Product Market Competition, Profit Sharing and Equilibrium Unemployment

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Abstract

We investigate the implications of product market imperfections on profit sharing, wage negotiation and equilibrium unemployment. The optimal profit share, which the firms use as a wage-moderating commitment device, is below the bargaining power of the trade union. Intensified product market competition decreases profit sharing, but increases the negotiated base wage, because the wage-increasing effect of reduced profit sharing dominates the wage-reducing effect associated with a higher wage elasticity of labor demand. Finally, we show that intensified product market competition does not necessarily reduce equilibrium unemployment, because it induces both higher wage mark-ups and lower optimal profit shares.

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I.   Introduction

According to standard wisdom of economics competition promotes economic efficiency. In line with this general view intensified competition in product markets could be expected to promote employment. However, with labor market imperfections the effects of intensified product market competition on unemployment are far from self-evident**.**

In the present study we explore the impact of intensified product market competition in the presence of profit sharing on price setting, wage formation and equilibrium unemployment. We show the following results. The optimal profit share, to which firms commit themselves prior to the wage negotiation, is smaller than the bargaining power of the trade union unlike existing results in the current literature and more consistent with empirics. Intensified product market competition decreases optimal profit sharing, but it will have a positive effect on the negotiated base wage. Intensified product market competition increases the negotiated base wage, because the wage-enhancing effect of the reduced profit shares dominates relative to the wage-moderating effect associated with higher wage elasticity of labor demand. For that reason intensified product market competition does not necessarily reduce equilibrium unemployment, because it induces a higher base wage mark-up through a lower optimal profit share.

In light of the arguments developed above, reduced distortions in the product market do not necessarily improve the performance of the labor market, which suffers from a primary distortion with its roots in the bargaining power of the trade union. However, when firms commit to optimal profit sharing, intensified product market competition will indeed decrease equilibrium unemployment in the case of a monopoly trade union, while it has no effect on equilibrium unemployment when the trade union has no bargaining power. Finally, in the absence of profit sharing, intensified product market competition will always decrease the equilibrium unemployment by unambiguously decreasing the distortionary wage mark-up in the labor market. Thus, the performance-based remuneration system in the form of profit sharing seems to play an important role for the relationship between imperfections in product and labor markets. Overall, we characterize in detailed simulations those circumstances where

intensified product market competition, in the presence of profit sharing, hurts employment.

Some employment consequences of intensified competition and deregulation in product markets have been analyzed in the recent literature. Next we briefly characterize these. Nickell (1999) has surveyed how market power in the product markets impacts on the performance of the labor market by reviewing collective bargaining models and efficiency wage models for the wage determination. There is some evidence that sharing of monopoly rents leads to higher wages in the presence market power in the product markets, but it is not clear whether this is essentially a union effect or applies equally well in the non-union sector. Gersbach (2000) summarizes three mechanisms, through which reductions in product market imperfections might enhance employment and concludes that product market reforms in Europe could imply employment gains. These mechanisms are based on lower mark-ups, higher total productivity and expanded sets of product varieties (see also Gersbach and Schniewind 2001).

Blanchard and Giavazzi (2003) and Spector (2004) have developed a monopolistic competition model with collective wage bargaining, but not profit sharing, to study the effects of product market competition under imperfectly competitive labor markets and argued that higher product market competition will increase employment. Ebell and Haefke (2003) have studied the relationship between product market structure and labor market outcomes by focusing on Mortensen-Pissarides-type search and matching frictions and monopolistic competition in the product markets when there is individual wage bargaining. Their qualitative findings are roughly similar to those of Blachard and Giavazzi (2003) and Spector (2004). Amable and Gatti (2004) have developed a different type of framework. They use a model of monopolistic competition with an endogenous determination of worker flows in and out of employment where wages are determined, not by bargaining, but by an efficiency wage mechanism and they show that higher product market competition may generate employment losses rather than gains.

Bayomi, Laxton and Presenti (2004) have applied a general equilibrium model of the global economy to examine the benefits from greater competition in product and labor markets on output, consumption and the stability of the economy. They estimate

the macroeconomic benefits and international spillovers of intensified competition in the product and labor markets and conclude that greater competition significantly stimulates macroeconomic performance and that it may improve macroeconomic management by increasing the responsiveness of wages and prices to market conditions. However, they do not model labor markets explicitly. Abowd and Lemieux (1993) has studied how product market conditions affect wages through their effects on the financial strength of the firm by using data from collective agreements in Canada and they show that higher foreign competition reduces wages. Nickell, Vainiomaki and Wadhwani (1994) and Konings and Walsh (2000) have also empirically explored some aspects of the employment effects of product market imperfections with imperfectly competitive labor markets. Using British firm level data Nickell, Vainiomaki and Wadhwani (1994) argue that product market power raises wages, while Konings and Walsh (2000) indicate that the impact of stronger product market competition on employment loss is lower in unionised firms compared with non-unionised firms.

It seems timely to investigate the effects of stronger product market competition on employment in light of the steady trend towards more intense product market competition in the OECD countries, and, in particular, in Europe. Conway, Janod and Nicoletti (2005) have in great detail delineated recent trends of product market deregulation, and intensified competition, in OECD countries by using indicators of product market regulation. Clearly, regulatory impediments to product market competition have declined significantly in all OECD countries in recent years. For the group of EU member countries product market regulation is typically more homogenous, at least when evaluated year 2003, than in the rest of OECD.[1] Furthermore, European competition policy in combination with improvements in the implementation of competition law has promoted product market competition by making it more difficult for firms to abuse dominant market positions.

The entire literature mentioned above, no matter whether theoretically oriented or empirically oriented, has abstracted from profit sharing as part of the compensation

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[1]   Countries that were estimated to be relatively liberal in 1998 – the United Kingdom, the Unites States, Australia, New Zealand, Canada, Ireland and Denmark – have reported relatively small degrees of relaxation in product market regulation. Countries estimated to be in the middle in terms of regulation indicator in 1998 are Iceland, the Netherlands, Sweden, Norway, Germany, Austria, Japan, Belgium, Finland, Switzerland and Portugal. All of these countries have made

scheme in the labor market. However, profit sharing is an empirically important phenomenon in many OECD countries and our model predicts that it plays a significant role for the theoretical relationship between the imperfections in product markets and equilibrium unemployment with imperfectly competitive labor markets. The OECD Employment Outlook (1995) reports general cross-country evidence on the incidence of profit sharing in OECD countries. Pendleton et. al. (2001) presents more recent and detailed data on the significant proportion of workplaces with financial employee participation, in particular in the form of profit sharing schemes, in 14 EU countries. This information is illustrated in Figure 1. For example, among EU-countries in 1999/2000 a double-digit percentage of the workplaces apply profit sharing in Austria, Finland, France, Germany Ireland, Netherlands, Portugal, Spain, Sweden and United Kingdom. In some countries with particularly extensive profit sharing systems, like France, public policy explicitly encourages profit sharing. For further evidence regarding the incidence of profit sharing we refer to, for example, the DICE database collected by CESifo (http://www.CESifo.de), Wadhwani and Wall (1990), Cahuc and Dormont (1997) as well as Conyon and Freeman (2001).
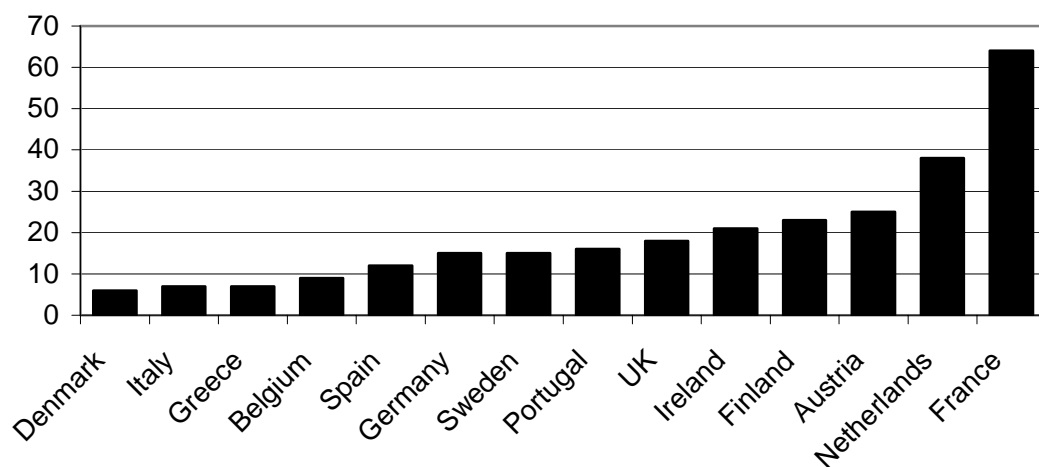
Figure 1: Workplaces with Profit Sharing in Percent, 1999/2000

Source: Pendleton, A., Poutsma, E., van Ommeren, J., Brewster, C., Employee Profit Sharing in the European Union, European Foundation for the Improvement of Living and Working Conditions, Office for Official Publications of the European Communities, Luxembourg, 2001.

progress in reducing the extent of state control, while reductions in barriers to entrepreneurship have been more disparate across these countries.

Our study proceeds as follows. Section II presents the basic structure of the model as well as the time sequence of decisions with product and labor market imperfections. Price setting and labor demand by firms are studied in section III. In section IV we analyze the wage determination using the Nash bargaining approach subject to price setting and labor demand. Section V explores the determination of optimal profit sharing, to which firms commit themselves prior to the wage determination. In section VI we characterize the determinants of the equilibrium unemployment with a particular emphasis on how it depends on the intensity of product market competition. Finally, in section VII we present concluding comments.

II.   Basic Framework

We focus on a deterministic model under product and labor market imperfections with the following time sequence of decisions. In the long run, at stage 1, the firms commit themselves to a profit-sharing arrangement, which specifies to what extent the wage contracts are performance-related. The profit share, τ, determines what fraction of the firms' profits will be transferred to employed workers. The profit sharing decision is made in anticipation of its effects on the negotiated base wage as well as on price setting and labor demand. At stage 2 firms and labor unions bargain with respect to the base wage and this negotiation takes place under conditions where the firms are committed to the profit sharing contracts. The wage negotiations take place in anticipation of the consequences for labor demand and price setting. Finally, at stage 3 firms make employment decisions and set product prices in the monopolistic competition by taking the profit sharing and the negotiated base wage as given.

We summarize the time sequence of decisions in Figure 1. In the subsequent sections we derive the decisions taking place at different stages by using backward induction.

This timing structure captures the idea that the profit sharing decisions take place within the framework of an institutional environment where the profit-sharing schemes have to be independent of the wage agreements. This timing structure seems to be a reasonably accurate description of how profit-sharing arrangements operate in many

countries[2] (see, for example, Cahuc and Dormont (1997) and Pendleton et. al. (2001)). Of course, the relative timing between the negotiated wage setting and the profit-sharing decision could also be reversed so as to capture the case where the negotiated base wage is a long-term contract relative to the firms' design of the performance-related compensation component.[3]
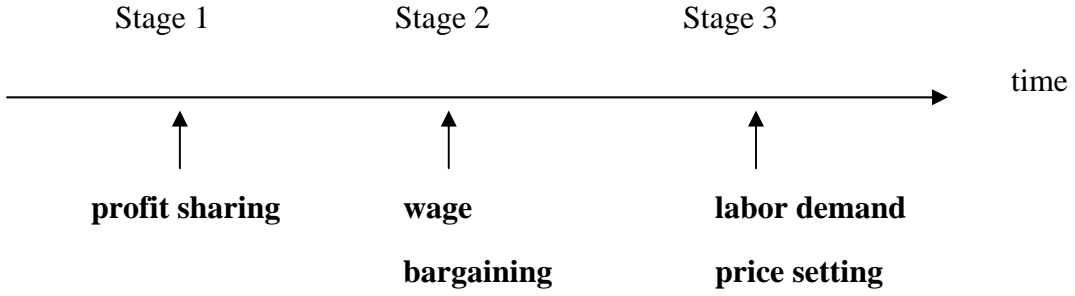
Figure 2: Time sequence of decisions

We postulate (for each firm i) a Cobb-Douglas production function according to

$$R_i(L_i) = \frac{L^\alpha}{\alpha}, \ i = 1,\ldots,n \tag{1}$$

where L_i denotes the amount of labor (i.e. employment), and a is a parameter satisfying $0 < a < 1$. Thus, (1) is a well-defined production function exhibiting decreasing returns to scale with respect to employment.

III. Price Setting and Labor Demand

In this paper the product market is modeled to operate with monopolistic competition in line with Dixit and Stiglitz (1977). The firms face consumers endowed with the CES - utility function

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2   For example, in France, where the reported proportion of workplaces with profit sharing exceeds 50 %, firms can qualify for tax exemptions if they apply profit sharing schemes, which stipulate bonuses which are independent of the negotiated base wage.

3   Koskela and Stenbacka (2005) have explored the impact of different time sequences between profit sharing decisions and base wage negotiations in a different model, which did not investigate the role of imperfections in the product market.

$$U = \left[n^{-\frac{1}{s}} \sum_{i=1}^{n} D_i^{\frac{s-1}{s}} \right]^{\frac{s}{s-1}}, \tag{2}$$

where $s > 1$ denotes the elasticity of substitution between products and where n is the number of products (and firms). We assume that this elasticity of substitution measures the degree of product market competition.[4] A higher elasticity of substitution means a higher degree of product market competition. In particular, the limiting case of perfect competition is associated with the elasticity of substitution s approaching infinity.

Firm i decides on price and employment so as to maximize the following profit function

$$\max_{(p_i, L_i)} (1 - \tau_i) \pi_i = (1 - \tau_i) \left[p_i R_i(L_i) - w_i L_i \right] . \tag{3}$$

At this stage the firm takes the negotiated wage rate w_i and the profit share τ_i as given. From the underlying utility function, given by (2), the demand in the product market can be seen to be of the form

$$D_i = \frac{M}{P} \left(\frac{p_i}{P} \right)^{-s}, \tag{4}$$

where p_i is the price of good i, $P \equiv \left[\frac{1}{n} \sum_{i=1}^{n} p_i^{1-s} \right]^{\frac{1}{1-s}}$ is the index of the aggregate price level, M is the aggregate nominal income. Thus, M/P denotes the real income.[5]

By imposing market-clearing in the product markets, $D_i = R_i$, we can re-express the profit function (3) for the purpose of price setting according to

$$\max_{p_i} \pi_i = p_i D_i - w_l L_i = M \left(\frac{p_i}{P} \right)^{1-s} - w_i \alpha^{\frac{1}{\alpha}} \left(\frac{M}{P} \left(\frac{p_i}{P} \right)^{-s} \right)^{\frac{1}{\alpha}} \tag{5}$$

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where M, P and w_i are taken as given. The necessary first-order condition associated with (5) can be expressed as

$$w_i \, \alpha^{\frac{1-\alpha}{\alpha}} \left(\frac{M}{P} \left(\frac{p_i}{P} \right)^{-s} \right)^{\frac{1-\alpha}{\alpha}} p_i^{-1} \; = \; \frac{s-1}{s} \qquad . \tag{6}$$

By imposing the symmetry condition $p_i = P$ for all i, (6) can be simplified according to the following price-setting rule

$$p_i \; = \; \alpha^{1-\alpha} \, M^{1-\alpha} \left(\frac{s}{s-1} \right)^\alpha w_i^\alpha \quad \text{for all } i, \tag{7}$$

where the mark-up factor, $\mu(s) = s/(s-1)$, associated with the pricing equilibrium, depends negatively on the elasticity of substitution between products, i.e. on the higher product market competition.

From (7) we can derive the following qualitative properties to the price setting:

$$\frac{\partial p_i}{\partial w_i} > 0, \; \frac{\partial p_i}{\partial M} > 0, \; \frac{\partial p_i}{\partial s} < 0. \tag{8}$$

These findings are summarized in

Proposition 1 *Higher wage rates and higher income will raise the equilibrium price in the product market, while higher product market competition will decrease the price.*

We next study labor demand with a particular emphasis on the effects of product market competition. The necessary first-order condition determining labor demand can be written as

$$\frac{\partial \pi}{\partial L_i} = p_i R_{i L_i} - w_i = 0 \qquad , \tag{9}$$

implying that the labor demand can be expressed as

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[5]   A formal standard proof is available upon request.

$$L_i = p_i^{\frac{1}{1-\alpha}} \, w_i^{-\frac{1}{1-\alpha}} \quad . \tag{10}$$

It should be emphasized that (10) is an implicit formulation of the labor demand, because p_i is endogenous and determined by (7). For the subsequent analysis we focus on a symmetric configuration with a representative firm and leave out the firm-specific index.

The wage elasticity of labor demand, which turns out to be important later on, can be written as (see Appendix A)

$$\eta = -\frac{L_w w}{L} = \frac{s}{s(1-\alpha)+\alpha} \quad . \tag{11}$$

From (11) we can conclude that the wage elasticity of labor demand is determined by two parameters: the concavity of the production function (α) and the degree of competition in the product markets (s). We observe that intensified product market competition, measured by higher elasticity of substitution between the products, increases the wage elasticity of labor demand. Namely, formally we find that

$$\eta_s = \frac{\alpha}{(s(1-\alpha)+\alpha)^2} > 0 \quad . \tag{12}$$

Intuitively, intensified product market competition makes it harder for the firms to survive with higher wages and thus increased competition makes the firms' employment decisions more sensitive to changes in the wage rate. It is important to emphasize that there is no direct effect of profit sharing on the wage elasticity. This is because profit sharing operates like a non-distortionary profit tax and, therefore, does not affect labor demand (see (3)).

We can summarize this in

Proposition 2 *Intensified product market competition will increase the wage elasticity of labor demand.*

IV. Wage Negotiation

We now turn to analyze the stage where the base wage is determined under circumstances where the profit share τ is given. We apply the Nash bargaining solution within the context of the 'right-to-manage' approach according to which employment is unilaterally determined by the firms. The wage bargaining takes place in anticipation of the optimal price and employment decisions by the firms.

We write the linear utilitarian objective function of the trade union as

$$\hat{U}(w) = L^* \left[w + (\tau/L^*) \pi^* \right] + (N - L^*) b, \tag{13}$$

where the first term captures the rent to the employed and the second term that to the unemployed union members and where π^* denotes the indirect profit function. The parameter b captures the exogenous outside option. We denote the relative bargaining power of the union by β, and that of the firm by $(1-\beta)$, and assume that the threat points of the trade union and the firm are described by $U^o = Nb$ and $\pi^o = 0$, respectively. Applying the Nash bargaining solution the negotiating parties decide on the base wage w in order to solve

$$\underset{(w)}{Max}\ \Omega(w) = \left[U(w)\right]^\beta \left[(1-\tau)\pi^*(w)\right]^{1-\beta} \text{ s.t. } \pi_p = \pi_L = 0 \tag{14}$$

where $U = \hat{U} - U^o = L^* \left[(w-b) + (\tau/L^*) \pi^* \right]$ is the bargaining surplus to the union. As shown in detail in Appendix B the indirect profit can be expressed as

$$\pi^* = (1-\alpha) M \left(\frac{s}{s-1} \right)^{\frac{\alpha}{1-\alpha}} w. \tag{15}$$

The Nash bargaining solution satisfies the following first-order condition

$$\beta \frac{U_w}{U} + (1-\beta) \frac{\pi_w^*}{\pi^*} = 0. \tag{16}$$

As shown in Appendix C, we can explicitly solve the first-order condition (16) to find the following Nash bargaining solution

$$w^N \quad = \quad \frac{\left[\beta\eta\,(1-\alpha)\,+\,(1-\beta)\alpha\right]}{\left[(\beta(\eta-1)+\tau)\,(1-\alpha)\,+\,(1-\beta)\alpha\right]}\,b \quad . \tag{17}$$

According to (17) the negotiated wage rate is proportional to the outside option (b) and the proportionality factor delineates the mark-up incorporated in the negotiated wage. As usual, this wage mark-up depends positively on the relative bargaining power of the trade union (β). Moreover, we can directly observe that an increased profit share (τ) will have a wage-moderating effect. Thus, under the specified time sequence of decisions, profit sharing serves as a strategic commitment device, which will affect the distribution of the rents achieved through wage bargaining.

In the absence of profit sharing, differentiating (17) with respect to the index s of product market competition gives

$$\left.\frac{\partial w^N}{\partial s}\right|_{\tau=0} \quad = \quad -\frac{\beta^2(1-\alpha)^2\eta_s}{\left[\beta(\eta-1)(1-\alpha)+(1-\beta)\alpha\right]^2} \quad < \quad 0 \quad , \tag{18}$$

where $\eta_s = \left[s(1-\alpha)+\alpha\right]^{-2}\alpha > 0$. Hence, in the absence of profit sharing intensified product market competition will moderate wage formation, ceteris paribus. This lies in conformity with empirical evidence, according to which higher product market competition will moderate wage formation when profit sharing is not taken into account. Nickell (1999) presents a survey of this literature, which includes, for example, Abowd and Lemieux (1993) (Canadian data), Nickell, Vainiomäki and Wadhwani (1994) (British manufacturing data) and Neven, Röller and Zhang (1999) (data from eight European airline companies) to analyze links between product market competition and union power.

Finally, in the presence of profit sharing straightforward calculations demonstrate that

$$\frac{\partial w^N}{\partial \eta} \quad = \quad \frac{\beta(1-\alpha)^2\left[\tau-\beta\right]}{\left[(\beta(\eta-1)+\tau)\,(1-\alpha)\,+\,(1-\beta)\alpha\right]^2}\,b \quad . \tag{19}$$

Consequently, we can conclude that the difference between the profit share and the bargaining power of the trade union is a crucial determinant of how an increase in the

wage elasticity of labor demand (η) impacts on the negotiated wage rate in the presence of profit sharing. We summarize our characterization of the negotiated base wage in

Proposition 3 *The negotiated base wage is proportional to the outside option. The wage mark-up is decreasing as a function of the profit share. Also in the presence of profit sharing it is decreasing as a function of the wage elasticity of labor demand if and only if the profit share is smaller than the relative bargaining power of the trade union, while in the absence of profit sharing the wage mark-up is a decreasing function of the wage elasticity of labor demand.*

In terms of empirics, it seems reasonable that the relative bargaining power of the trade union would exceed the adopted profit shares meaning that there would be a negative relationship between the wage elasticity of labor demand and the negotiated base wage. In the next section we show that this also holds true in our theoretical framework when firms decide on profit sharing in an optimal way. Furthermore, from (17) we can conclude that the intensity of competition in the product market has no direct effect on the negotiated base wage. However, the intensity of competition in the product market affects the negotiated wage through two indirect mechanisms, namely via the profit share and the wage elasticity of labor demand. The wage elasticity of labor demand will increase as a result of intensified product market competition (see (12)). We evaluate the relationship between optimal profit sharing and product market competition in section V. This will make it possible to offer a complete characterization of the relationship between the intensity of product market competition and the negotiated base wage in the presence of optimal profit sharing.

The Nash bargaining solution (17) implies a number of interesting special cases. If all the bargaining power lies with the union ($\beta = 1$), the Nash bargaining solution is simplified to the monopoly union solution[6]

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[6]   This special case has been earlier presented by Jackman (1988) in the case of imperfect product market competition.

$$w^M\big|_{\beta=1} \quad = \quad \frac{\eta}{\eta-1+\tau}\, b \quad . \tag{20a}$$

If, on the other hand, all the bargaining power is concentrated in the hands of the firm, (17) will reduce to

$$w^M\big|_{\beta=0} \quad = \quad \frac{\alpha}{\alpha+\tau(1-\alpha)}\, b \quad , \tag{20b}$$

Both the special cases (20a) and (20b) highlight the wage-moderating effects of profit sharing. In particular, with no bargaining power for the trade union, (20b) shows that introduction of profit sharing makes it possible to reduce the base wage of the workers even below the exogenous outside option.

V. Determination of Committed Profit Sharing

We now proceed to analyze the firm's optimal commitment to the compensation structure in the form of a profit share. As we have demonstrated in the previous section, the profit share will subsequently impact on the negotiated base wage and thereby on employment. The firm decides on the profit share in order to solve the following optimization problem[7]

$$\max_{(\tau)} (1-\tau)\,\pi^* \quad = \quad (1-\tau)\left[p\,\frac{(L^*)^\alpha}{\alpha} \quad - \quad w^N L^* \right] \quad \text{s.t. } \Omega_w = \pi_L = \pi_p = 0 \quad . \tag{21}$$

The first-order optimality condition is

$$\underbrace{-\pi^*}_{-} \quad + \quad \underbrace{(1-\tau)\pi_w^* \frac{\partial w^N}{\partial \tau}}_{+} \quad = \quad 0 \quad . \tag{22}$$

By substituting $\pi_w^* = -\dfrac{\alpha\,\pi^*}{(1-\alpha)\,w^N}$ into (22) the first-order condition can be reformulated according to

$$- \frac{(1-\tau)}{w^N}\,\frac{\partial w^N}{\partial \tau} \;=\; \frac{1-\alpha}{\alpha}\;, \tag{23}$$

where $\dfrac{\partial w^N}{\partial \tau} = -\dfrac{(1-\alpha)\,w^N}{(\beta\,(\eta-1)+\tau)\,(1-\alpha)\;+\;(1-\beta)\alpha} < 0$. By substituting this into (23) we can explicitly solve for the optimal profit share. Executing this operation we find that the optimal profit share is given by

$$\tau^* \;=\; \frac{\beta\,\alpha}{s\,(1-\alpha)+\alpha}\;. \tag{24}$$

According to (24) the optimal profit share increases with the relative bargaining power of the trade union, because the induced base wage moderation stimulates the firm's use of profit sharing. Further, we can infer that the optimal profit share is always below the bargaining power of the trade union, i.e. $\tau^* < \beta$.[8] Finally, from (24) we can conclude that intensified product market competition reduces the firm's incentives to use profit sharing. We summarize our findings in

Proposition 4 *The optimal profit share is increasing as a function of the relative bargaining power of the trade union, but it is always below this bargaining power. Further, intensified competition in the product market decreases the optimal profit share.*

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[8]   Holmlund (1991) analyzed profit sharing in the absence of product market imperfections and within a framework of simultaneous negotiations with respect to both the base wage and the profit share. In such a framework he showed that the negotiated profit share is equal to the relative bargaining power of the trade union. Clearly, when firms commit themselves to profit sharing the optimal profit share (24) is below the trade union's bargaining power. Furthermore, the difference between the trade union's bargaining power and (24) is larger the more competitive are the product markets. This is a new finding as well. Sorensen (1992) used a unionized duopoly model to ask when it is optimal for firms to introduce profit sharing as part of the compensation system. He argued that a profit-sharing system is established by both firms in a Nash equilibrium if both trade unions have limited bargaining power.

From (24) we can extract two interesting special cases. First, in the absence of product market imperfections, i.e. when $s \to \infty$, the optimal profit share approaches zero. In other words, with perfect competition in the product market the firm would have no incentives to introduce profit sharing. This is because with perfect competition in the product market the wage elasticity of labor demand is very high and thereby wage moderation can be achieved without introducing the profit sharing. Second, in the absence of labor market imperfections, i.e. when $\beta = 0$, the optimal profit share is zero. Thus, we can formulate the following

Corollary 1 *In the absence of product market imperfections ($s \to \infty$) or labor market imperfections ($\beta = 0$) the optimal profit share is zero.*

Now, after having characterized the optimal profit share we can analyze the impact of intensified product market competition on the negotiated base wage. Differentiating (17) with respect to the index s of product market competition gives

$$\frac{\partial w^N}{\partial s} = \frac{\left[(\beta(\eta-1)+\tau)(1-\alpha)+(1-\beta)\alpha\right]\beta(1-\alpha)\eta_s - \left[\beta(1-\alpha)\eta+(1-\beta)\alpha\right](\beta\eta_s+\tau_s)(1-\alpha)}{\left[(\beta(\eta-1)+\tau)(1-\alpha)+(1-\beta)\alpha\right]^2} b$$

(25)

According to (25), intensified product market competition will have a twofold effect on the negotiated wage: (1) a positive effect on the wage elasticity of labor demand ($\eta_s > 0$) and (2) a negative effect on the optimal profit share ($\tau_s < 0$). Using the fact

$\beta\eta_s + \tau_s = \dfrac{\beta\alpha^2}{\left[s(1-\alpha)+\alpha\right]^2} > 0$ we can re-express (25) as follows

$$\frac{\partial w^N}{\partial s} = \frac{(1-\alpha)^2 \beta\alpha(1-\beta)\alpha}{\left[s(1-\alpha)+\alpha\right]^2\left[(\beta(\eta-1)+\tau)(1-\alpha)+(1-\beta)\alpha\right]^2} b \quad > \quad 0 \quad . \qquad (26)$$

Hence we report the following new finding

Proposition 5 *When the firms commit themselves to an optimal system of profit sharing, intensified product market competition will increase the negotiated wage rate.*

The interpretation of Proposition 5 goes as follows. Intensified product market competition will both (i) increase wage elasticity of labor demand and (ii) decrease the firm's optimal profit share. The higher wage elasticity moderates the negotiated base wage, while the lower profit share will have an offsetting effect and, in fact, the latter effect will dominate. To the best of our knowledge this question about the relationship between the intensity of product market competition and the base wage formation in the presence of profit sharing has not been studied empirically.

VI. Equilibrium Unemployment, Product Market Competition and Profit Sharing

So far we have studied the formation of the negotiated base wage and the optimal profit share with a particular emphasis on how intensified product market competition affects these. We now integrate these elements in order to explore the consequences of imperfections in the labor and product markets for total employment in a general equilibrium context, where the labor force is mobile across industries.

According to (17) for each industry the negotiated wage has the form

$$w_i^N = A_i \, b \, , \tag{27}$$

where the mark-up factor $A_i = \dfrac{\beta\eta\,(1-\alpha)\,+\,(1-\beta)\alpha}{(\beta\eta\,-\,\beta+\tau)\,(1-\alpha)\,+\,(1-\beta)\alpha}$ is, in principle, industry-specific. We assume that all industries are identical so that so that the mark-ups are $A_i = A$. In a general equilibrium context with labor mobility across identical industries, which all apply profit sharing, the outside option b is now, in line with, for example, Jerger and Michaelis (1999), interpreted to be

$$b = (1-u)\left[w^N + \frac{\tau\,E\pi^*}{L^*} \right] + uB \, , \tag{28}$$

where u denotes the unemployment rate, B denotes the unemployment benefit, τ is the profit share and w^N is the negotiated wage rate in all the identical industries.[9] Thus, the economy-wide base wage, the rate of profit sharing and the unemployment benefit constitute those components of the outside option, which are relevant for the wage negotiation.

From (28) we can immediately infer that intensified product market competition will impact on the outside option available to the trade union in a general equilibrium context through several mechanisms. In the subsequent analysis we will be able to compare these various opposite effects and thereby to evaluate the overall employment consequences of intensified product market competition.

In line with the literature we restrict ourselves to a constant benefit-replacement ratio $q \equiv B / w^N$. Combining (27) and (28) the equilibrium unemployment, u^N, can be solved from the equation

$$1 \quad = \quad \frac{\beta\eta\,(1-\alpha)\,+\,(1-\beta)\alpha}{(\beta(\eta-1)+\tau^*)\,(1-\alpha)\,+\,(1-\beta)\alpha}\left[(1-u^N)\,(1+\frac{\tau^*\,\pi^*}{w^N\,L^*})\ +u^N q\right],$$

where we can calculate that $\dfrac{\tau^*\,\pi^*}{w^N\,L^*} = \dfrac{\tau^*\,(1-\alpha)}{\alpha}$. Substituting (24) into this equation

and solving with respect to the equilibrium unemployment we find that

$$u^N \quad = \quad \frac{1+\dfrac{(1-\alpha)\tau^*}{\alpha}-\dfrac{1}{A}}{1+\dfrac{(1-\alpha)\tau^*}{\alpha}-q} \quad . \tag{29}$$

According to (29) the equilibrium unemployment u^N depends positively both on the benefit-replacement ratio (q) and on the wage mark-up in the labor market ($A > 1$).[10] This mark-up is a positive function of the relative bargaining power of the trade union (β) and a negative function on the profit share (τ).

Differentiating (29) with respect to the relative bargaining power of the trade union, β, gives

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[9] For a standard justification of this interpretation, see Layard et. al (1991) and Nickell and Layard (1999).

[10] The unemployment rate satisfies $0 < u^N < 1$ if and only if $q < \dfrac{1}{A}$, which we assume to hold throughout the analysis.

$$\frac{\partial u^N}{\partial \beta} = \frac{\left[\frac{(1-\alpha)}{\alpha}\tau_\beta^*(\frac{1}{A}-q)+\frac{A_\beta}{A^2}(1+\frac{(1-\alpha)}{\alpha}\tau^*-q)\right]}{\left[1+\frac{(1-\alpha)}{\alpha}\tau^*\right]^2} > 0 \ , \tag{30}$$

where $\tau_\beta^* > 0$ and $A_\beta > 0$. Thus, equilibrium unemployment is always an increasing function of the relative bargaining power of the trade union, because the bargaining power has positive effects on both the profit share and on the wage mark-up in labor market.

Differentiating (29) with respect to s, which captures the index of product market competition, shows that

$$\frac{\partial u^N}{\partial s} = \frac{\left[\frac{(1-\alpha)}{\alpha}\tau_s^*(\frac{1}{A}-q)+\frac{A_s}{A^2}(1+\frac{(1-\alpha)}{\alpha}\tau^*-q)\right]}{\left[1+\frac{(1-\alpha)}{\alpha}\tau^*\right]^2} \ . \tag{31}$$

Hence, $sign\,(\frac{\partial u^N}{\partial s}) = sign\,\left[\frac{(1-\alpha)}{\alpha}\tau_s^*(\frac{1}{A}-q)+\frac{A_s}{A^2}(1+\frac{(1-\alpha)}{\alpha}\tau^*-q)\right]$, where $\tau_s^* < 0$,

$\frac{1}{A}-q > 0$, $A_s > 0$ (see (26)) and $1+\frac{(1-\alpha)}{\alpha}\tau^*-q > 0$. According to (31) two offsetting mechanisms are important when evaluating the overall effects of intensified product market competition on equilibrium unemployment. On the one hand, stronger product market competition will decrease the optimal profit share and thereby reduce unemployment (the term $\frac{(1-\alpha)}{\alpha}\tau_s^*(\frac{1}{A}-q) < 0$). But on the other hand, stronger product market competition will also increase the mark-up in the labor market, which will raise equilibrium unemployment (the term $\frac{A_s}{A^2}(1+\frac{(1-\alpha)}{\alpha}\tau^*-q) > 0$). We summarize these observations in

Proposition 6 *Equilibrium unemployment is an increasing function of the relative bargaining power of the trade union. Intensified product market competition will have an ambiguous effect on equilibrium unemployment due to the negative effect on profit sharing and the positive effect on the wage mark-up.*

From (31) we can deduce a number of interesting special cases. If all the bargaining power lies with the union ($\beta = 1$), it holds that $A_s = 0$ by (26), whereas the optimal profit share is decreased $\tau_s < 0$. On the other hand, if the union does not have any bargaining power ($\beta = 0$), then according to (26) $A_s = 0$ and it also holds that $\tau_s = 0$. This can be summarized in

Corollary 2 *When the firms commit to optimal profit sharing, then intensified product market competition (i) decreases equilibrium unemployment in the case of a monopoly trade union, but (ii) it has no effect on equilibrium unemployment when the trade union has no bargaining power.*

In the absence of profit sharing the equilibrium unemployment (29) can be expressed as $u^N\big|_{\tau=0} = \dfrac{1 - \dfrac{1}{\hat{A}}}{1-q}$, where the mark-up $\hat{A} = \dfrac{\left[\beta\eta(1-\alpha) + (1-\beta)\alpha\right]}{\left[\beta(\eta-1)(1-\alpha) + (1-\beta)\alpha\right]}$ depends only on the relative bargaining power of the trade union and the wage elasticity of labor demand. In this case we have the following relationship between equilibrium unemployment and the intensity of product market competition

$$\frac{\partial u^N}{\partial s}\bigg|_{\tau=0} = (1-q)^{-1}\frac{\hat{A}_s}{\hat{A}^2} < 0, \text{ where } \hat{A}_s = -\frac{\beta^2(1-\alpha)^2\eta_s}{\left[\beta(\eta-1)(1-\alpha) + (1-\beta)\alpha\right]^2} < 0 . \tag{32}$$

Thus we have

Corollary 3 *In the absence of profit sharing intensified competition in the product market will decrease equilibrium unemployment as it decreases the wage mark-up.*

According to Proposition 6 intensified product market competition will, in general, have an ambiguous effect on equilibrium unemployment in the presence of committed profit sharing when the trade union has an intermediate relative bargaining power ($0 < \beta < 1$). From (31) we can generally conclude that the impact of intensified

product market competition on equilibrium unemployment is determined by the interplay between labor market institutions (captured by β), labor market policy (captured by the benefit-replacement ratio q) and the production technology (captured by the production function parameter α). These affect equilibrium unemployment through the wage elasticity of labor demand, wage mark-up, and profit sharing. In order to understand and open up this ambiguity it is important to conduct numerical simulations in order to characterize those circumstances when intensified product market competition will decrease (increase) equilibrium unemployment.

In Table 1 we characterize numerically how intensified product market competition, measured by s, affects (i) the wage elasticity of labor demand (η), (ii) the firm's optimal profit share (τ), (iii) the wage mark-up (A) and (iv) equilibrium unemployment (u^N) for a given configuration of parameter values of the concavity of production function (α), the relative bargaining power of the trade union (β) and the benefit-replacement ratio (q).

| | Fixed parameter values are $\alpha = 0.8$, $\beta = 0.3$ and $q = 0.4$. | | | |
s	η	τ	A	u^N
2	1.667	0.200	1.031	0.124
4	2.500	0.150	1.044	0.125
8	3.333	0.100	1.056	0.124
16	4.000	0.060	1.064	0.122
32	4.444	0.033	1.069	0.120
64	4.706	0.018	1.072	0.118
128	4.848	0.009	1.073	0.117
256	4.923	0.005	1.074	0.117
512	4.961	0.002	1.075	0.117

Table 1:   The wage elasticity, optimal profit share, wage mark-up and equilibrium unemployment as a function of the intensity of product market competition.

The simulations reported in Table 1 verifies that the wage elasticity of labor demand, the profit share and the wage mark-up are all strictly monotonic as a function of the intensity of product market competition as theoretically predicted by (12), (24) and (26). Furthermore, the simulated values all tend to be fairly realistic from an

empirical point of view.[11] But interestingly, the equilibrium unemployment is not fully monotonic as a function of the intensity of product market competition. For a restricted segment with sufficiently strong product market imperfections the equilibrium unemployment is increasing as a function of the intensity of competition. However, under sufficiently weak product market imperfections increased competition will monotonically decrease unemployment.[12]
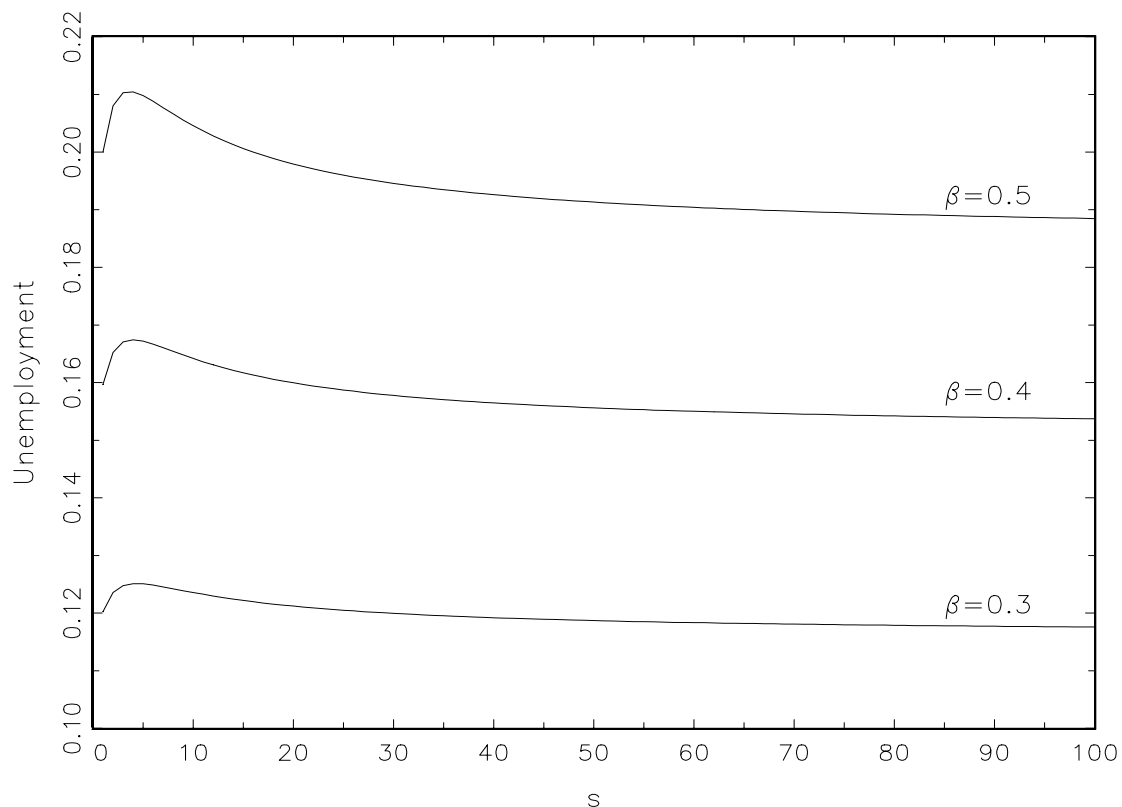
Figure 3: Equilibrium unemployment as a function of the intensity of product market competition under different levels of the relative bargaining power of the trade union (β), when $\alpha = 0,7$ and $q = 0,4$.

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[11] For example, the wage mark-up seems to be broadly in line with the empirical estimates presented by Blanchflower and Bryson (2002).

[12] The simulations displayed in Figure 3 also illustrate that reduced labor market imperfections (characterized by lower bargaining power of the trade union) might have a more significant impact on equilibrium unemployment than intensified product market competition. However, it is outside the scope to this paper to systematically investigate how important intensified product market competition is relative to labor market imperfections as an explanation of equilibrium unemployment.

Figure 3 illustrates the significance of the labor market imperfection (β) for the relationship between the intensity of product market competition and equilibrium unemployment. The qualitative nature of this relationship is robust across different levels of the trade union's bargaining power, but naturally a higher relative bargaining power of the trade union generates a significant shift towards higher levels of equilibrium unemployment.

In light of Figure 3 we can ask: Under which combinations (s, β) does it hold true that the equilibrium unemployment depends monotonically on the intensity of product market competition? With sufficiently relaxed product market competition, intensified competition (higher s) will increase the wage mark-up and decrease profit sharing with the former effect being stronger. However, the relative strength of these opposite effects will change with intensified product market competition. Figure 4 exhibits the location of those (s, β)-combinations under which equilibrium unemployment is independent of the degree of product market competition when the parameter of the production function is $\alpha = 0,7$ and the benefit-replacement ratio is $q = 0,4$. For combinations below and to the left of this curve intensified product market competition will actually harm employment. As we can observe from Figure 4, this may happen for sufficiently strong product market imperfections, i.e. for sufficiently low values of s. Furthermore, higher relative bargaining power of the trade union shifts this threshold towards stronger product market imperfections. Conversely, the required value of s above which intensified product market competition promotes employment is decreasing as a function of β. In this respect labor market and product market imperfections are complementary channels in the creation of circumstances under which intensified product market competition harms employment.
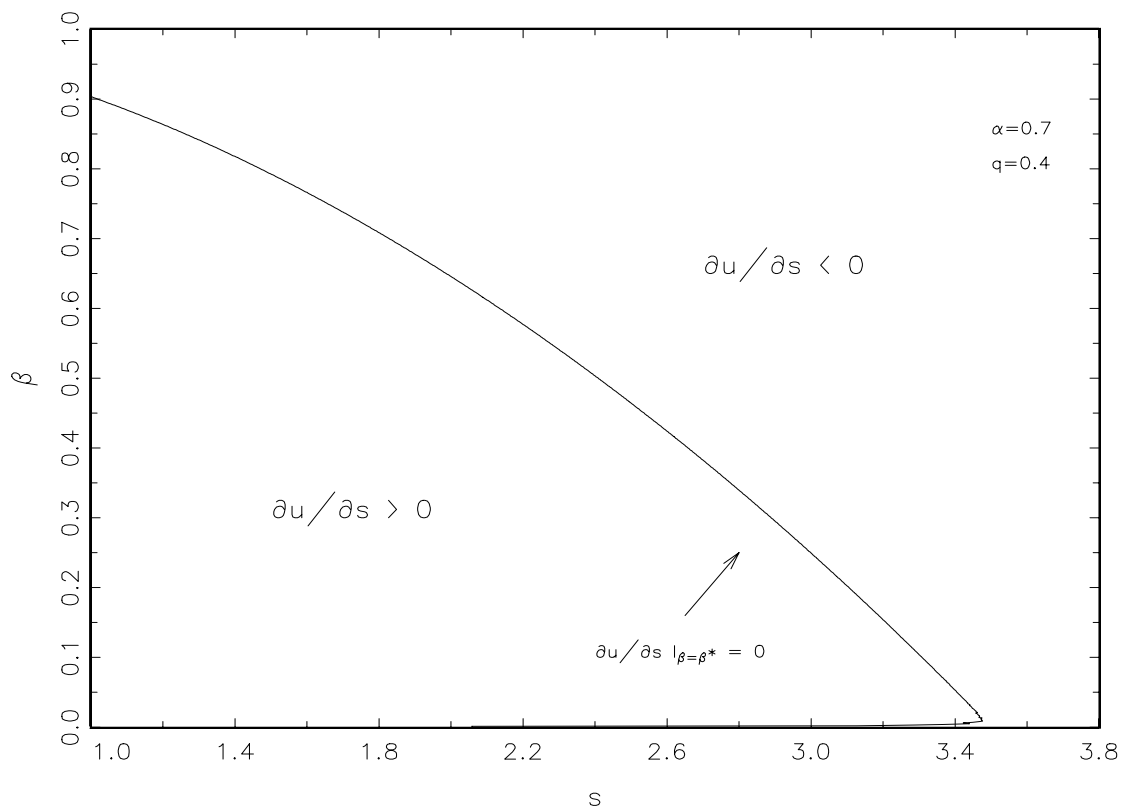
Figure 4: Characterization of (s, β) **-combinations under which the equilibrium unemployment is independent of the intensity of product market competition when** $\alpha = 0{,}7$ **and** $q = 0{,}4$**.**

In Figure 5 we illustrate how the concavity of the production function impacts significantly on the region under which intensified product market competition hurts employment. Namely, by increasing the parameter to $\alpha = 0{,}9$ so that the production function is less concave we observe that the region under which intensified product market competition hurts employment is significantly expanded. In particular, the location of the curve describing the (s, β)-combinations under which the equilibrium unemployment is independent of the intensity of product market competition is significantly shifted to the right.
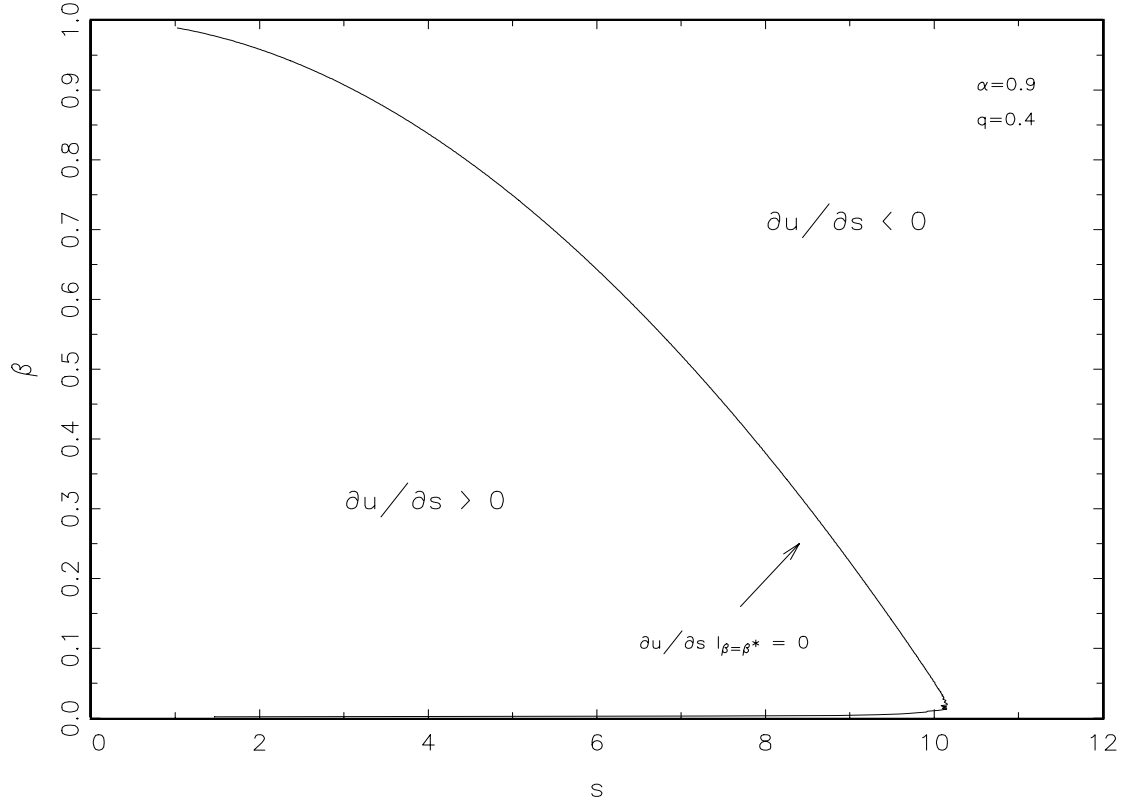
Figure 5: Characterization of (s, β)-combinations under which the equilibrium unemployment is independent of the intensity of product market competition when $\alpha = 0,9$ and $q = 0,4$.

In fact, as the production function approaches linearity the parameter combinations such that intensified product market competition hurts employment is expanded to capture a significant segment of the feasible (s, β)-combinations. This feature is verified in Figure 6.

How can we intuitively explain why the parameter α is important for the relationship between the intensity of product market competition and equilibrium unemployment? Within the general equilibrium framework the relevant outside option for the individual is given by (28), which can be rewritten as follows

$$w^N \left[(1-u)(1 + \frac{1-\alpha}{\alpha} \tau^*) + u\,q \right].$$

This shows that the intensity of product market competition impacts on the outside option through two offsetting effects: (i) it moderates the equilibrium profit share, but (ii) it also increases the negotiated base wage. Formally, the impact of the intensity of product market competition on this outside option is determined by

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$$(1-u) \left[\frac{1-\alpha}{\alpha} \left[\frac{\partial w^N}{\partial s} \tau^* + \frac{\partial \tau^*}{\partial s} w^N \right] + \frac{\partial w^N}{\partial s} (1-u(1-q)) \right],$$

from which we can see that the positive effect $\frac{\partial w^N}{\partial s} > 0$ always dominates when α is sufficiently close to 1.[13]
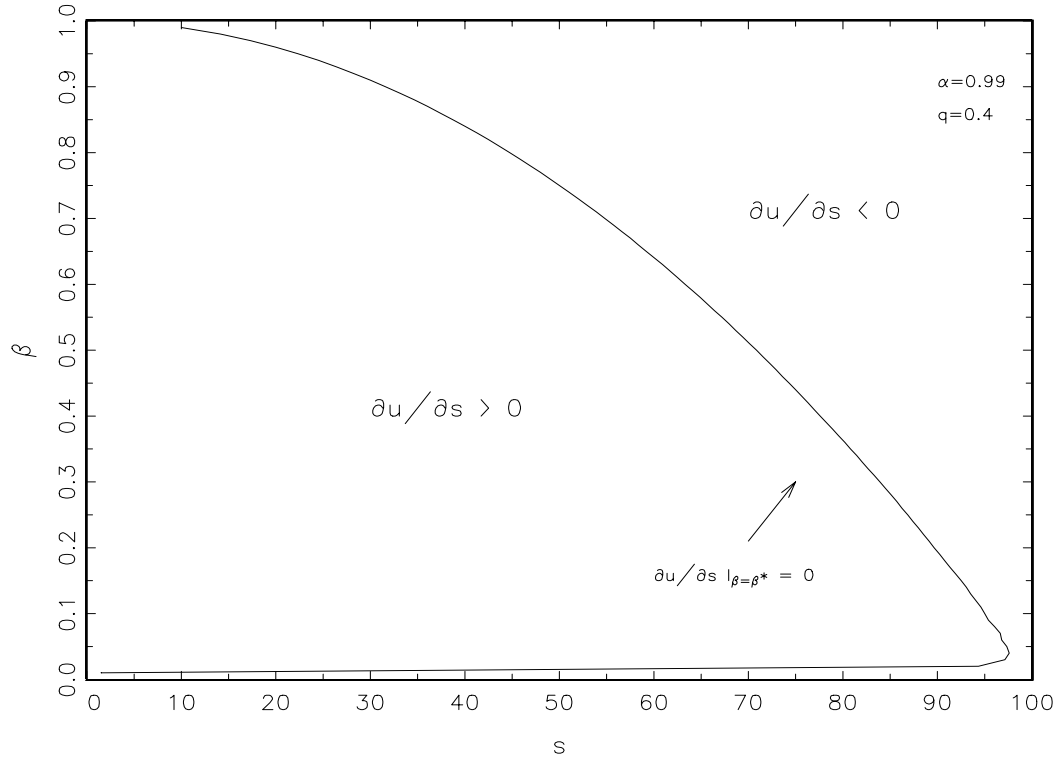
Figure 6: Characterization of (s,β)-combinations under which the equilibrium unemployment is independent of the intensity of product market competition when $\alpha = 0{,}99$ and $q = 0{,}4$.

Finally, from the argument above we can also infer that a higher benefit-replacement ratio q tends to make it more likely that intensified product market competition would hurt employment. This feature is illustrated in Appendix D by Figures 7 and 8, which graphically explores the effects of intensified competition on equilibrium unemployment for an increase in the replacement ratio q.

VII. Concluding Comments

We have developed a framework with product and labor market imperfections and their interactions to study the effects of intensified product market competition on the optimal profit sharing, on the associated negotiated base wage and, importantly, on the equilibrium unemployment. The time sequence of decisions has been postulated as follows: First, in the long run firms have been assumed to commit themselves to profit sharing in anticipation of the negotiated base wage as well as price setting in the product markets and labor demand. Second, contingent on the profit sharing decision, firms and labor unions have been postulated to bargain about the base wage by using the 'right-to-manage' approach, anticipating its impacts on labor demand and price setting in the product markets. Finally, firms have been assumed to make employment and price setting decisions taking both the optimal profit sharing and the negotiated base wage as given.

We have obtained several new results. The optimal profit share, which the firms use as a wage-moderating commitment device, is smaller than the bargaining power of the trade union unlike in the current literature and more consistent with empirics. Intensified product market competition decreases the optimal profit shares. This holds true, because the wage-increasing effect of the reduced optimal profit share dominates relative to the wage-reducing effect associated with a higher wage elasticity of labor demand. Finally, and importantly, intensified product market competition does not necessarily reduce equilibrium unemployment. Intensified product market competition will have a direct negative effect on equilibrium unemployment as it induces a lower optimal profit share and an indirect positive effect on unemployment as it increases the wage mark-up. Hence a reduced distortion in the product market may not improve the performance of the labor market, which suffers from a primary distortion with its roots in the bargaining power of the trade union.[14]

In particular, intensified product market competition will hurt employment if the product market imperfection is "sufficiently strong" and the relative bargaining power

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[13]   In practice a configuration with α close to one could capture a situation where the utilization of capital would be very low. This might lead to a production function not far from linear with respect to labor and thereby increasing the wage elasticity of labor demand.

of the trade union is not "high enough". But when firms commit to optimal profit sharing, intensified product market competition will decrease equilibrium unemployment in the case of monopoly trade union, while it has no effect on equilibrium unemployment when the trade union has no bargaining power. Finally, in the absence of profit sharing, intensified competition in the product market will always decrease the equilibrium unemployment by decreasing the wage mark-up in the labor market. Thus, profit sharing constitutes an essential feature of the mechanism according to which intensified product market competition may actually harm employment. In this respect our analysis emphasizes the importance of policies directed at reducing labor market imperfections under those circumstances where profit sharing is applied across the economy.

Koskela and Stenbacka (2004b) have investigated the interaction between credit and labor market imperfections for equilibrium unemployment in the presence of profit sharing. They demonstrated that intensified credit market competition increases equilibrium unemployment if the labor market 'rigidities', characterized by high relative bargaining power of unions and high benefit-replacement ratios, are sufficiently strong and vice versa if 'rigidities' are sufficiently weak (see also Koskela and Stenbacka (2004a)). Wasmer and Weil (2004) have investigated a related issue in a different framework with job search, labor and credit matching frictions and negotiated mark-ups in the labor and credit markets. It would be an important and challenging new topic for further research to analyze the interaction between product, labor and credit market imperfections and their impacts on equilibrium unemployment within the framework of an integrated model.

Within our framework with monopolistic competition the degree of competition has been measured by the elasticity of substitution between products. It would be an analytical challenge for future research to capture the product market imperfections by an oligopoly model. Under such circumstances the returns from the use of profit sharing might depend on whether the product market decisions are strategic substitutes or complements (for example, quantities or prices). Within such a framework the

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[14]   This argument is analogous to the classical second best analysis by Lipsey and Lancaster (1956-57), according to which it is not necessarily desirable from a welfare point of view to decrease distortions in one particular market if several markets face distortions.

relationship the effects of product market competition on equilibrium unemployment might also depend on the strategic nature of the competition.

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APPENDIX A: The Wage Elasticity of Labor Demand

In order to simplify notation we now abstract from the firm-specific index i and define the wage elasticity of labor demand

$$\eta = -\frac{L_w w}{L} = -\frac{p R_L}{p R_{LL} + p_L R_L} = -\frac{1}{L\dfrac{R_{LL}}{R_L} + L\dfrac{p_L}{p}} \tag{A1}$$

Using production function (1) we have $L\dfrac{R_{LL}}{R_L} = \alpha - 1 < 0.$ Using the demand function in the product market (4) the condition $R = D$ is $\dfrac{L^\alpha}{\alpha} = \dfrac{M}{P}(\dfrac{p}{P})^{-s}$. This can be written as

$$p = \left[\frac{L^\alpha}{\alpha}\frac{P}{M}\right]^{-\frac{1}{s}} P \tag{A2}$$

Using (A2) we have

$$L\frac{p_L}{p} = -\frac{1}{s}\left[\frac{L^\varepsilon}{\alpha}\frac{P}{M}\right]^{-\frac{1}{s}-1}\frac{P}{M}L^\alpha = -\frac{1}{s}\left[\frac{L^\varepsilon}{\alpha}\frac{P}{M}\right]^{-\frac{1}{s}}\alpha = -\frac{\alpha p}{sP} \tag{A3}$$

By imposing the symmetry condition $p = P$ we get the wage elasticity of labor demand expression presented in (11). QED.

APPENDIX B: The Indirect Profit Function

Substituting the labor demand (10) into the profit function yields

$$\pi_i^* = p_i\frac{L_i^\alpha}{\alpha} - wL_i^* \quad = \quad \frac{p_i^{\frac{1}{1-\alpha}} w^{-\frac{\alpha}{1-\alpha}}}{\alpha} \quad - \quad w^{-\frac{\alpha}{1-\alpha}} p_i^{\frac{1}{1-\alpha}} \quad = \quad w^{-\frac{\alpha}{1-\alpha}} p_i^{\frac{1}{1-\alpha}}\left(\frac{1-\alpha}{\alpha}\right). \tag{B1}$$

By further substituting in the optimal price-setting (7) we find that the indirect profit function is given by

$$\pi_i^* = \left(\frac{s}{s-1}\right)^{\frac{\alpha}{1-\alpha}} w M (1-\alpha). \tag{B2}$$

QED.

APPENDIX C: The Negotiated Base Wage

This appendix develops the expressions for the terms $\dfrac{\pi_w^*}{\pi^*}$ and $\dfrac{U_w}{U}$ in the first-order condition (16) determining the Nash bargaining solution. We start by looking at the profit response by the firm to a change in the wage rate. The indirect profit function was derived in Appendix B. By applying the envelope theorem, according to which the effect which take place through the labor demand vanish at the optimum, we find that

$\pi_w^* = -L_i^* = -w^{-\frac{1}{1-\alpha}} p_i^{\frac{1}{1-\alpha}} < 0$. Hence,   we   can   conclude   that

$$\frac{\pi_w^*}{\pi^*} = - \frac{\alpha}{(1-\alpha)\,w} \quad < \quad 0 . \tag{C1}$$

As for the trade union side we find that $U_w = \dfrac{L^*}{w}\left[w(1-\tau-\eta)+\eta b\right]$. Thus, it follows that

$$\frac{U_w}{U} = \frac{1}{w}\left[\frac{w\,(1-\tau-\eta)+\eta b}{w - b + \dfrac{\tau}{L^*}\pi^*} \right] ,$$

and observing the fact $\dfrac{\pi^*}{L^*} = (1-\alpha)w/\alpha$ this can be simplified further to

$$\frac{U_w}{U} = \frac{1}{w}\left[\frac{w\,(1-\tau-\eta)+\eta b}{w - b + \dfrac{\tau\,(1-\alpha)\,w}{\alpha}} \right] \tag{C2}$$

Substituting (C1) and C2) into (16) and solving the resulting equation with respect to w yields (17). QED.

APPENDIX D: The Effects of the Benefit-Replacement Ratio on the Relationship between the Intensity of Product Market Competition and Equilibrium Unemployment
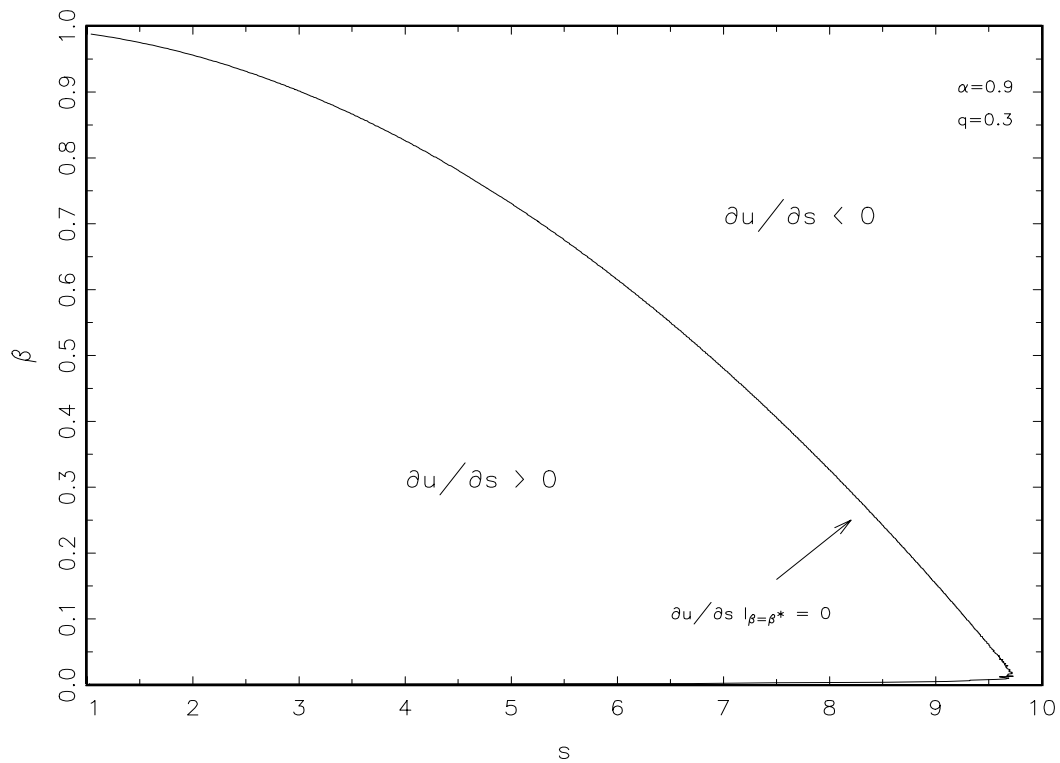
Figure 7: Characterization of (s, β)-combinations under which the equilibrium unemployment is independent of the intensity of product market competition when the benefit-replacement ratio is $q = 0.3$ and $\alpha = 0{,}9$.

β

1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0

α=0.9
q=0.5

∂u∕∂s < 0

∂u∕∂s > 0

∂u∕∂s |β=β* = 0

0   2   4   6   8   10   12

s
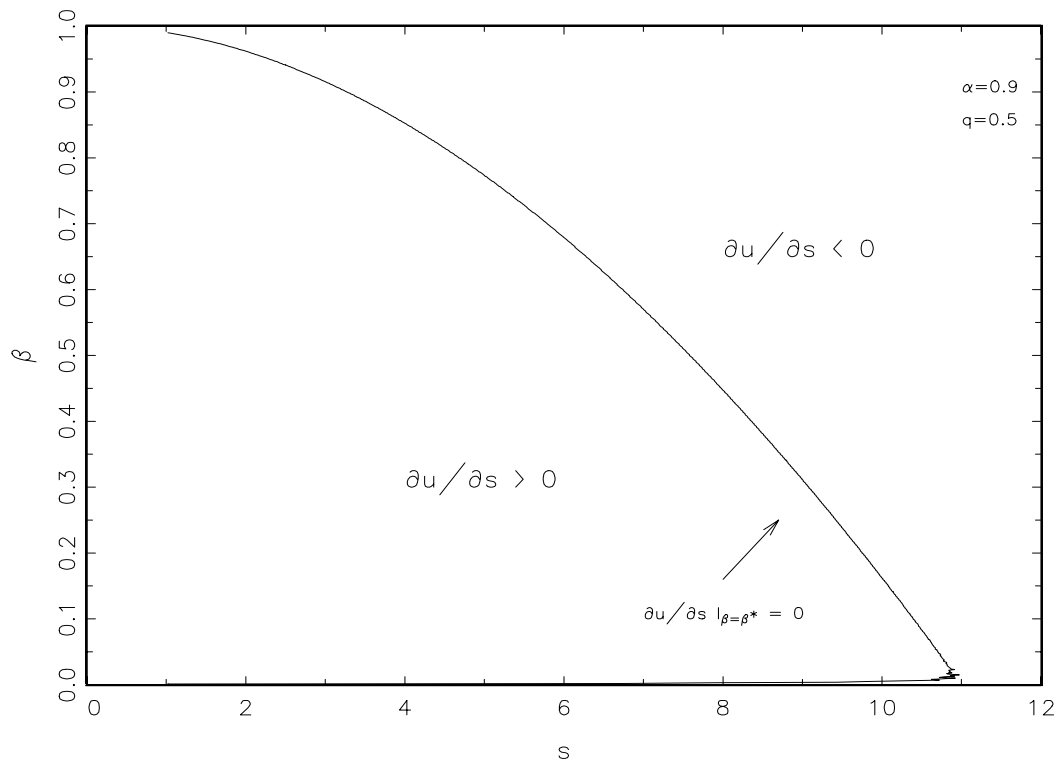
Figure 8:   **Characterization of** (s, β)**-combinations under which the equilibrium unemployment is independent of the intensity of product market competition when the benefit-replacement ratio is** $q = 0.5$ **and** $\alpha = 0{,}9$ **.**

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