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Research Department
16.3.2001

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Suomen Pankin keskustelualoitteita
Finlands Banks diskussionsunderlag

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Equilibrium unemployment with credit and labour market imperfections

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Erkki Koskela – Rune Stenbacka
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Abstract

We study the role of labour and credit market imperfections in the determination of equilibrium unemployment. In the credit market, loan contracts are negotiated between financiers and firms, both of which have bargaining power, while firms and organized labour bargain over the base wage. The sequential labour and credit market negotiations are assumed to take place conditional on the firm having committed to the use performance-related profit sharing in addition to the negotiated base wage. It is shown that, in the presence of profit sharing, intensified credit market competition will raise equilibrium unemployment, because it induces wage-enhancing effects that cause an increase in the outside option available to union members. Equilibrium unemployment, which is also an increasing function of firms' bankruptcy risks, is however independent of the extent of credit market imperfection, provided that the compensation system is unrelated to firms' profits or that there is a monopoly union in the labour market.

Key words: wage and loan bargaining, compensation systems, equilibrium unemployment

JEL classification: J 51, J 41, G 32

Lainamarkkinoiden kilpailun vaikutus tasapainotyöttömyyteen

Suomen Pankin keskustelualoitteita 5/2001

Erkki Koskela – Rune Stenbacka
Tutkimusosasto

Tiivistelmä

Tutkimuksessa analysoidaan pankkien neuvotteluvoimalla mitatun lainamarkkinoiden kilpailun vaikutusta tasapainotyöttömyyteen tilanteessa, jossa yritykset kokevat satunnaisia tulosokkeja. Lainamarkkinoilla rahoitussopimuksesta neuvottelevat pankki ja yritys, kun taas työmarkkinoiden peruspalkasta neuvottelevat yritys ja ay-liike. Laina- ja työmarkkinaneuvottelujen ehtona oletetaan olevan, että yritys on neuvotellun peruspalkan lisäksi sitoutunut tulospalkkaukseen. Tutkimuksessa osoitetaan, että kun käytetään tulospalkkausta ja kun ay-liikkeen neuvotteluvoima on epätäydellinen, lainamarkkinakilpailun lisääntyminen kasvattaa tasapainotyöttömyyttä, koska se johtaa suurempiin palkkoihin ja näin parantaa työntekijöiden vaihtoehtoistuloja. Tasapainotyöttömyyden osoitetaan myös kasvavan yritysten konkurssiriskin myötä. Jos ay-liikkeen neuvotteluvoima on täydellinen tai yrityksillä ei ole kannustinta ottaa käyttöön tulospalkkausta, lainamarkkinakilpailun aste ei vaikuta tasapainotyöttömyyteen.

Asiasanat: palkka- ja lainaneuvottelut, kompensaatiojärjestelmät, tasapainotyöttömyys.

JEL-luokittelu: J 51, J 41, G 32

Contents

Abstract 3

1 Introduction 7

2 The basic structure of the model 10

3 Determination of employment 12

4 Nash bargaining in the credit market 13

5 Nash bargaining and wage structure 16
5.1 Wage negotiation 16
5.2 Determination of profit sharing 19

6 Equilibrium unemployment with credit and labour market imperfections 21

7 Alternative timing structure: credit and labour market negotiations reversed 25

8 Concluding comments 30

References 32

Appendix 35

1 Introduction

European unemployment rate has shown a rising trend during the last twenty-five years. This has raised the question of how to explain this development. Without going explicitly into that issue, which is still partly unresolved, one should notice that at the moment there are several complementary approaches to study and explain high European unemployment. In this context various versions of the union bargaining theory have been quite popular. This is natural as in most European countries over three quarters of the workforce are still covered by collective bargaining. According to a commonly held view high European unemployment is (at least partly) associated with interactions between labour market imperfections (such as the bargaining power of trade unions, unemployment compensations systems, employment protection legislation) and economic shocks (see Blanchard and Wolfers (2000), Nickell and Layard (1999) and Pissarides (1999)).

Union bargaining theories have usually abstracted from financial considerations by focusing on the role of wages as factor costs. There is currently, however, a fair amount of empirical evidence from several countries suggesting that the real interest rate and the firm's leverage (or share of debt financing) will have a negative effect on employment (see eg Sharpe (1994), Hanka (1999), Nickell and Nicolitsas (1999) and Funke, Maurer and Strulik (1999)). Theoretical models of employment determination should be able to also explain the mechanisms behind these findings.

The potential role of financial factors in employment determination raises questions regarding the implications of financial factors more generally. Do financial factors affect the wage determination and, if so, how will these effects influence the optimal capital structure of the firms? In their comprehensive survey of capital structure theories Harris and Raviv (1991) argue that "capital structure models based on product/input market interactions are in their infancy" (p. 319). Since then an emerging literature has focused on the interaction between corporate finance, wage and employment policies. Bronars and Deere (1991) as well as Perotti and Spier (1993) demonstrate how firms can use debt as a strategic instrument to reduce the costs that unionized workers can impose on shareholders through their collective bargaining power. In a different vein Garvey and Gaston (1998) introduce a strategic role of debt into a simple version of an efficiency wage model, while Dasgupta and Sengupta (1993) investigate the role of capital structure as a strategic instrument designed to affect the outcome of bilateral bargaining with workers or other input suppliers. In their model debt is chosen so as to balance the bargaining advantage of debt against its agency costs (due to moral hazard) and debt is an optimal financial instrument only when it can provide a bargaining advantage for the firm.

Concludingly, several papers have focused on the impact of financial factors on wage bargaining, but with mixed results. Koskela and Stenbacka (2000c) develops a unified framework to simultaneously deal with the determination of wages, employment, employee effort, profit sharing and the choice of capital structure by firms. However, in Koskela and Stenbacka (2000c) the interaction between the operation of labour and credit markets is not fully analyzed, because in the credit market the determination of the interest rate is not endogenized.

Considerations focusing on the interaction between credit and labour markets, both characterized by market imperfections, draw attention to the potential role of credit markets in the determination of unemployment. The literature on this issue is currently quite thin. Wasmer and Weil (2000) investigate the impact of the interaction between labour and credit market imperfections on unemployment within the framework of a model with job search, credit matching frictions and negotiated mark-ups in the labour and credit markets. Their model generates a decompostion of unemployment into two parts, one depending on labour market imperfections and the other depending on credit market imperfections. These imperfections exhibit interaction in the form of a credit multiplier such that the credit market imperfections amplify the unemployment generated through the imperfections in the labour market. Wasmer and Weil's calibration shows that the total flow pecuniary cost of credit frictions represents approximatively 5,3% of annual GDP, and in such an environment they find credit market imperfections to increase the unemployment from 6% to 10%.

Acemoglu (2000) presents another mechanism for how credit market frictions may contribute to unemployment. He abstracts from labour market imperfections and demonstrates how failures in the credit market to channel funds to socially valuable projects can have a substantial impact on unemployment, in particular in the "medium" run.

In the present study we re-examine the role of labour and credit market imperfections as well as the interaction between these for the determination of equilibrium unemployment. The analysis takes place within the framework of the "right-to-manage" approach. In the credit market loan contracts are negotiated between financiers and firms, both possessing bargaining power, while the firms and organized labour bargain over the base wage in the imperfectly competitive labour market. These two types of negotiations take place sequentially and are assumed to be conditional on the firm having committed itself to the form of wage contract determining to what extent it makes use of performace-related profit sharing in addition to the negotiated base wage.

Our analysis makes it possible to characterize the relationship between the competitiveness of the credit market and the equilibrium unemployment for environments where firms apply performance-related wage contracts relying on profit sharing. We show that in a general equilibrium context intensified credit market competition will raise equilibrium unemployment, because it induces wage-enhancing effects causing an increase in the outside option available to union members. For such a relationship the general equi-librium perspective is crucial, since with attention restricted to a partial equilibrium setting with the outside option determined by the unemployment benefit intensified credit market competition will decrease employment. Furthermore, our general equilibrium analysis demonstrates that the equilibrium unemployment is an increasing function of firms' bankruptcy risks and thereby of the degree of debt financing. The presence of profit sharing or incomplete bargaining power of the trade union are necessary conditions for the relationship between the competitiveness of the credit market and the equilibrium unemployment. Namely, we demonstrate that equilibrium unemployment will be independent of the degree of imperfections in the credit market if the compensation systems used are unrelated to firms' profits or if there is a monopoly union in the labour market. Finally, we establish that in a general equilibrium context our results concerning equilibrium unemployment are robust to the mutual order of credit and labour market negotiations.

Our model differs in several respects from that of Wasmer and Weil (2000). Firstly, our results heavily depend on the general equilibrium analysis, which is important, because, in contrast to studies based on a partial equilibrium analysis, wage increases are channelled into the outside option available to union members. Secondly, we operate with more general wage contracts. In fact, most of the analysis in Wasmer and Weil is restricted to exogenous wages.[1] In particular, the performance-related profit sharing included in our model was shown to be a necessary condition for the predicted relationship between the competitiveness of the credit market and the equilibrium unemployment. Thirdly, Wasmer and Weil restrict their analysis to a sequence of negotiations where wage contracts are negotiated conditional on binding commitments to loan contracts, which are negotiated at an earlier stage of the game. Our analysis investigates the sensitivity to the selected sequence of labour and credit market negotiations by also reversing the stages of labour and credit market bargaining.

In our model the credit market negotiations affect the wage formation and thereby equilibrium unemployment through the mechanism of rent formation, but not through the impact on the wage elasticity of employment. Namely, under our assumption of a Cobb-Douglas type technology (A1) the wage elasticity of employment is constant. Such a production function implies that changes in factors like capital accumulation, and thereby the real interest rate, will have no impact on equilibrium unemployment, in particular if the unemployment benefits are adjusted so as to keep the replacement ratio constant. However, in light of empirical evidence it has been argued eg by Phelps (1994) that the real interest rate affects equilibrium employment. One way of bringing such facts into harmony with theory is to generalize the production function to be of CES-type, in which case the wage elasticity of demand depends on the real interest rate. Our model presents another channel for breaking the implausible result of unemployment neutrality to changes in the real interest rate. With wage systems incorporating profit sharing our model establishes a systematic relationship between imperfections in credit as well as labour markets and equilibrium unemployment while maintaining the analytically convenient assumption of a Cobb-Douglas technology. In the presence of profit sharing a change in the repayment rate will have a negative effect on the wage rate and thereby on equilibrium unemployment. On the other hand, in the absence of profit sharing or if there is a monopoly union in the labour market the performance of the labour market does not depend on the repayment rate.

We proceed as follows. In section 2 we present the basic structure of the model as well as the time sequence of decisions under circumstances where a representative firm operates in an environment characterized by uncertainty and thereby risk of bankruptcy. The firm's determination of employment in the short run is studied in section 3, while the Nash bargaining in the credit market is explored in section 4. Wage determination is investigated in section 5, and section 6 outlines the implications of the model for the determination of equilibrium unemployment in a general equilibrium framework. In section 7 we ask: What difference does it make if we have an alternative timing structure between credit and labour market negotiations? Finally, section 8 comprises concluding comments as well as some suggestions for future research.

[1] Wasmer and Weil (2000) do not endogenize wages until section 6 of their analysis and to the extent that wages are endogenized through a bargaining process the wage contracts are restricted to fixed base wages.

2 The basic structure of the model

We consider a financially constrained firm operating in an environment characterized by uncertainty. Production requires the firm to employ homogeneous workers within the framework of a unionized labour market. By employing labour input to the amount L the firm is able to generate random revenues, γ, which are distributed continuously with $\gamma > 0$ according to the conditional density function[2]

$$f(\gamma \mid L) = \lambda(L)e^{-\lambda(L)\gamma} \tag{2.1}$$

where $\lambda'(L) < 0$ and $\lambda''(L) > 0$. Thus, the underlying technology specifies that the generated random revenue is an increasing and concave function of the production factor, labour, in a stochastic sense.

In order to focus on the interaction between imperfections in credit markets and labour markets we assume the financial constraints of the firm to mean that it has to finance the fraction $\delta(0 \le \delta \le 1)$ of labour costs by debt so that the effective labour cost can be written as $(1 - \delta)w + \delta(1 + r)w = (1 + r\delta)w = \Delta w = \tilde{w}$, where r is the interest rate. Faced with an ordinary debt contract and operating under limited liability, the risk-neutral firm decides on the level of employment L in order to maximize its expected profits, $E\pi$, defined by

$$E\pi(L) = \int_{\hat{\gamma}}^{\infty} (\gamma - \tilde{w}L) f(\gamma \mid L) d\gamma = \frac{e^{-\lambda(L)\hat{\gamma}}}{\lambda(L)} \tag{2.2}$$

For the derivation of the RHS expression of (2.2) we have applied integration by parts and used the specification (2.1). In (2.2) the lower bound of the range of integration

$$\hat{\gamma} = \tilde{w}L \tag{2.3}$$

denotes the "break-even" state of nature, in which the projectholder is just able to remain solvent. The objective function (2.2) captures limited liability, which means that the firm's attention is restricted to the upper tail of the distribution of project returns $(\gamma \ge \hat{\gamma})$, while ownership of the project shifts to the bank in case the firm cannot fulfill its contractual obligation. Thus, the firm is bankrupt when $\gamma \ge \hat{\gamma}$.

In the long run the firm commits itself to the form of the wage contract characterizing to what extent it will make use of performance-related profit sharing. The profit share, τ, determines what fraction of the firm's profits will be transferred to employed workers as part of the contract. Conditional on the structure of compensation to organized labour the firm and the trade union engage in wage bargaining. The firm-union negotiations at this stage determine the base

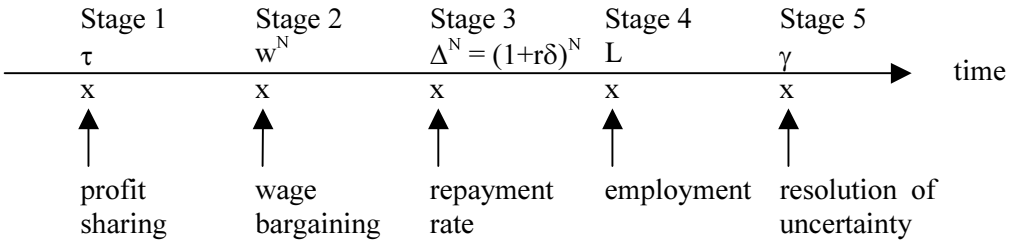
[2] This kind of specification in a more general form has been used in Koskela – Stenbacka (2000a).

wage, w, to be paid to all workers employed by the firm as the outcome of Nash bargaining. Conditional on the outcome of the wage bargaining, in its turn, the firm and the bank negotiate over the firm's repayment rate defined as $\Delta = 1 + r\delta$. Together with the negotiated base wage this repayment rate determines the effective cost of production for the firm. We again apply the Nash bargaining solution as the outcome of the firm-financier negotiations determining the firm's cost of debt financing. Finally, the firm unilaterally decides on employment once the negotiations in the labour and credit markets are settled. This sequential bargaining – with sequential separation of the negotiations in the labour and credit markets – seems to us not only natural but also essential for our purpose of studying the impact of the interaction between labour and credit markets on equilibrium unemployment. In their paper, with a different focus, Caballero and Hammour (1998) have abstracted from this by assuming block bargaining (workers versus financiers and firms). More precisely, they have assumed that the employees and the "owners" of the firm (the firm and the external financier) transact as two monolithic partners.

The selected order of moves between the bargaining taking place in the labour market and that in the credit market is by no means self-evident. The sequence with the wage contracts serving as a commitment relative to the firm-bank negotiations captures a scenario, whereby the wage negotiations generate fairly long-term wage contracts while fairly short-term debt contracts are used to finance the production. Alternatively, a shift in focus with the intention of investigating long term debt commitments could be modelled by reversing the stages of labour and credit market bargaining. Section 7 explores the robustness with respect to the sequence of labour and credit market negotiations by focusing on the reverse relative timing of these.

We summarize the time sequence of the decisions made by the firm, the financier and the union in Figure 1. In the subsequent sections we turn to a detailed analysis of the decisions taking place at each of the different stages of interaction between the firm, the bank and the union. We proceed by applying backward induction and thereby solving the game in reverse order by starting to investigate the determination of employment in the next section.

Figure 1. **Time sequence of decisions**



3 Determination of employment

At this stage we assume that the firm has committed itself to a profit sharing system and that the negotiations in the labour and credit markets have fixed the base wage and the repayment rate. This implies that the effective cost of employing L workers can be expressed as $w\Delta L$, thereby exhibiting a straightforward dependence on the negotiated base wage and repayment rate, respectively.

In order to simplify the presentation we make the following assumption[3] regarding the production technology.

Assumption 1: The hazard rate function $\lambda(L)$ is assumed to satisfy

$$\lambda(L) = \frac{\alpha}{L^{\alpha}} \quad \text{with} \quad 0 < \alpha < 1. \tag{A1}$$

Assumption (A1) immediately implies that $\lambda'(L) = -\alpha^2/L^{\alpha+1} < 0$ and $\lambda''(L) = \alpha^2(\alpha+1)/L^{\alpha+2} > 0$. This means firstly that an increase in employment shifts the density to higher returns according to the ordinary condition of first-order stochastic dominance. Furthermore, this shift to higher returns takes place at a decreasing rate. To investigate the firm's optimal employment determination as a function of the effective cost of labour we differentiate the latter part of (2.2) with respect to L. Through such a procedure we find that the labour demand has to satisfy the first-order condition

$$E\pi_L = -\lambda'(L)\left[1 + \lambda(L)\hat{\gamma}\right] - \lambda(L)^2 \tilde{w} = 0. \tag{3.1}$$

Using the specification (A1) for $\lambda(L)$ we can explicitly express the firm's optimal employment L* defined by equation (3.1) according to

$$L^* = \tilde{w}^{-\eta}\eta^{\eta}, \tag{3.2}$$

where $\eta \equiv \frac{1}{1-\alpha}$ is the elasticity of employment with respect to the effective wage rate $\tilde{w} = \Delta w$ with $\Delta = 1 + r\delta$. The effective labour cost consists not only of the wage rate, but also of the interest rate r and the leverage rate, δ, ie the fraction of the firm's production expenses covered by debt. Thus, acccording to (3.2) the firm's optimal employment exhibits a constantly elastic dependence on the wage rate and the repayment rate. Further, (3.2) suggests that the higher is the firm's leverage rate, the lower is employment, ceteris paribus. Empirical evidence from USA (see eg Sharpe (1994) and Hanka (1998)), from UK (see eg Nickell and Wadhwani (1991) and Nickell and Nicolitsas (1999)) as well as from Germany (see eg Funke, Maurer and Strulik (1999)) lies in conformity with this prediction that the firm's leverage will have a negative effect on employment.

[3] In what follows the derivatives are noted by primes for functions with one argument and the partial derivatives by subscripts for functions with many arguments. Hence for example $\lambda'(L) = d\lambda(L)/dL$, while $A_x(x,y) = \partial A(x,y)/\partial x$, etc.

Substituting the optimal employment (3.2) into the firm's expected profit function yields the following expected indirect profit function

$$E\pi^*(\Delta) = \frac{e^{-\lambda(L^*)\hat{\gamma}}}{\lambda(L^*)}, \tag{3.3}$$

with the optimality feature that $E\pi^*_L = 0$. This is used in the subsequent analysis of bargaining in credit and labour markets.

4 Nash bargaining in the credit market

We now turn to the analysis of the second stage of the game, the determination of the cost of external funds, captured by the repayment rate, Δ, in the credit market. In the literature there is no unique and standardized way to characterize the intensity of lending rate competition. In traditional oligopoly models the consequences of increased competition are analyzed by increasing the number of competing lenders. Another approach, frequently applied in the area of industrial organization, is to measure the intensity of competition by the degree of product differentiation like for example in the Hotelling type models of horizontal product differentiation. A third way of capturing the degree of credit market imperfections is to identify these with the lender's bargaining power relative to that of the borrower, ie to apply the Nash bargaining approach. This is the approach we will apply in the present analysis.[4] For our purposes this approach has two advantages: it both incorporates the polar market structures of monopoly and perfect competition as special cases and it avoids incorporation of market-specific, and often controversial, institutional details (like the precise type of competition) of credit markets as a part of the analysis.[5]

The financier of the firm's project, the bank, is assumed to be risk-neutral and abstracting from bankruptcy costs we can express its expected profit function as

$$EB(\Delta) = \Delta L^*(1 - F(\hat{\gamma})) + \int_0^{\hat{\gamma}} \gamma f(\gamma | L^*) d\gamma - L^*, \tag{4.1}$$

where the first term describes the bank's expected profits in states of nature where the projectholder remains solvent, while the second term delineates the expected profits when bankruptcy occurs. For simplicity, we assume, as reflected in the third term of (4.1), that the opportunity cost of granting loans is zero. Using integration by parts we can rewrite the expected profit function of the financier as follows

[4] The Nash bargaining approach can be justified either axiomatically or strategically (see eg Muthoo (1999)). For applications of the Nash bargaining approach to analyze lending martket competition in slightly different contexts we refer to Koskela and Stenbacka (2000b), Besci and Li and Wang (2000) and Wasmer and Weil (2000).

[5] A related bargaining approach has been used in Haskel and Sanchis (1995) in order to evaluate the consequences of privatization for the firm's X-efficiency. Their analysis focuses on the intra-organizational agency costs.

$$EB(\Delta) = L^*\left[\Delta(1 - F(\hat{\gamma})) - 1\right], \tag{4.2}$$

where $1 - F(\hat{\gamma}) = e^{-\lambda(L)\hat{\gamma}}$ denotes the probability of the firm remaining solvent.

The repayment is assumed to be determined as the outcome of bargaining between the lender and the firm. These negotiations take place subject to the constraint that the firm unilaterally determines the level of employment in line with the well-established "right-to-manage" approach. In what follows we further assume that the zero expected profits represent the threat point of both the firm and the financier. In such a situation the determination of Δ can be modelled as the solution to the following Nash bargaining problem

$$\text{Max}_{\Delta}\Psi(\Delta) = \left[EB(\Delta)\right]^{\mu}\left[E\pi^*(\Delta)\right]^{1-\mu} \quad \text{s.t.} \quad E\pi^*_L = 0, \tag{4.3}$$

where μ and $1-\mu$ denote the relative bargaining power of the financier and the firm, respectively. The first-order condition for this bargaining problem can be expressed as

$$\mu\frac{EB_{\Delta}}{EB} + (1-\mu)\frac{E\pi^*_{\Delta}}{E\pi^*} = 0, \tag{4.4}$$

where EB_{Δ} and $E\pi^*_{\Delta}$ denote the partial derivatives with respect to Δ of the financier's and the firm's objective functions, respectively. The equation (4.4) defines implicitly the optimal repayment as a function of the bank's relative bargaining power, μ, as well as other exogenous parameters.[6]

As the firm unilaterally optimizes employment, we can apply the envelope theorem to see that

$$E\pi^*_{\Delta} = -wL^*(1 - F(\hat{\gamma})) = -wL^*e^{-\lambda(L^*)\hat{\gamma}} < 0. \tag{4.5}$$

As for the effect of the repayment rate on the expected profit of the bank we have

$$EB_{\Delta} = L^*\left[\frac{\eta}{\Delta} + (1-\eta)(1 - F(\hat{\gamma}))\right] = L^*\left[\frac{\eta}{\Delta} + (1-\eta)\lambda(L^*)E\pi\right] \tag{4.6}$$

where we have utilized the fact that $\partial(\hat{\gamma}\lambda(L^*))/\partial\Delta = \lambda(L^*)\hat{\gamma}_{\Delta} + \hat{\gamma}\lambda'(L^*)L^*_{\Delta} = 0$. From the optimal labour demand (3.2) we get the result that the probability of solvency for the firm is determined by $(1 - F(\hat{\gamma})) = e^{1-\eta}$, which is constant and independent of the effective wage rate $\tilde{w} = \Delta w$.[7]

From combination of (3.3), (4.1), (4.5) and (4.6) we can re-formulate the first-order condition, (4.4), so as to find the Nash bargaining solution

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[6] We assume that the sufficient second-order condition for the Nash bargaining solution holds, ie that $\Psi_{\Delta\Delta} = \frac{\mu}{EB^2}\left[EBEB_{\Delta\Delta} - (EB_{\Delta})^2\right] + \frac{1-\mu}{(E\pi^*)^2}\left[E\pi^*E\pi^*_{\Delta\Delta} - (E\pi^*_{\Delta})^2\right] < 0.$

[7] Proof: Substituting the labour demand and the specification for $\lambda(L)$ for the expression of the probability of solvency gives $(1 - F(\hat{\gamma})) = e^{-\lambda(L)\hat{\gamma}} = e^{-\frac{\alpha\tilde{w}^{1-\eta}\eta^{\eta}}{\tilde{w}^{-\alpha\eta}\eta^{\alpha\eta}}} = e^{1-\eta}$. Q.E.D.

$$\Delta^{N} = \left[\frac{\mu + \eta - 1}{\eta - 1}\right]\frac{1}{e^{1-\eta}}. \tag{4.7}$$

According to (4.7) the negotiated repayment rate depends on three factors: (i) the firm's probability of solvency ($e^{1-\eta}$), (ii) the elasticity of labour demand (η) and (iii) the relative bargaining power of the financier (μ). It is easy to see that the repayment rate depends positively on both the probability of bankruptcy ($F(\hat{\gamma}) = 1 - e^{1-\eta}$) and the relative bargaining power of the financier. As for the impact of the elasticity of labour demand on the repayment rate, there are two offsetting effects in contrast to what is the case in standard bargaining models. On the one hand, a higher elasticity of labour demand restricts the ability of the financier to extract rents from the credit negotiations, which affects the repayment rate (the term $(\mu + \eta - 1)/(\eta - 1)$) negatively. On the other hand, higher wage elasticity increases the bankruptcy risks and thereby affects the repayment rate positively (the term $e^{1-\eta}$). Thus, the overall impact of the elasticity of labour demand involves a tradeoff between these two effects and it is a priori unclear.

From (4.7) we get as special cases the repayment rate prevailing in a credit market characterized by monopoly and perfect competition, respectively, as

$$\Delta^{M} = \left[\frac{\eta}{\eta - 1}\right]\frac{1}{e^{1-\eta}} \quad \text{and} \quad \Delta^{c} = \frac{1}{e^{1-\eta}}. \tag{4.8}$$

Thus, the repayment rate set by a monopoly bank is determined by the probability of project bankruptcy in such a way that this repayment rates is adjusted to take considerations resulting from the elasticity of labour demand into account in a way which is typical to monopoly behaviour. On the other hand, with perfect competition in the banking industry the lending rate is determined in order to simply adjust for the probability of bankruptcy so that the bank will break even.

We summarize our analysis of the bargaining taking place in the credit market in

Proposition 1. *The Nash bargaining repayment rate is given by (4.7). This Nash bargaining solution exhibits that the repayment rate depends positively on the relative bargaining power of the bank as well as on the bankruptcy risk of the project funded, while the dependence on the elasticity of labour demand reflects the offsetting effects of market power and bankruptcy.*

It is worth emphasizing that the Nash bargaining solution (4.7) is independent of the wage rate w. This is due to the constant wage elasticity of labour demand defined in equation (3.2), which results from the Cobb-Douglas specification of the hazard rate function $\lambda(L)$. This feature, whereby the bargaining taking place in the credit market can be separated from that taking place in the labour market, means a crucial simplification for the subsequent analysis of the wage negotiations.

5 Nash bargaining and wage structure

We now turn to analyze the wage negotiations between the union and the firm both possessing market power. In the wage negotiations the firm and union takes the profit sharing τ as given and behave in anticipation of optimal employment determination and the subsequently negotiated bargaining outcome regarding the repayment rate in the credit market.

5.1 Wage negotiation

We denote the relative bargaining power of the union by β, and, consequently, that of the firm by $(1-\beta)$. In the presence of the profit share τ accumulating to the employed union members, the objective function of the trade union can be written as

$$E\hat{U}(w) = L^*\left[(1-F(\hat{\gamma}))(w+\frac{\tau}{L^*}E\pi) + F(\hat{\gamma})\,b\right] + (N-L^*)b,$$

where the first term captures the rent to the employed and the second term that to the unemployed union members. With probability $F(\hat{\gamma})$ the firm confronts bankruptcy, in which case the worker becomes unemployed receiving the unemployment benefit b. With the complementary probability, $1-F(\hat{\gamma})$, the firm remains solvent and the employed union member is remunerated according to the compensation contract, ie the sum of the base wage, w, negotiated with the firm and the share of the profit realization, τ/L^*, determined by the firm.

We assume that the threat points of the trade union and the firm can be described by $EU^o = Nb$ and $E\pi^o = 0$, respectively. Applying the traditional Nash bargaining solution the negotiating parties decide on the base wage w in order to maximize

$$Max_w \Omega(w) = \left[EU(w)\right]^{\beta}\left[(1-\tau)E\pi^*(w)\right]^{1-\beta} \quad \text{s.t.} \quad \Psi_{\Delta} = E\pi^*_L = 0, \tag{5.1}$$

where $EU = E\hat{U} - EU^o = (1-F(\hat{\gamma}))\left[L^*(w-b)+\tau E\pi\right]$ and $E\pi^* = e^{1-\eta}/\lambda(L^*)$. The calculation of the trade union's expected rent relative to the outside option, EU, captures the idea that all of the N workers have incentives to seek employment. Those union members who are left unemployed, either due to the magnitude of the firm's production or due to bankruptcy, enjoy the unemployment benefit. The Nash bargaining solution has to satisfy the following first-order condition

$$\Omega_w = 0 \Leftrightarrow \beta\frac{EU_w}{EU} + (1-\beta)\frac{E\pi^*_w}{E\pi^*} = 0, \tag{5.2}$$

where the subscript w denotes differentiation with respect to the basic wage rate w.[8]

Differentiating the expected profit function of the firm and utilizing the envelope theorem we find that

$$E\pi^*_w = -\frac{e^{1-\eta}\lambda'(L^*)L^*_w}{\lambda(L^*)^2} = -\frac{e^{1-\eta}(\eta-1)}{w\lambda(L^*)} < 0$$

so that

$$\frac{E\pi^*_w}{E\pi^*} = -\frac{(\eta-1)}{w} < 0. \tag{5.3}$$

For the trade union analogous calculations show that

$$EU_w = \frac{(1-F(\hat{\gamma}))L^*}{w}\left[w(1-\eta)+b\eta\right] > 0. \tag{5.4}$$

Utilizing these expressions we can explicitly solve the first-order condition (5.2) with respect to the Nash bargaining solution, w^N. We thereby find that

$$w^N = \frac{\beta+\eta-1}{\eta-1+(1-\beta)\Delta\tau e^{1-\eta}}b. \tag{5.5a}$$

According to (5.5a) the repayment rate Δ will have a negative effect on the wage rate in the presence of profit sharing as long as the trade union does not have full monopoly power. In particular, this means that both the interest rate, r, and the leverage rate, δ, will have wage-moderating effects. This lies in conformity with the econometric evidence, based on panel data on a large number of UK companies, reported in Nickell and Nicolitsas (1999). However, these wage-moderating effects disappear in the absence of profit sharing or in a situation where all the bargaining power is fully concentrated into the hands of the trade union. Without profit sharing changes in the wage elasticity of labour demand would be the only channel whereby financial variables could influence wage formation. However, under the technology assumption (A1) such an effect does not exist. Further, a monopoly union in the labour market has an incentive to capture all available rent in the form of base wage independently of the profit share applied. When the trade union's bargaining power is incomplete (ie $\beta < 1$) the negotiated wage depends negatively on the expected profit share, ie the product of the probability of solvency, $e^{1-\eta}$, and the profit share, τ. Hence under profit sharing the probability of bankruptcy will have a positive effect on the negotiated wage rate.

[8] We assume that the sufficient second-order condition for the Nash bargaining solution holds, ie that $\Omega_{ww} = \frac{\beta}{EU^2}\left[EUEU_{ww} - (EU_w)^2\right] + \frac{1-\beta}{(E\pi^*)^2}\left[E\pi^* E\pi^*_{ww} - (E\pi^*_w)^2\right] < 0.$

Substituting the negotiated repayment ratio reported in (4.7) for Δ into (5.5a,b) exhibits the Nash bargaining solution for the base wage in a way which explicitly accounts for the relative bargaining power of the financier

$$w^N = \frac{\beta + \eta - 1}{\eta - 1 + (1-\beta)\tau \dfrac{\mu + \eta - 1}{\eta - 1}} b. \tag{5.5b}$$

According to both alternative specifications (5.5a) and (5.5b) the negotiated wage is a multiple of the outside option, the unemployment benefit b. From (5.5b) we can further draw conclusions regarding the relationship between the negotiated based wage and the relative bargaining power of the trade union and the financier, respectively. As expected, the negotiated wage (5.5b) depends positively on the relative bargaining power of the trade union, β. Further, in the presence of profit sharing the Nash bargaining solution is negatively related to the relative bargaining power of the financier, μ. From (5.5b) the effect of the wage elasticity of labour demand is unclear a priori (see the arguments presented subsequent to (4.7)).

We summarize our characterization of the negotiated base wage in

Proposition 2. *The Nash bargaining wage, given by (5.5a) or (5.5b), is proportional to the unemployment benefit. In the presence of profit sharing and trade union's incomplete bargaining power the Nash bargaining solution exhibits that the factor of proportionality is decreasing as a function of the repayment rate, the expected profit share and the relative bargaining power of the financier, while it is increasing as a function of the relative bargaining power of the trade union.*

From the Nash bargaining solution (5.5b) we can infer that the negotiated wage is related to the intensity of competition prevailing in the credit market as soon as wage contracts incorporate a performance-related component in the form of profit sharing. Namely, an increased degree of competition in the credit market (in the sense of a lower μ) leads to higher negotiated wages.

From (5.5a) or (5.5b) we can conclude that there will be no relationship between the competitiveness of the credit market and the negotiated wage rate in the absence of profit sharing. Namely, substituting $\tau = 0$ into (5.5a) or (5.5b) yields the following negotiated wage rate

$$w^N\big|_{\tau=0} = \frac{\beta + \eta - 1}{\eta - 1} b, \tag{5.6}$$

which is independent of the credit market situation.

Further, from (5.5b) we can extract interesting results for several special cases. If the lender has monopoly power we end up with

$$w^N\Big|_{\mu=1} = \frac{\beta + \eta - 1}{\eta - 1 + (1-\beta)\tau \dfrac{\eta}{\eta - 1}} b. \tag{5.7}$$

According to (5.7) a higher outside option, b, as well as a higher bargaining power of the trade union, β, lead to higher wage rate. From (5.5b) we can draw a further particular conclusion with reference to a monopoly trade union. In that case the negotiated base wage is independent of both the profit share, τ, and the repayment rate factor, Δ, implying that we end up with the standard formulation for the wage determination

$$w^M\Big|_{\beta=1} = \frac{\eta}{\eta-1}b, \tag{5.8}$$

for any $0 \le \mu \le 1$. Finally, if neither the trade union nor the financier has any bargaining power so that both the wage rate and the repayment factor are determined by the firm, the wage is given by

$$w^N\Big|_{\beta=\mu=0} = \frac{\eta-1}{\eta-1+\tau}b. \tag{5.9}$$

It can be seen from (5.9) that the presence of profit sharing will induce a competitive labour market to set the base wage below the unemployment benefit in such a way that the expected compensation including the profit share equalizes this outside option.[9]

5.2 Determination of profit sharing

In this section we proceed to the first stage of the game in order to analyze the firm's optimal commitment to the wage structure in the form of a profit share. As we have seen in the previous sections the profit share will subsequently impact on the negotiated wage and thereby on employment. The firm's optimal decision with respect to the profit share has to take these effects into account.[10]

The firm decides on the profit share in order to solve the following optimization problem

$$\mathrm{Max}_\tau (1-\tau)E\pi^* = (1-\tau)\frac{e^{-\lambda(L^*)\hat{\gamma}}}{\lambda(L^*)} \quad \text{s.t.} \quad \Omega_w = \psi_\Delta = E\pi_L^* = 0, \tag{5.10}$$

[9] As we can conclude later on (see (5.13)), the optimal profit share will be zero if both the labour and credit markets are competitive and in light of (5.9) such a case implies that $w^N = b$.

[10] Profit sharing refers to renumeration mechanisms where the traditional fixed-wage remuneration is replaced by a scheme with a fixed base wage plus a share of profits or revenues of firms. Profit sharing mechanisms represent an incentive device whereby the compensation is performance related. Weitzman (1985) argues that the profit sharing system leads to better business cycle performance when compared to a fixed wage system and conjectures that profit sharing systems will reduce equilibrium unemployment (Weitzman (1987)). A number of contributions to the literature on wage bargaining, for example, Jerger and Michaelis (1999), Holmlund (1991), Pohjola (1987) and Anderson and Devereux (1989) have analyzed profit sharing within a framework where the union-firm negotiations include profit shares in addition to base wages. In this literature the profit shares are determined simultaneously with base wages, a feature which can be questioned on grounds of realism. At least the authors are not aware of cases where the nature of the incentive scheme offered to unionized workers would have been subject to negotiations with unions within the framework of collective bargaining.

where $L^* = \left[w^N \Delta^N\right]^{-\eta} \eta^\eta$ and $L^* = \left[w^N \Delta^N\right]^{-\eta} \eta^\eta$ (see the equations (3.2), (4.7) and (5.5a,b) for the determination of employment, the base wage and the repayment factor). The first-order condition for the profit share is

$$\underbrace{-E\pi^*(w^N, \Delta^N)}_{-} + \underbrace{(1-\tau) E\pi_w^* \frac{\partial w^N}{\partial \tau}}_{+} = 0, \tag{5.11}$$

where

$$E\pi_w^* = -\frac{e^{1-\eta}(\eta - 1)}{w^N \lambda(L^*)} < 0 \tag{5.12a}$$

and

$$\frac{\partial w^N}{\partial \tau} = -w^N (1-\beta) \frac{\mu + \eta - 1}{(\eta - 1)\left[\eta - 1 + (1-\beta)\tau \frac{\mu + \eta - 1}{\eta - 1}\right]} < 0 \quad \text{if} \quad \beta < 1. \tag{5.12b}$$

The first-order condition (5.10) exhibits that the optimal profit share is determined so that the negative dilution effect (the first term) is counterbalanced by the positive wage-moderating effect of the profit share τ (the second term).

Under what circumstances will (5.11) generate an interior solution for the profit share? Substituting the expressions (5.12a) and (5.12b) into (5.11) and rearranging gives the following explicit solution for the optimal profit share

$$\tau^* = \frac{(\eta - 1)\left[\mu(1-\beta) - \beta(\eta - 1)\right]}{\eta\left[(1-\beta)(\mu + \eta - 1)\right]} > (=)\, 0 \quad \text{as} \quad \mu^* > (\leq) \frac{\beta(\eta - 1)}{(1-\beta)} \tag{5.13}$$

We restrict ourselves to non-negative profit shares for natural reasons. Therefore from (5.13) we can conclude that the firm abstains from using the profit sharing instrument if $\mu/(\eta - 1) \leq \beta/(1-\beta)$. In that case, as we will see later on, the interaction between labour and credit markets will disappear under our assumed production function (A1).

One can see from the numerator of (5.13) that the optimal profit share is well-defined and positive if $\mu/(\eta - 1) > \beta/(1-\beta)$. From this condition we can draw several interesting conclusions.

Firstly, if the credit market is sufficiently competitive in the sense of μ being sufficiently close to zero, the firm has no incentive to offer a positive profit share. This is a natural feature because with a sufficiently competitive credit market the profit share does not have sufficiently strong wage-moderating effects so as to overcome the dilution effect. It is worth emphasizing that this property always holds as long as the trade union has some bargaining power. Secondly, and related, we can conclude from (5.13) that $\partial \tau^* / \partial \mu > 0$ meaning that the optimal profit share increases with the relative bargaining power of the financier. This holds because a base wage moderation increases the firm's incentives to use profit

sharing. Thirdly, when facing a trade union with strong bargaining power, ie a union which is sufficiently close to a monopoly union, the firm has no incentive to make use of the profit sharing instrument. This feature holds because the wage-moderating effect of the profit share vanishes under a regime with a monopoly union. Finally, and also related, from (5.13) we can infer that $\partial\tau^*/\partial\beta < 0$ meaning that the optimal profit share increases as a function of the firm's relative bargaining power in the labour market negotiations.

We summarize our findings of this section in

Proposition 3. *The optimal profit share, given by (5.13), is determined so that the positive wage-moderating effect exactly counterbalances the negative dilution effect. In particular, the optimal profit share is increasing as a function of the relative bargaining power of the bank in the credit market and of that of the firm in the labour market. For sufficiently competitive credit markets or sufficiently strong bargaining power of the trade union in the labour market the firm finds it optimal not to make use of the profit sharing instrument.*

6 Equilibrium unemployment with credit and labour market imperfections

After having studied the interaction between the determination of the wage structure and the repayment rate conditional on labour demand we now integrate the material developed so far in order to explore the relationship between total employment and imperfections in the labour and credit markets, measured by the relative bargaining powers of the negotiating parties. Earlier we oserved that imperfections in the labour and credit markets have opposite effects on the negotiated base wage. The negotiated base wage was found to be an increasing function of the trade union's relative bargaining power, while a decresing function of the bank's relative bargaining power. In order to investigate the implications for employment we start by considering the partial equilibrium effects when the outside option b is exogenously given.

Let us first consider the case of a change in the degree of labour market imperfection. Since the negotiated repayment rate factor, Δ^N, is independent of the wage rate, we have the following expression for the employment effect

$$\frac{dL}{d\beta} = \underbrace{L_{\tilde{w}}\Delta}_{-}\left[\underbrace{\frac{\partial w^N}{\partial\beta}}_{+} + \underbrace{\frac{\partial w^N}{\partial\tau^*}\frac{\partial\tau^*}{\partial\beta}}_{+}\right] < 0. \tag{6.1}$$

According to (6.1) employment is boosted by a fall in the relative bargaining power of the trade union. There are two reasons for this. Firstly, decreased labour market imperfections generate a fall in the wage rate, ceteris paribus, and secondly, the profit share is induced to increase, which leads to wage moderation and thus reinforces the direct effect of the relative bargaining power on the wage rate. These features jointly contribute to the impact on employment mentioned above.

As for the degree of credit market imperfection, measured by the relative bargaining power of the financier μ, we can see that it affects employment directly via the repayment rate factor and indirectly via the base wage rate and the profit share. More specifically, the employment effect of a change in μ can be expressed as

$$\frac{dL}{d\mu} = \underbrace{L_{\tilde{w}} w^N \left[\frac{\partial \Delta^N}{\partial \mu}\right]}_{-} + \underbrace{L_{\tilde{w}} \Delta^N \left[\frac{\partial w^N}{\partial \mu} + \frac{\partial w^N}{\partial \tau^*}\frac{\partial \tau^*}{\partial \mu}\right]}_{+}. \tag{6.2}$$

The employment effect of a rise in the relative bargaining power of the financier is determined through three channels of influence. First, there is the direct effect, whereby the employment falls as a consequence of an increase in the negotiated repayment rate factor (the first term on the RHS). In addition, there are two offsetting effects operating through the mechanism for wage formation. The negotiated wage rate is moderated both directly and indirectly via the resulting increase in the profit share. Both of these effects stimulate employment (the second term on the RHS).

Substituting the relevant expressions into (6.2) and rearranging gives

$$\frac{dL}{d\mu} = \frac{wL_{\tilde{w}}}{(\eta-1)e^{1-\eta}}\left(1 - \frac{(\eta-1)^2 + (1-\beta)\tau(\mu+\eta-1)\eta}{\left[(\eta-1)^2 + (1-\beta)\tau(\mu+\eta-1)\right]\eta}\right) < 0. \tag{6.3}$$

Therefore, despite the offsetting effects we can conclude that the direct effects of a change in the relative bargaining power of the bank dominate relative to the indirect effects via the wage and profit share determination indepedently of the relative size of the bargaining power of trade union in the labour market. Consequently, in a partial equilibrium context with an exogenous outside option more intense competition in the credit market generates lower unemployment.[11]

Until now our analysis has been restricted to a representative industry, say i. In what follows we investigate how credit and labour market imperfections will impact on equilibrium unemployment from a general equilibrium perspective. According to (5.5a) or (5.5b), for each representative industry the Nash bargaining solution has the form

$$w_i^N = A_i b \tag{6.4}$$

with $A_i = \dfrac{\beta+\eta-1}{\eta-1+(1-\beta)\tau\dfrac{\mu+\eta-1}{\eta-1}}$ or, equivalently, $A_i = \dfrac{\beta+\eta-1}{\eta-1+(1-\beta)\Delta\tau e^{1-\eta}}$,

where, in principle, the variables on the RHS are industry-specific. However, for simplicity, we have abstracted from an industry-specific notation.

We assume that all industries are symmetrical in the sense that $A_i = A$. In a general equilibrium context the term b should be interpreted to be the outside option given by

[11] It could emphasized that the partial equilibrium employment effect of credit market competition is invariant to whether profit sharing is applied or not. As we can see from equation (6.2), however, profit sharing affects the magnitude of the employment effect.

$$b = (1-u)w + uB, \tag{6.5}$$

where u denotes the unemployment rate, B the unemployment benefit and w is the negotiated wage rate in all the identical industries (for a standard justification we refer to Layard et. al (1991), p. 100–101). We follow Jerger and Michaelis (1999) in so far as we further restrict ourselves to the case of a constant replacement ratio $q \equiv B/w$. Combining (6.4) and (6.5) we get

$$u^N = \frac{1}{1-q}\left[1 - \frac{1}{A}\right]. \tag{6.6a}$$

In light of (6.6a) we can conclude that the structural unemployment is an increasing function of the bankruptcy risk as long as the wage contracts incorporate profit sharing. This ties the structural unemployment to the capital structure of firms. Namely, under these circumstances our model predicts that increased leverage or increased interest rate will lower the equilibrium unemployment. Moreover, in the case of a monopoly union we have $A = \frac{\eta}{\eta - 1}$ so that the intensity of competition will have no effect on equilibrium unemployment.

Substituting the RHS of (5.13) for τ in 1/A and rearranging gives the following expression for equilibrium unemployment

$$u^N = \frac{\beta}{1-q}\left[\frac{(\eta-1)+(\eta-\mu)}{\eta(\beta+\eta-1)}\right]. \tag{6.7}$$

It is easy to see from (6.7) that $\partial u^N/\partial q > 0$, $\partial u^N/\partial \beta > 0$ and $\partial u^N/\partial \mu < 0$. Hence, the equilibrium unemployment increases with the benefit replacement ratio q and the relative bargaining power of the trade union β. On the other hand, and surprisingly, higher relative bargaining power of the financier leads to lower equilibrium unemployment.

Economic intuition goes as follows: A rise in μ will increase the repayment rate. This has two offsetting effects in a partial equilibrium setting: on the one hand, the effective labour cost increases as a result of a rise in Δ and on the other hand, in the presence of profit sharing higher Δ leads to wage moderation, which decreases the effective labour cost. In a partial equilibrium the former effect dominates and employment falls. But in a general equilibrium framework, wage moderation induces the value of the outside option to decrease (see equation (6.5), which tends to enhance employment. In a general equilibrium, the outside option effect dominates so that higher relative bargaining power of the financier in the credit market is associated with lower equilibrium unemployment.

In the absence of bankruptcy risks and interaction between credit and labour markets an increase in the wage elasticity of labour demand will generally decrease equilibrium unemployment via wage moderation. In our framework a rise in the wage elasticity of labour demand will also increases the probability of bankruptcy thereby offering an additional unemployment enhancing effect. This effect comes from wage-increasing effect of bankruptcy risk. Therefore, an

increase in the wage elasticity of labour demand need not necessarily lower equilibrium unemployment as in standard models of wage and employment determination.

For environments where firms apply performance-related wage contracts relying on profit sharing we summarize two main findings regarding the relationship between the competitiveness of the credit market and the equilibrium unemployment in the following two propositions.

Proposition 4. *When wage contracts are performance-related, in a general equilibrium context intensified credit market competition will raise equilibrium unemployment, because it induces wage-enhancing effects causing an increase in the outside option available to union members. In contrast, with attention restricted to a partial equilibrium perspective with the outside option determined directly by the unemployment benefit alone, intensified credit market competition will decrease unemployment.*

One can see from equation (6.4) that the mark-up of the negotiated wage (the term $A_i = A$ is a positive function of the bankruptcy risk and thereby of the degree of debt financing. This together with the expression for the equilibrium unemployment, (6.6a), makes it possible to formulate

Proposition 5. *When wage contracts are performance-related, equilibrium unemployment is an increasing function of bankruptcy risks and thereby of the degree of debt financing.*

As one can see from Propositions 4 and 5, the mechanism of profit sharing serves as the bridge between the credit and labour markets. Namely, under our assumption of a Cobb-Duoglas type technology with constant wage elasticity of labour demand elimination of the performance-related compensation instrument in the form of profit sharing would break the strategic interaction between the imperfections in the credit and labour markets.

From (5.13) we can conclude that the firm will not find it worthwhile to make use of profit sharing so that the compensation system is unrelated to firms' profits if the relative bargaining power of the financier μ is less or equal to the critical level $\mu^* = \beta(\eta - 1)/(1 - \beta)$. This critical level depends positively both on the relative bargaining power of the trade union β and the wage elasticity of employment η. Thus, for example, for given relative bargaining powers of the financier and the trade union it follows that increased wage elasticity of employment makes it more likely that the equilibrium unemployment is no longer dependent on the degree of imperfection in the credit market.

In particular, substituting $\tau = 0$ (absence of profit sharing) or $\beta = 1$ (monopoly union) into (6.6a) yields the following equilibrium unemployment, respectively

$$u^N\big|_{\tau=0} = \frac{\beta}{(1-q)[\beta+\eta-1]}, \quad u^N\big|_{\beta=1} = \frac{1}{(1-q)\eta}. \tag{6.6b}$$

For these case the equilibrium unemployment is independent of the credit market characteristics.

This crucial conclusion is expressed in the next proposition.

Proposition 6. *Equilibrium unemployment will be independent of the degree of imperfections in the credit market if the compensation systems used are unrelated to firms' profits or if there is a monopoly union in the labour market.*

In our model the credit market negotiations affect the wage formation and thereby equilibrium unemployment through the mechanism of rent formation, but not through the impact on the wage elasticity of employment. Namely, under our assumption of a Cobb-Douglas type technology (A1) the wage elasticity of employment is constant. As pointed out by, for example Rowthorn (1999), such a production function implies that changes in factors like capital accumulation, the real interest rate, technical progress or labour force expansion will have no impact on equilibrium unemployment, in particular if the unemployment benefits are adjusted so as to keep the replacement ratio constant. However, in light of empirical evidence some of the variables mentioned above, like the real interest rate, seem to affect equilibrium unemployment (see eg Phelps (1994)). As suggested by Rowthorn (1999), these facts can be brought into harmony with theory by modifying the production function so as to imply elasticities of substitution between capital and labour different from one.

Our model presents another channel for breaking the result of unemployment neutrality to structural changes of the type mentioned above. With wage systems incorporating profit sharing and assuming that the relative bargaining power of the trade union in the labour market is incomplete, our model establishes a systematic relationship between imperfections in credit as well as labour markets and equilibrium unemployment while maintaining the analytically convenient assumption of a Cobb-Douglas technology. In the presence of profit sharing a change in the repayment rate will have a negative effect on the wage rate and thereby on equilibrium unemployment. On the other hand, in the absence of profit sharing or if there is a monopoly union in the labour market, the wage rate and thereby the equilibrium unemployment does not depend on the repayment rate meaning and credit market imperfections do not matter for equilibrium unemployment.

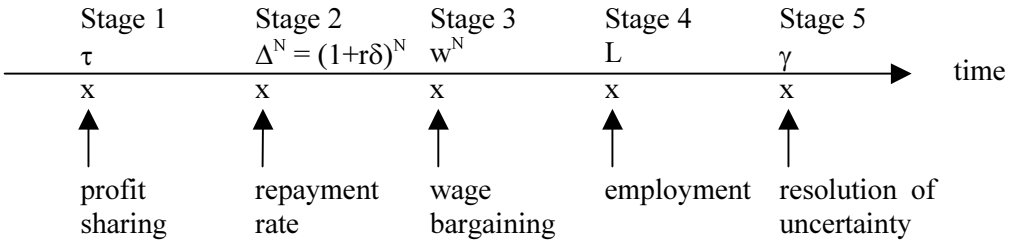
7 Alternative timing structure: credit and labour market negotiations reversed

As we mentioned earlier in section II, the selected sequence with the wage contracts serving as a commitment relative to the firm-bank negotiations captures a scenario, whereby the wage negotiations generate fairly long-term compensation contracts, while fairly short-term debt contracts are used to finance the production. This sequence is not, however, by any means self-evident.

In this section we study the implications of an alternative timing structure by reversing the stages of labour and credit market bargaining. This shift in focus towards long term debt commitments has the intention of exploring the robustness of the predictions regarding the relationship between equilibrium unemployment and imperfections in the labour and credit markets. Now the time sequence of the decisions made by the firm, the financier and the union can be summarized as in

Figure 2.[12] As earlier, we proceed by applying backward induction and solving the game in the reverse order.

Figure 2. **Time sequece of decisions**



As for the determination of employment we can rely on the earlier analysis which is summarized in the labour demand equation (3.2) and in the resulting expected indirect profit function of the firm (3.3). The determination of the wage rate can now be obtained by maximizing $\Omega = [EU]^{\beta}[(1-\tau)E\pi^*]^{1-\beta}$ subject to $E\pi_L^* = 0$ and taking the repayment rate factor Δ as given. This gives

$$w^N = \frac{\beta + \eta - 1}{\eta - 1 + (1-\beta)\Delta\tau e^{1-\eta}} b, \tag{7.1}$$

where $e^{1-\eta}$ is the probability of solvency for the firm. According to (7.1), in the presence of profit sharing the base wage rate depends positively on the outside option b and the relative bargaining power of the union β, negatively on the firm's probability of solvency, $e^{1-\eta}$, the profit share, τ, and the repayment rate factor, Δ, while the effect of wage elasticity of labour demand is unclear a priori (see the discussion subsequent to (4.7)). Hence, as in Koskela and Stenbacka (2000c), Dalmazzo (1996) and Wasmer and Weil (1999) (Corollary 1, p. 27)) the debt serves as a strategic instrument for wage moderation (see Nickell and Nicolitsas (1999) for supporting empirical evidence). The Nash bargaining wage rate is thus similar to the case where the timing of the credit and labour market negotiations is reversed (see equation (5.5a,b) and Proposition 2). This is due to the fact that for such a timing structure the negotiated repayment rate is independent of the wage rate under our assumptions.

We will now turn to analyze the determination of the repayment rate factor Δ between the firm and the financier both possessing market power. In the repayment rate negotiations the firm and the financier take the profit share as given and behave in anticipation of optimal employment determination and of the bargaining outcome regarding the base wage rate in the labour market. This can be modeled as the solution to the following Nash bargaining problem

$$\text{Max}_{\Delta}\Psi = [EB]^{\mu}[E\pi^*]^{1-\mu} \quad \text{s.t.} \quad \Omega_w = E\pi_L^* = 0, \tag{7.2}$$

where

[12] This sequence between the interactions in the credit and labour market is also applied by Wasmer and Weil (2000) and Dalmazzo (1996).

$$
\begin{aligned}
&\text{(a)} \quad EB(\Delta) = L^{*}\left[\Delta e^{-\lambda(L^{*})\hat{\gamma}} - 1\right] \\
&\text{(b)} \quad E\pi^{*}(\Delta) = \frac{e^{-\lambda(L^{*})\hat{\gamma}}}{\lambda(L^{*})} \\
&\text{(c)} \quad \hat{\gamma} = w^{N}\Delta L \\
&\text{(d)} \quad L^{*} = \left[w^{N}\Delta\right]^{-\eta}\eta.
\end{aligned}
\tag{7.3}
$$

The Nash bargaining solution satisfies the following first-order condition $\Psi_{\Delta} = 0 \Leftrightarrow \mu\frac{EB_{\Delta}}{EB} + (1-\mu)\frac{E\pi^{*}_{\Delta}}{E\pi^{*}} = 0$. Utilizing the envelope theorem and (7.1) we end up (see the Appendix for details) with the following implicit expression for the negotiated repayment rate factor

$$
\Delta^{N} = \frac{\hat{A}\left[\mu\eta + (1-\mu)\dfrac{1}{\eta-1}\right]}{\left[\mu(\eta\hat{A}-1) + (1-\mu)\dfrac{\hat{A}}{\eta-1}\right]e^{1-\eta}},
\tag{7.4}
$$

where $0 < \hat{A} = \dfrac{\eta-1}{\eta-1+(1-\beta)\Delta\tau e^{1-\eta}} \le 1$ with the following properties: $\hat{A}_{\tau} < 0, \hat{A}_{\beta} > 0, \hat{A}_{\Delta} < 0$ and $\hat{A}_{\eta} < 0$. Since $\hat{A}$ depends on the repayment factor Δ the equation (7.4) represents an implicit solution for Δ. The relationship between the repayment rate Δ^{N} and the term $\hat{A}$ is negative.

The repayment factor depends on the relative bargaining power of the financier, the wage elasticity of labour demand, the probability of solvency for the firm, the profit share and the relative bargaining power of the trade union. In particular, a rise in the relative bargaining power of the trade union β decreases the repayment rate factor since $\Delta^{N}_{\beta} = \Delta^{N}_{\hat{A}}\hat{A}_{\beta} < 0$. This is natural because the higher bargaining power of the trade union leads to higher base wage and thereby weakens the possibility of the financier to extract rent from credit market negotiation so that the repayment rate goes down (this is a similar finding as proposition 6 in the different model of Wasmer and Weil (2000)). This dependence of the repayment rate on the bargaining power of the trade union, however, vanishes in the absence of profit sharing in which case $\hat{A} = 1$ in (7.4). The reason for this independence lies in the constant effective wage elasticity of labour demand.

In the special cases of monopoly and perfectly competitive financiers we have

$$
\Delta^{M} = \frac{\hat{A}\eta}{(\eta\hat{A}-1)e^{1-\eta}} \quad \text{and} \quad \Delta^{c} = \frac{1}{e^{1-\eta}}
\tag{7.5}
$$

respectively. Under competitive credit markets the repayment factor depends negatively only on the probability of solvency for the firm, while in the case of a monopoly financier it also depends on the relative bargaining power of the trade

union as well as on the profit share, the risk of bankruptcy and the wage elasticity of labour demand.

Next we proceed to the first stage of the game in order to analyze the determination of the profit share rate conditional on the subsequent equilibrium with respect to employment and the determination of the base wage rate and the repayment rate.

At this stage the firm decides upon the profit share in order to solve the following optimization problem

$$\text{Max}_{\tau}(1-\tau)\text{E}\pi^{*} = (1-\tau)\frac{e^{-\lambda(L^{*})\hat{\gamma}}}{\lambda(L^{*})} \quad \text{s.t} \quad \Psi_{\Delta} = \Omega_{w} = \text{E}\pi_{L}^{*} = 0, \tag{7.6}$$

where $L^{*} = \left[w^{N}\Delta^{N}\right]^{-\eta}\eta^{\eta}$ and $\hat{\gamma} = w^{N}\Delta^{N}L^{*}$ (see (3.2), (7.1) and (7.4) for the equilibria with respect to employment, the base wage and the repayment rate factor). The necessary first-order condition for the profit share is

$$\underbrace{-\text{E}\pi^{*}}_{-} + \underbrace{(1-\tau)\text{E}\pi_{w}^{*}\frac{\partial w^{N}}{\partial\tau}}_{+} + \underbrace{(1-\tau)\text{E}\pi_{\Delta}^{*}\frac{\partial\Delta^{N}}{\partial\tau}}_{-} = 0, \tag{7.7}$$

where

$$\text{(a)} \quad \text{E}\pi_{w}^{*} = -\frac{e^{1-\eta}(\eta-1)}{w^{N}\lambda(L^{*})} < 0$$

$$\text{(b)} \quad \text{E}\pi_{\Delta}^{*} = -w^{N}L^{*}e^{1-\eta} < 0$$

$$\text{(c)} \quad \frac{\partial w^{N}}{\partial\tau} = \frac{\beta+\eta+1}{\eta+1}\hat{A}_{\tau} < 0 \tag{7.8}$$

$$\text{(d)} \quad \frac{\partial\Delta^{N}}{\partial\tau} = \frac{-\mu\left[\mu\eta+\frac{1-\mu}{\eta-1}\right]}{\left[\mu(\eta\hat{A}-1)+\frac{1-\mu}{\eta-1}\hat{A}\right]^{2}e^{1-\eta}}\hat{A}_{\tau} > 0.$$

The first-order condition (7.7) exhibits that the optimal profit share is determined so that the negative dilution effect (the first term) is counterbalanced by the positive wage-moderating effect of the profit share τ (the second term) and reinforced by the repayment-increasing effect of the profit share (the third term). Therefore under this timing structure there is an additional negative effect which result from the positive relationship between the repayment rate and the profit share.

In what follows we assume that there is an interior solution for (7.6), ie that equation (7.7) has a solution, and study the relationship between credit and labour market imperfections and equilibrium unemployment under this alternative sequence of wage and repayment rate negotiations. Until now our analysis has referred to a representative industry, say i. According to (7.1) for each representative industry the Nash bargaining solution has the form

$$w_i^N = C_i b, \tag{7.9}$$

where $C_i = \dfrac{\beta + \eta - 1}{\eta - 1 + (1-\beta)\Delta\tau e^{1-\eta}}$ and where the variables on the RHS are industry-specific. However, for simplicity, we have again abstracted from industry-specific notation by assuming that all industries are symmetrical in the sense that $C_i = C$.

In the general equilibrium context the term b should be interpreted to be the outside option, which is given by $b = (1-u)w + uB$, where u denotes the unemployment rate, B the unemployment benefit and w is the negotiated wage rate in all the identical industries. As earlier, we further restrict ourselves to the case of a constant replacement ratio $q \equiv B/w$. Combining (7.5) and the definition of outside option b yields, after some manipulation, the following expression for the equilibrium unemployment rate

$$u^N = \frac{\beta}{1-q}\left[\frac{1-((1-\beta)/\beta)\Delta e^{1-\eta}}{\beta + \eta - 1}\right]. \tag{7.10}$$

It can directly be seen from (7.10) that $\partial u^N/\partial q > 0$, $\partial u^N/\partial \beta > 0$ and $\partial u^N/\partial \mu < 0$ (since $\partial \Delta^N/\partial \mu > 0$). Hence, the equilibrium unemployment increases with the benefit replacement ratio q and the relative bargaining power of the trade union β. On the other hand, higher relative bargaining power of the financier leads to lower equilibrium unemployment.[13]

Economic intuition goes as follows: A rise in μ will increase the repayment rate. This has two offsetting effects in a partial equilibrium context: on the one hand, the effective labour cost increases as a result of a rise in Δ and on the other hand, in the presence of profit sharing higher Δ leads to a wage moderation, which decreases the effective labour cost. In a partial equilibrium the total effect on employment is ambiguous a priori. But in general equilibrium, the value of the outside option decreases due to a wage moderation, which tends to decrease unemployment. In a general equilibrium, the outside option effect dominates so that higher relative bargaining power of the financier in the credit market is associated with lower equilibrium unemployment. Furthermore, from (7.10) we can infer that equilibrium unemployment increases as a function of the bankruptcy risks – a feature identical to that reported in Proposition 6.

Consequently, in the presence of compensation contracts incorporating profit sharing we have demonstrated the following feature of robustness regarding the relationship between the degree of credit market imperfections and equilibrium unemployment.

Proposition 7. *When wage contracts are performance-related, in a general equilibrium context equilibrium unemployment is a decreasing function of the market power of the bank and an increasing function of the bankruptcy risks independently of the mutual order of credit and labour market negotiations.*

[13] As for the impact of the wage elasticity of labour demand on equilibrium unemployment, see the discussion subsequent to equation (6.7).

Again, in the absence of profit sharing the structural unemployment (7.10) will be reduced to (6.6b). Thus, with compensation systems unrelated to profits the structural unemployment will be independent of the bargaining power of the financier independently of the sequence by which labour and credit market negotiations take place.

Independently of the sequence of credit and labour market negotiations the repayment rate has a negative impact on the negotiated wage in the presence of performance-related compensation in the form of profit shares, as we can conclude from (5.5a,b) or (7.1). This relationship forms the basis for the strategic interaction between the credit and labour markets. Increased credit market imperfections moderates wages sufficiently much so as to enhance employment provided that these wage-moderating effects are strengthened by influence on the outside option available to organized labour. This is precisely what happens in a general equilibrium.

The intuition for why increased credit market imperfections will enhance employment reminds qualitatively of a mechanism identified in a different context by Coricelli, Cukierman and Dalmazzo (2000a, 2000b). These authors demonstrate how in the presence of imperfect labour markets a more conservative central bank will enhance employment as a result of the strategic interaction between unions and the central bank. In their case, a larger degree of central bank consevativeness will increase the elasticity of labour demand and therefore generate wage moderation among unions in possession of bargaining power. In our case the negative effect of the financier's bargaining power on equilibrium unemployment also reflects the strategic interaction between credit and labour markets. Here the interaction is not intermediated through the effects on the wage elasticity of labour demand, but through the effect on wage moderation instead.

8 Concluding remarks

We have studied the role of labour and credit market imperfections as well as on the interaction between these for the determination of equilibrium unemployment by using framework of the "right-to-manage" approach. In the credit market loan contracts are negotiated between financiers and firms, both possessing bargaining power, while the firms and organized labour bargain over the base wage in the imperfectly competitive labour market. These two types of negotiations take place sequentially. Our analysis has exhibited the robustness of the results for alternative sequence of relative timing between the labour and credit market negotiations. The labour and credit market negotiations have been assumed to take place conditional on the firm having committed itself to the form of wage contract determining to what extent it makes use of performance-related profit sharing in addition to the negotiated base wage.

Our analysis makes it possible to characterize the relationship between the competitiveness of the credit market and the equilibrium unemployment for environments where firms apply performance-related wage contracts relying on profit sharing. We show, in a general equilibrium context, that intensified credit market competition will raise equilibrium unemployment, because it induces wage-enhancing effects causing an increase in the outside option available to union members. For such a relationship the general equilibrium perspective is

crucial, since with attention restricted to a partial equilibrium setting with the outside option determined by the unemployment benefit intensified credit market competition will decrease employment. Furthermore, our general equilibrium analysis demonstrates that the equilibrium unemployment is an increasing function of firms' bankruptcy risks and thereby of the degree of debt financing. Also, the presence of profit sharing is a necessary condition for the relationship between the competitiveness of the credit market and the equilibrium unemployment. Namely, we also demonstrate that equilibrium unemployment will be independent of the degree of imperfections in the credit market if the compensation systems used are unrelated to firms' profits or if there is a monopoly union in the labour market. Finally, we establish that, in a general equilibrium context, equilibrium unemployment is a decreasing function of the market power of the bank independently of the mutual sequence of credit and labour market negotiations as long as the wage contracts are performance-related.

In light of our study we would like to suggest some agendas for further research. First, we have employed a production function of Cobb-Douglas type, which implies labour demand with constant wage elasticity. For more general production functions, for example CES, the wage elasticity of labour demand depends also on the price of capital. This offers an additional mechanism whereby the intensity of credit market competition will affect wage negotiation and thereby equilibrium unemployment.

Secondly, we have abstracted from product market considerations by postulating a stochastic revenue funtion where the product market is not incorporated. It can be argued that a higher degree of competitiveness in the product market in the sense of higher price elasticity of products increases the wage elasticity of labour demand and thereby affects wage negotiations and equilibrium unemployment. Usually this has been modelled in a Dixit-Stiglitz way, where mark-ups depend on exogenously determined price elasticities. But the essential meaning of economic integration is certainly something different. Economic integration changes strategic incentives for firms and there are several ways to model changes in the degree of competitiveness (see eg Andersen and Sorensen 2000 and Hoon (2001)).

Thirdly, as long as the stage of wage bargaining serves as a commitment relative to the credit market negotiations we have shown that the negotiated repayment factor incorporated in debt contracts is independent of the negotiated base wage. For the wage-moderating effect of increased market imperfections in the credit market to dominate relative to the direct cost-increasing effect of external capital it is necessary that the wage moderation reduces the outside option in addition to the direct wage reduction. It still remains an issue for further research to investigate whether this properties are specific for debt contracts, or whether it possibly applies to a more general class of financial contracts within the framework of imperfectly competitive capital markets. One could mention that Wasmer and Weil (2000) includes an empirical study exploring the relationship between venture capital investment and unemployment for 16 countries between 1986 and 1995. They provide some supporting evidence for the notion that venture capital investment will have a negative effect on unemployment.

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Appendix

Derivation of the Nash bargaining repayment rate

The Nash bargaining solution for the repayment rate satisfies the following first-order condition

$$\Psi_{\Delta} = 0 \Leftrightarrow \mu \frac{EB_{\mu}}{EB} + (1-\mu)\frac{E\pi^{*}_{\Delta}}{E\pi^{*}} = 0 \qquad \text{(I)}$$

Straightforward calculations show that

$$\frac{EB_{\Delta}}{EB} = \frac{1}{\Delta}\left[\frac{\Delta e^{1-\eta}}{\Delta e^{1-\eta} - 1} - \eta\hat{A}\right] \qquad \text{(II)}$$

and

$$\frac{E\pi^{*}_{\Delta}}{E\pi^{*}} = -\frac{\hat{A}}{\Delta(\eta - 1)} < 0 \qquad \text{(III)}$$

where $\hat{A}$ is defined in association with (7.4). Using (II) and (III) we can solve (I) to obtain the implicit solution (7.4) **in the text**.

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