal price shocks are of foreign origin and can be thought of as deriving from either demand or supply disturbances abroad. The supply shock is a domestic productivity shock, which must be uncorrelated with the nominal price shock because of the small-open-economy assumption. There could, of course, also be domestic demand shocks, but again the small-open-economy assumption implies that they cannot affect prices and hence not output and employment (but only the trade balances), which makes them uninteresting for our analysis.[2]

The production function of a representative firm is

$$Y = \frac{1}{\alpha}\theta L^{\alpha}, \tag{1}$$

where $0 < \alpha < 1$, Y is output, θ is an economy-wide productivity variable and L is employment.

The real per-period gross profit (neglecting contract costs), π, of a firm is

$$\pi = (1-\tau)\left(Y - \frac{W}{P}L\right), \tag{2}$$

[2]In closed-economy models, it is customary instead to distinguish between demand and supply shocks. The former imply only price changes, and the latter both productivity and price changes (see e.g. Gray 1978; Ball, 1987; or Calmfors and Johansson, 2002a). Under certain assumptions productivity shocks in these models give rise to price changes that exactly offset the employment effects of productivity shocks. This mechanism cannot by assumption occur in a model of a small open economy.

where τ is the tax rate on profits, W is the money wage, and P is the price. Profit maximisation results in the labour demand equation

$$L = \left(\frac{W}{\theta P}\right)^{-\varepsilon}, \tag{3}$$

where $\varepsilon = 1/(1-\alpha) > 1$ is the labour demand elasticity. As we shall assume that employment is demand-determined (see Section 2.1), (3) also gives actual employment.

Productivity θ and the price P are stochastic variables. In most of the analysis, we only have to assume that the probability distributions are known and independent. To derive some results, we shall, however, impose an assumption of log-normality.

A representative union has the per-period objective function

$$U = \frac{L}{L_0}(1-t)\frac{W}{P} + \left(1 - \frac{L}{L_0}\right)(1-t)\,b, \tag{4}$$

where U is the gross utility of the union (neglecting contract costs), L_0 is the number of members, b is the real value of unemployment compensation, and t is the tax rate on labour income. The objective of the union is thus to maximise the expected income of a representative member. Both wage income and unemployment compensation are taxed.

Wage contracts are for either one or two periods . The information structure is depicted in Figure 1. Price and productivity shocks occur in the beginning of each period. If a new wage is set in the period, wage setting occurs after shocks have been realised. One-period contracts are thus concluded on the basis of the actual shocks. If there is a two-period contract, wage setters know the actual price and productivity shocks for the first period, and thus set the same wage for this period as in a one-period contract. But for the second period they have to base the wage decision on expectations.

A key assumption is that the unemployment benefit is fixed in real terms. This is equivalent to assuming that the government has a target for the real benefit level and adjusts the nominal benefit to the actual price in each period independently of the length of wage contracts. The assumption captures the stylised fact that there appears to be more nominal inertia in wage setting than in government transfer systems: nominal wages are often set in wage contracts that may encompass several years, wheras long-term decisions on nominal transfer levels are rare. Instead, the latter are usually determined in the annual government budget process, possibly through an explicit indexation procedure.[3]

It is natural to think about contract length and wages being determined in a two-stage procedure. In the first stage, each firm-union pair bargains over the length of wage contracts at a "meta level". In the second stage, each pair bargains over wages. Complete modelling of these two bargaining processes, using backward induction, is possible but complex. Therefore we follow a simpler procedure. We first calculate the wages in contracts of different duration. Then we analyse the optimal contract length for the union and the employer separately. This tells us which contract length would be chosen if it were determined unilaterally by one party. We do not have to model how the actually bargained contract length for each firm-union pair is decided in order to draw conclusions on how average contract length in the economy is affected by changes in macroeconomic variability and benefit generosity, which is the aim of the analysis.[4] Instead, it suffices

[3]We do not attempt to model formally *why* nominal transfers are less rigid than nominal wages. A plausible - though partial - explanation is that the cost of changing nominal transfer levels are small if budget decisions on how to balance government revenues and expenditures have to be taken anyway.

[4]Obviously, if both parties to a bargain prefer contracts of a certain length, this length is chosen. If one party prefers a one-period contract and the other one a two-period contract, the bargained contract length in this case cannot be determined unless a mechanism to trade off the conflicting interests is specified. One possibility might be to assume a Nash bargaining solution where the two parties bargain over the probability with which one-period and two-period contracts are chosen. This would give results similar to those in our analysis.

to show that the incentives of unions and employers always change in the same direction. If, for example, both more unions and more employers prefer one-period to two-period contracts, we conclude that the relative frequency of one-period contracts in the economy rises and thus that average contract length falls.

The wage in one-period contracts

Consider first a one-period contract. Bargaining about wages entail bargaining costs for both the employer and the union: C_F and C_U, respectively. These contract cost can be viewed as either expenses for buying bargaining services or reductions of employers' and union members' incomes when they themselves perform the bargaining. In both cases the contract cost is tax deductible. The contract cost is incurred both when bargaining results in a new contract and when it fails. When bargaining results in a new contract the net profit of the firm is $\pi - (1-\tau)\,C_F$ and when it fails $-(1-\tau)\,C_F$. The corresponding net utility of the union is $U - (1-t)\,C_U$ and $U_0 - (1-t)\,C_U$, where $U_0 = (1-t)\,b$, as workers are assumed to receive the unemployment benefit when a new contract is not reached.

Assuming a Nash-bargaining solution, the wage in a one-period contract is obtained by maximising

$$B = (\pi)^{\beta}\,(U - U_0)^{1-\beta}\,, \tag{5}$$

where $0 < \beta < 1$ is the relative bargaining strength of the firm. Both the tax rate and the benefit level are exogenous to the individual firm. Assuming an interior solution, which implies that labour demand (employment) is smaller than union-membership, i.e.

$L < L_0$, the maximisation gives

$$W_1 = \frac{\varepsilon - \beta}{\varepsilon - 1} Pb, \tag{6}$$

where the 1-subscript denotes a one-period contract. The real wage is thus a fixed mark-up over the real unemployment compensation. Because of the assumption of constant-elastic labour demand, supply shocks shocks do not affect the real wage, as is a well-known result first pointed out by McDonald and Solow (1981).

Using (6) we obtain expected employment under a one-period contract as

$$E\left(L_1\right) = E\left(\theta^{\,\varepsilon}\right) \left(\frac{\varepsilon - \beta}{\varepsilon - 1}\right)^{-\varepsilon} b^{-\varepsilon}. \tag{7}$$

Using (3), (4), (6), and (7), we can derive the expected gross utility of a union as

$$E\left(U_1\right) = \left(\frac{(1-\beta)}{(\varepsilon - 1)} \frac{E\left(L_1\right)}{L_0} + 1\right)(1-t)\, b. \tag{8}$$

Similarly, using (1), (2), (3), and (6), we obtain the expected profit as

$$E\left(\pi_1\right) = (1-\tau)\, E\left(\theta^{\,\varepsilon}\right) \left(\frac{1}{\varepsilon - 1}\right) \left(\frac{\varepsilon - \beta}{\varepsilon - 1}\right)^{1-\varepsilon} b^{1-\varepsilon}. \tag{9}$$

As $\theta^{\,\varepsilon}$ is convex, it is obvious that a mean-preserving increase in the variability of productivity raises expected employment, expected union utility, and expected profit. With a log-normal distribution for θ, so that $ln\ \theta \sim N\left(0, \sigma^2_{\theta}\right)$, it follows that $E\left(\theta^{\,\varepsilon}\right) = \exp\left((1/2)\, \varepsilon^2 \sigma^2_{\theta}\right)$ and hence

$$\frac{dE\left(\theta^{\,\varepsilon}\right)}{d\sigma^2_{\theta}} = \frac{1}{2} \varepsilon^2 \exp\left(\frac{1}{2} \varepsilon^2 \sigma^2_{\theta}\right) > 0.$$

Consequently, we have from (7) that

$$\frac{dE\left(L_1\right)}{d\sigma^2_{\theta}} = \left(\frac{\varepsilon - \beta}{\varepsilon - 1}\right)^{-\varepsilon} b^{-\varepsilon} \frac{dE\left(\theta^{\,\varepsilon}\right)}{d\sigma^2_{\theta}} > 0$$

and from (9) that

$$\frac{d\left(E\left(\pi_1\right)\right)}{d\sigma_\theta^2} = (1-\tau)\left(\frac{1}{\varepsilon-1}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{1-\varepsilon} b^{1-\varepsilon}\frac{dE\left(\theta^{\,\varepsilon}\right)}{d\sigma_\theta^2} > 0.$$

Wages in two-period contracts

The second-period wage of a two-period contract (which we shall henceforth refer to as the two-period contract wage) is set on the basis of expectations of the price and productivity variables. We assume that the contract costs for a two-period contract are paid in the first period. Hence, in the second period of a two-period contract neither the utility/profit when bargaining is successful nor the utility/profit when it fails depends on this contract cost. The Nash bargaining product to be maximised in this case is

$$\overline{B} = \left[E\left(\pi\right)\right]^{\,\beta}\left[E\left(U-U_0\right)\right]^{1-\beta} = \left[E\left(\pi\right)\right]^{\,\beta} E\left[\left((1-t)\frac{L}{L_0}\left(\frac{w}{P}-b\right)\right)\right]^{1-\beta}, \tag{10}$$

The outcome is

$$W_2 = \frac{(\varepsilon-\beta)}{(\varepsilon-1)}\frac{E\left(P^{\,\varepsilon}\right)}{E\left(P^{\,\varepsilon-1}\right)}b, \tag{11}$$

where the 2-subscript denotes the second period of a two-period contract. The nominal wage in a two-period contract is thus also a mark-up over the unemployment benefit. But the mark-up now depends on $E\left(P^{\,\varepsilon}\right)/E\left(P^{\,\varepsilon-1}\right)$. If the distribution of P is log-normal, i.e. $ln\ P \sim N\left(0,\sigma_P^2\right)$, it can be derived that $E\left(P^{\,\varepsilon}\right)/E\left(P^{\,\varepsilon-1}\right) = \exp\left(\sigma_P^2\left(\varepsilon-1/2\right)\right)$, which gives[5]

$$W_2 = \frac{(\varepsilon-\beta)}{(\varepsilon-1)}\exp\left(\sigma_P^2\left(\varepsilon-1/2\right)\right)b. \tag{12}$$

[5] Similar formulas have been derived by Andersen and Sørensen (1988), Sørensen (1992), Rankin (1998), and Obstfeld and Rogoff (2000).

Using (11) it follows that

$$E\left(L_2\right) = \phi E\left(\theta^{\,\varepsilon}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{-\varepsilon} b^{-\varepsilon}, \tag{13}$$

$$E\left(U_2\right) = \left(\frac{E\left(L_2\right)}{L_0}\frac{(1-\beta)}{(\varepsilon-1)}+1\right)(1-t)\,b, \tag{14}$$

and

$$E\left(\pi_2\right) = (1-\tau)E\left(\theta^{\,\varepsilon}\right)\left(\frac{\phi}{\varepsilon-1}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{1-\varepsilon} b^{1-\varepsilon}, \tag{15}$$

where

$$\phi = \frac{\left(E\left(P^{\,\varepsilon-1}\right)\right)^{\,\varepsilon}}{\left(E\left(P^{\,\varepsilon}\right)\right)^{\,\varepsilon-1}} < 1,$$

follows from Jensen's inequality.[6]

With a log-normal distribution for P, it holds that

$$\phi = \frac{\left(E\left(P^{\,\varepsilon-1}\right)\right)^{\,\varepsilon}}{\left(E\left(P^{\,\varepsilon}\right)\right)^{\,\varepsilon-1}} = \exp\left(-\frac{1}{2}\varepsilon\left(\varepsilon-1\right)\sigma_P^2\right).$$

It then follows that

$$\frac{d\phi}{d\sigma_P^2} = -\frac{\varepsilon\left(\varepsilon-1\right)}{2}\exp\left(-\frac{\varepsilon\left(\varepsilon-1\right)}{2}\sigma_P^2\right) < 0,$$

and

$$\frac{dE\left(L_2\right)}{d\sigma_P^2} = E\left(\theta^{\,\varepsilon}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{-\varepsilon} b^{-\varepsilon}\frac{d\phi}{d\sigma_P^2} < 0.$$

Expected employment thus decreases if price variability increases.

We also have that

$$\frac{dE\left(\pi_2\right)}{d\sigma_P^2} = (1-\tau)E\left(\theta^{\,\varepsilon}\right)\left(\frac{1}{\varepsilon-1}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{1-\varepsilon} b^{1-\varepsilon}\frac{d\phi}{d\sigma_P^2} < 0,$$

[6] The proof is as follows. $\phi < 1$ is equivalent to $E\left(P^{\,\varepsilon}\right) > \left(E\left(P^{\,\varepsilon-1}\right)\right)^{\frac{\varepsilon}{\varepsilon-1}}$. Let $P^{\,\varepsilon-1} = x$, so that $P^{\,\varepsilon} = f\left(x\right) = x^{\frac{\varepsilon}{\varepsilon-1}}$. Hence the inequality can be written $E\left(x^{\frac{\varepsilon}{\varepsilon-1}}\right) > \left(E\left(x\right)\right)^{\frac{\varepsilon}{\varepsilon-1}}$ or $E\left(f\left(x\right)\right) > f\left(E\left(x\right)\right)$. According to Jensen's inequality this holds if f is convex, which is the case here.

i.e. the expected profit falls when price variability increases. Moreover, we conclude that

$$\frac{d\left(E\left(L_2\right)\right)}{d\sigma_{\theta}^2}=\phi\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{-\varepsilon} b^{-\varepsilon}\frac{dE\left(\theta^{\,\varepsilon}\right)}{d\sigma_{\theta}^2}>0,$$

and

$$\frac{dE\left(\pi_2\right)}{d\sigma_{\theta}^2}=(1-\tau)\frac{\phi}{\varepsilon-1}\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{1-\varepsilon} b^{1-\varepsilon}\frac{dE\left(\theta^{\,\varepsilon}\right)}{d\sigma_{\theta}^2}>0.$$

Thus, both expected employment and expected profit with a two-period contract increase when variability in productivity increases, just as was the case with a one-period contract.

Comparison of one-period and two-period contracts

It is readily established that expected employment, expected gross union utility, and expected gross profit are larger under one-period contracts than under two-period contracts. (7) and (13) give

$$E\left(L_1\right)-E\left(L_2\right)=(1-\phi)\,E\left(\theta^{\,\varepsilon}\right)\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{-\varepsilon} b^{-\varepsilon}>0. \tag{16}$$

The result that $E\left(L_1\right)>E\left(L_2\right)$ means that certainty equivalence does not hold for employment in our model. The dependence of expected employment on contract length follows from the explicit modelling of union and employer objectives and distinguishes our model from earlier ones with quadratic ad hoc preference functions, where expected employment is independent of contract length (see e.g. Gray. 1978; Ball, 1987; or Groth and Johansson, 2002). What is the intuition? There are two factors at work. On one hand, expected employment is affected by variations of the real wage around a *given* level. Because the labour demand schedule is convex, as shown in Figure 2, the real wage variability that arises with a two-period contract tends to give higher expected employment than the constant real wage with a one-period contract. But on the other hand, the expected real wage is higher with a two-period contract than with a one-period contract. This can most easily be seen in the case of log-normality. Then we have

$$E\left(\frac{W_2}{P}\right)=\frac{(\varepsilon-\beta)}{(\varepsilon-1)}\frac{E\left(P^{\,\varepsilon}\right)\left(E\left(P^{-1}\right)\right)}{E\left(P^{\,\varepsilon-1}\right)}b=\frac{(\varepsilon-\beta)}{(\varepsilon-1)}\left(\exp\left(\varepsilon\sigma_P^2\right)\right)b>\frac{(\varepsilon-\beta)}{(\varepsilon-1)}b=E\left(\frac{W_1}{P}\right).$$

In an Appendix we show that the result that $E\left(W_2/P\right) > E\left(W_1/P\right)$ is general. The higher real wage in a two-period contract than in a one-period contract works in the direction of lower expected employment. The real-wage effect dominates the effect that arises from the convexity of the labour demand schedule.

The higher expected real wage in a two-period than in a one-period contract can be explained by help of Figure 3, where the Nash bargaining product (5) is drawn as a function of the real wage. The crucial factor is that the function exhibits decreasing concavity around the maximum.[7] Under certainty in a one-period contract, the real wage ω maximises the function. Under uncertainty in a two-period contract, the nominal wage can be set so that the same expected real wage ω is obtained. But then the Nash bargaining product falls by more if the real wage, because of a high price realisation, turns out to be $(1-k)\,\omega$ than if it, because of a low price realisation, turns out to be $(1+k)\,\omega$. This creates an incentive to set a higher expected real wage than ω.[8] One can view this higher expected real wage in a two-period than a one-period contract as reflecting a *risk*

[7] At the maximum, it holds that $\partial B^3/\partial W^3 = 2\left(\varepsilon-\beta\right)bW^{-3} > 0$, since $0<\beta<1$ and $\varepsilon>1$. The crucial assumptions that give this are constant-elastic demand and constant relative risk aversion (zero above).

[8] The reasoning is similar to that of Sørensen (1992). In a monopoly-union setting, he and earlier Andersson and Sørensen (1988), showed that the expected log of the real wage, $E\left(\ln W-\ln P\right)$, is higher under uncertainty than under certainty and the expected log of employment, $E\left(\ln L\right)$, lower. As they pointed out, based on Rotschild and Stiglitz (1971), this result is not general, but it will always obtain with a log-normal price distribution. The difference in our analysis is that we look at the expectations of the unlogged real wage and employment levels and use a bargaining instead of a monopoly-union model. Our results that $E\left(W/P\right)$ is higher and $E\left(L\right)$ lower under uncertainty than under certainty about prices are general and do not presuppose any specific probability distributions. Rankin (1998) derives the similar, but not identical, result that increased monetary unceratinty will reduce the (unlogged) "natural rate" of employment, which he defines as the employment level when monetary variables take their expected values.

premium.

It should be noted that price variability is a necessary condition for expected employment to differ between one-period and two-period contracts. If there were only productivity shocks, but no price uncertainty, then the same real wage would be chosen in one-period and two-period contracts and $\phi = 1$. This follows because the real wage under certainty is invariant to productivity shocks. Variability in productivity has an effect on the difference in expected employment only when it interacts with variability in the price. This is clear as $E(\theta^{\varepsilon})$ enters multiplicatively in the expression for $E(L_1) - E(L_2)$.

With log-normal probability distributions, we obtain

$$\frac{d(E(L_1) - E(L_2))}{d\sigma_P^2} = -\frac{dE(L_2)}{d\sigma_P^2} > 0,$$

and

$$\frac{d(E(L_1) - E(L_2))}{d\sigma^2{}_\theta} = (1 - \phi)\frac{dE(L_1)}{d\sigma^2{}_\theta} > 0.$$

Increased variability of both the price and productivity thus increases the difference in expected employment between one-period and two-period contracts.

From (8) and (14) we can also derive that

$$E(U_1) - E(U_2) = \left(\frac{1-\beta}{\varepsilon - 1}\right)\frac{(E(L_1) - E(L_2))}{L_0}(1-t)\,b > 0. \tag{17}$$

and from (9), (15), and (16) that

$$E(\pi_1) - E(\pi_2) = (1-\tau)\frac{(\varepsilon - \beta)}{(\varepsilon - 1)^2}(E(L_1) - E(L_2))\,b > 0. \tag{18}$$

Both the difference in expected union utility and the difference in expected profit between one-period and two-period contracts are thus proportional to the difference in expected employment. These results will be convenient when the incentives for choosing various contract lengths are analysed.

III. Determination of contract length

The next step is the determination of contract length. Each union-firm pair must agree on the duration of contracts. As discussed in Section 2, we do not model this bargaining process explicitly. Instead, we show that changes in macroeconomic variability and the benefit level influence the incentives of unions and firms in the same direction. We are mainly interested in the effect of the unemployment benefit level on contract length. Our analysis of this holds for all probability distributions. The assumption of log-normal distributions is used only to analyse the effects of increased variability.

Union incentives

Consider first the union side. The cost for a union of negotiating a wage contract, C_U, varies across unions according to a cumulative distribution function $F(C_U)$. F is continuous and differentiable, $F(0) = 0$, and $F'(C_U) > 0$ for all C_U such that $0 < F(C_U) < 1$. The fraction of unions that prefer one-period contracts is x_U. Each union decides the desired contract length by comparing the *net* utilities of one two-period and two one-period contracts that are obtained when contract costs are taken into account. Because the contract cost for a two-period contract is paid in the first period and thus gross utility in the first period is independent of contract length, the comparison only involves the expected net utilities of the second period. One-period contracts are preferred if

$$E(U_1) - (1-t)C_U > E(U_2). \tag{19}$$

The cut-off point is $E(U_1) - (1-t)\,C_U = E(U_2)$. It follows that the fraction of one-period contracts desired by unions is

$$x_U = F\left(\frac{E(U_1) - E(U_2)}{1-t}\right). \tag{20}$$

To derive the effects of changes in macroeconomic variability and the benefit level on the fraction of one-period contracts desired by unions, we differentiate (20), taking (16) and (17) into account. We obtain

$$\frac{dx_U}{d\sigma_P^2} = F'(.) \left(\frac{b(1-\beta)}{(\varepsilon-1) L_0} \frac{d(E(L_1) - E(L_2))}{d\sigma_P^2} \right) = -F(.)' \frac{b(1-\beta)}{(\varepsilon-1)} \left(\frac{1}{L_0} \frac{dE(L_2)}{d\sigma_P^2} \right) > 0, \tag{21}$$

$$\frac{dx_U}{d\sigma_\theta^2} = F'(.) \left(\frac{b(1-\beta)}{(\varepsilon-1) L_0} \frac{d(E(L_1) - E(L_2))}{d\sigma_\theta^2} \right) = F'(.) \frac{b(1-\beta)}{(\varepsilon-1)} \left(\frac{(1-\phi)}{L_0} \frac{E(L_1)}{d\sigma_\theta^2} \right) > 0, \tag{22}$$

$$\frac{dx_U}{db} = -F'(.)(1-\beta) \left(\frac{E(L_1) - E(L_2)}{L_0} \right) < 0. \tag{23}$$

According to (21) the desired fraction of one-period contracts increases with larger price variability. This is a similar result as in standard models of contract length based on ad-hoc quadratic loss functions (Gray, 1976; Ball, 1987; Ball et al., 1988). Here, it comes about because larger price variability reduces expected employment, and hence also expected union gross utility, with a two-period contract.

Equation (22) shows that the desired fraction of one-period contracts increases with the variability of productivity. The explanation is that increased supply-side variability results in a larger employment difference, and thus also in a larger difference in union gross utility, between one-period and two-period contracts due to the interaction with price variability, as discussed above.[9]

Equation (23) , finally, relates the desired length of wage contracts to the benefit level. Higher unemployment compensation reduces the desired fraction of one-period contracts.

[9]The result that increased supply-side variability increases nominal wage flexibility differs from that in some closed-economy models, such as Gray (1978) and Walsh (1995). In these models, a supply-side shock gives rise to an offsetting price change, so that employment - which is the only objective of wage setters - remains constant with an unchanged nominal wage. Such an offset cannot occur in our small-open-economy model as the price and productivity are by assumption uncorrelated.

There is a simple intuition for this. Because two-period contracts lead to lower expected employment than one-period contracts, the unemployment risk is larger with two-period contracts. Hence, the expected gross income gain for a representative union member from a rise in unemployment compensation is larger under two-period contracts than under one-period contracts. Union incentives to choose two-period contracts are thus stronger the higher the unemployment benefit.

Employer incentives

Consider then the incentives of firms. We assume that the contract cost for firms, C_F, also varies according to a cumulative distribution function, which we denote $K(C_F)$ and which has the same properties as the F-function.

A firm prefers a one-period contract if

$$E(\pi_1) - (1-\tau)C_F > E(\pi_2).$$

The fraction of one-period contracts desired by firms, x_F, is given by

$$x_F = K\left(\frac{E(\pi_1) - E(\pi_2)}{(1-\tau)}\right). \tag{24}$$

Differentiation of (24), taking (16), and (18) into account gives

$$\frac{dx_F}{d\sigma_P^2} = -K'(.)\frac{1}{(1-\tau)}\frac{dE(\pi_2)}{d\sigma_P^2} > 0 \tag{25}$$

$$\frac{dx_F}{d\sigma^2_\theta} = K'(.)\frac{d\left(\left(E(\pi_1) - E(\pi_2)\right)/(1-\tau)\right)}{d\sigma^2_\theta} = K'(.)\frac{(1-\phi)}{(\varepsilon-1)}\left(\frac{\varepsilon-\beta}{\varepsilon-1}\right)^{1-\varepsilon} b^{1-\varepsilon}\frac{dE(\theta^{\varepsilon})}{d\sigma^2_\theta} > 0 \tag{26}$$

$$\frac{dx_F}{db} = K'(.)\frac{d\left(\left(E(\pi_1) - E(\pi_2)\right)/(1-\tau)\right)}{db} = -K'(.)\frac{(\varepsilon-\beta)}{(\varepsilon-1)}\left(E(L_1) - E(L_2)\right) < 0 \tag{27}$$

Equations (25) and (26) show that employers, too, have an incentive to reduce contract length when there is more uncertainty about prices and productivity, as should be expected. Equation (27) shows that higher unemployment compensation strengthens the incentive to choose two-period contracts also for employers. This result may be more unexpected than the result for unions, but can be understood as follows. Consider a 1 percent increase of the unemployment benefit, b. It is clear from (6) and (11) that this gives a 1 percent increase in the money wage in both one-period and two-period contracts. From (9) and (15) we have that the expected profit is reduced by $(\varepsilon - 1)$ percent with both types of contracts. But because the expected profit is larger with a one-period contract than with a two-period contract, the profit reduction is larger in absolute terms with a one-period contract than with a two-period contract. So an increase in unemployment compensation reduces the expected profit difference, $E(\pi_1) - E(\pi_2)$, and hence creates an incentive also for employers to increase contract length.

The upshot is thus that changes in macroeconomic variability and unemployment compensation affect the incentives of employers and employees with regard to contract length similarly. Both more unions and more firms prefer one-period to two-period contracts when macroeconomic variability increases and more two-period to one-period contracts when unemployment benefits are raised. Hence we conclude that larger macroeconomic variability reduces average contract length in the economy and that more generous benefits increases it.

To our knowledge, the effect of the unemployment benefit level on contract length analyzed here has not been pointed out before. The effect implies that a higher benefit level will not only raise equilibrium unemployment, but also make nominal wages more sticky, and thus increase employment variations in the case of macroeconomic shocks. This result does not follow because higher unemployment compensation reduces the welfare cost of employment variations per se: such a mechanism cannot occur when the benefit level is set in real terms and the wage is a fixed mark-up over this benefit level, as this implies a fixed replacement ratio. Instead, the result follows from the lack of certainty equivalence in our model, which implies that the expected employment level depends on contract length. Another conclusion is that, unlike in most earlier models, the effects of changes in the degree of macroeconomic variability are associated with changes in expected employment levels.

IV. Possible modifications of the analysis

This section discusses various modifications of the assumptions. The following aspects are considered: (*i*) the assumption of exogenously determined contract costs; (*ii*) the treatment of taxes; (*iii*) the assumption of risk neutrality; and (*iv*) the assumption that unemployment compensation is set in real terms.

Endogenous contract costs

We have assumed that contract costs are exogenous. Another - more realistic - possibility is to let them depend on real wages. This is natural if we interpret contract costs either as costs for bargaining services purchased or as foregone incomes of union members. Assume, for example, that the contract cost for each local union is a fixed proportion of the real wage in a one-period contract, so that

$$C_U = \lambda \frac{W_1}{P} = \lambda \frac{(\varepsilon - \beta)}{(\varepsilon - 1)} b.$$

Assume also that λ is given by a cumulative distribution function Γ with the same properties as the earlier F-function. Unions now prefer one-period to two-period contracts if

$$E(U_1) - E(U_2) > \lambda \frac{(\varepsilon - \beta)}{(\varepsilon - 1)}(1-t)b,$$

so that the desired fraction of one-period contracts becomes

$$x_U = \Gamma\left(\frac{(E(U_1) - E(U_2))(\varepsilon - 1)}{(\varepsilon - \beta)(1-t)b}\right).$$

There is now an additional effect of a rise in unemployment compensation. It raises the aggregate real wage and hence contract costs relative to the difference in expected gross incomes between one-period and two-period contracts. This effect also tends to reduce the number of one-period contracts and hence to reinforce the increase in average contract length.

The treatment of taxes

Taxes have not mattered for the incentives to choose different contract lengths in our analysis, because the same tax rate has applied to gross incomes and contract costs. This assumption could be discussed. For example, we have assumed that the contract cost for unions is either foregone income of members or tax deductible expenses for bargaining services purchased. If one were instead to assume that the contract cost for unions consists of foregone leisure (or of effort) on the part of union members, which by definition is not subject to taxation, or of non-deductible expenses for bargaining services, (19) and (20) change to

$$E(U_1) - C_U > E(U_2) \tag{28}$$

and

$$x_U = F\left(E\left(U_1\right) - E\left(U_2\right)\right), \tag{29}$$

where $E\left(U_1\right) - E\left(U_2\right) = (1-\beta)(E(L_1) - E(L_2)\left(1-t\right)b$. When analysing the effect of, for example, an increase in the benefit level, one has now to take into account that there will be an increase in the tax rate through the government budget constraint. As analysed in Calmfors and Johansson (2002b), this reinforces the tendency to longer wage contracts, because the after-tax income gain of a short-term contract, which is to be set against the non-deductible contract cost, is reduced.

Risk aversion

To simplify the exposition, we have assumed risk neutrality. As shown in Calmfors and Johansson (2002b), an assumption of a constant degree of relative risk aversion makes the analysis much more complex, but does not change the fundamental results.

The determination of unemployment benefits

We have not addressed the political-economy issue of how the benefit level is determined. Although a formal treatment is outside the scope of the paper, one can sketch such an analysis. An explicit government budget constraint, showing how the costs of benefits are shared between employers and workers, has to be added. It can then be shown that employers always lose from a rise in the benefit level (the combined effect of lower before-tax profits when wages go up and increased tax costs for benefits), whereas union members gain from the induced transfers from employers via the tax/benefit system (provided that employers pay a sufficiently large share of the costs).[10] The equilibrium benefit level

[10] To illustrate the point, assume certainty and zero contract costs. Assume also that workers pay a

will be the result of a trade-off between employers´and employees´conflicting interests, which could be modelled in several ways. Such an analysis could be extended further if risk aversion were to be assumed, as this would introduce an explicit income-smoothing objective for the union side.

V. Concluding comments

It is often taken for granted that the same labour market reforms reduce both equilibrium unemployment and the variability of employment. But no microeconomic underpinnings are usually presented for this view. We look at one particular labour market institution, unemployment benefits, and derive from a standard wage-setting model that a lower benefit level increases both equilibrium employment and nominal wage flexibility. So there is a double gain from lower unemployment benefits in our model. This would seem to strengthen the case for such reform.

There are several natural extensions of our work. One is to let contract length be a continuous variable, which would allow an analysis of explicit bargaining over contract length. A second possibility is to abandon the assumption of constant-elastic labour demand and analyse explicitly how the shape of the labour demand schedule influences the results. A third extension would be to abandon the small-open-economy assumption and let the price level be determined endogenously by the interaction of supply and demand for domestic products as in traditional closed-economy models.[11]

fraction γ and employers a fraction $(1-\gamma)$ of benefit costs, so that $t\left(LW/P+b\left(L_0-L\right)\right)=\gamma b\left(L_0-L\right)$ and $\tau\left(Y-LW/P\right)=(1-\gamma)b\left(L_0-L\right)$. It then follows that $d\pi/db=-\left(\left(\varepsilon-\beta\right)/\left(\varepsilon-1\right)+\varepsilon(1-\gamma)\right)L-(1-\gamma)\left(L_0-L\right)<0$ always and $dU/db=\left(\varepsilon(1-\gamma)-(\varepsilon-\beta)\right)L/L_0+(1-\gamma)\left(1-L/L_0\right)>0$ provided that $\gamma<\left(1-(1-\beta)\,L/L_0\right)/\left(1-(1-\varepsilon)\,L/L_0\right)$. Introducing uncertainty, contract costs and contract periods of different length would make tha analysis more complex, but the same trade-off between employers' and employees' interest remain.

[11]The reason why we have not pursued such an analysis here is the increased complexity of the model, which arises because it is not possible to derive closed-form solutions for wages, expected employment,

A fourth possible extension is to examine the implications of other wage-setting assumptions. Obvious candidates are insider-outsider models, efficiency-wage models and models where wages are set in individual rather then in collective bargaining. A full general equilibrium analysis should also address the political-economy issue of how the benefit level is determined. To analyse this properly, both risk aversion and insider-outsider considerations should be introduced.

A final extension might be to allow different rates of time preferences for employers and employees. There is some (slight) evidence that multi-year wage contracts imply ceteris paribus lower real wages in the final year(s) than in the first year (Calmfors and Forslund, 1990). Such a time profile would be consistent with a higher rate of time preference for employees than for employers, allowing employers to buy wage restraint from unions by "front-loading" real wage developments over the contract period. But we do not expect such an extension to change our basic result that the higher uncertainty associated with longer-term contracts imply a risk premium that reduce expected employment as compared to short-term contracts.[12]

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and expected profits in this case.

[12]We are grateful to Steinar Holden for raising this issue. The implication is that, unlike in our model, the wage in the first period of a two-period contract is likely to be higher than in a one-period contract. Hence, one would need explicitly to compute wages as well as expected utilities and profits for each period in a two-period contract when the comparison is made with two one-period contracts.

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A Comparision of the one-period and two-period expected real wages

The proposition in Section 3.3 that the expected real wage is higher in a two-period contract than in a one-period contract, i.e. that $E(W_2/P) > E(W_1/P)$, can be proved as follows.[13] Using (6) and (11) it is straightforward to show that the proposition holds if

$$E\left(P^{\varepsilon-1}\right) < E\left(P^{\varepsilon}\right) E\left(P^{-1}\right). \tag{A1}$$

[13] We are grateful to Per Sjölin and Harald Lang for helping us with the proof.

To prove (A1), we first note that we have already derived in footnote 6 that

$$E\left(P^{\,\varepsilon-1}\right) < E\left(P^{\,\varepsilon}\right)^{\frac{\varepsilon-1}{\varepsilon}}. \tag{A2}$$

Jensen's inequality also implies that $(E(P))^{\,\varepsilon} < E(P^{\,\varepsilon})$ because $P^{\,\varepsilon}$ is convex. This is equivalent to

$$E(P) < E\left(P^{\,\varepsilon}\right)^{\frac{1}{\varepsilon}}. \tag{A3}$$

Another implication of Jensen's inequality is that

$$(E(P))^{-1} < E\left(P^{-1}\right), \tag{A4}$$

as P^{-1} is convex. (A2) and (A3) together give

$$E\left(P^{\,\varepsilon-1}\right) < E\left(P^{\,\varepsilon}\right)(E(P))^{-1}.$$

Because $(E(P))^{-1} < E(P^{-1})$ from (A4), it must hold that

$$E\left(P^{\,\varepsilon-1}\right) < E\left(P^{\,\varepsilon}\right)E\left(P^{-1}\right).$$

Q.E.D.

Figure 1. The sequence of events

(a) One-period contracts

(b) Two-period contracts

Figure 2. Employment effects of real-wage variability around a given real wage.

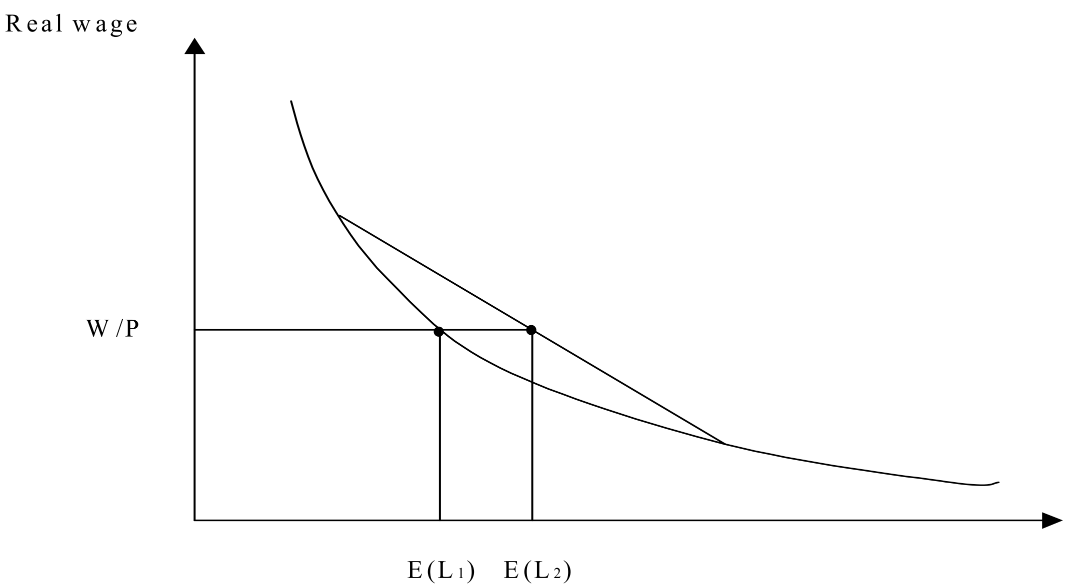

Figure 3. The concavity of the Nash bargaining product