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Abstract:
The effects of unions on productivity and firm performance have been the topic of extensive research. Existing studies have, however, primarily focused on firm-level bargaining and on markets that are characterised by a small and fixed number of identical firms. This paper studies how different unionisation structures affect firm productivity and firm performance in a monopolistic competition model with heterogeneous firms and free entry. While centralised bargaining induces tougher selection among heterogeneous producers and thus increases average productivity, firm-level bargaining allows less productive entrants to remain in the market. Centralised bargaining also results in higher average output and profit levels than either decentralised bargaining or a competitive labour market. From the perspective of consumers, the choice between centralised and decentralised bargaining involves a potential trade-off between product variety and product prices.

Keywords: Trade unions, heterogeneous firms, productivity, firm performance.

JEL classification: J24, J50, D43.

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1 Introduction

Since the late 1970s, there has been a tendency among OECD countries to grant greater flexibility in the determination of wages. In fact, nine out of twenty-one member countries examined by the OECD (2004)[1] have allowed wages to adjust more freely to local conditions at the firm level, while not a single member country has moved to more centralised bargaining structures. In many European OECD countries, however, wages continue to be predominantly determined in industry-level collective agreements that specify a uniform wage rate common to all firms in an industry. This paper examines how different bargaining structures affect firm productivity and firm performance in the long run.

What unions do to productivity and firm performance has been the topic of extensive research (cf. Metcalf, 2003; Hirsch, 2004, for recent surveys). Conventional wisdom suggests that by raising pay unions hurt the financial performance of firms 'unless there is a roughly equivalent union effect on productivity' (Metcalf, 2003, p. 118). Most of the literature on the relation between unionisation and productivity has focused on the incentives of unionised firms to innovate. Early studies by Grout (1984) and Van der Ploeg (1987) have pointed to a hold-up problem associated with unionisation. Once a firm has incurred the sunk costs of investment, unions can capture part of the innovation rent by demanding higher wages. The incentives of firms to innovate are therefore decreasing in union bargaining power. If firms, however, invest strategically so as to increase their market shares and profits, unionised enterprises may enjoy a strategic advantage over their non-unionised competitors (cf. Tauman and Weiss, 1987; Ulph and Ulph, 1994, 2001). Existing studies have not only focused mainly on firm-level bargaining but have also concentrated on markets that are characterised by a small and fixed number of firms. The market structure in these studies is exogenously given. Unionisation, however, is likely to influence the number and, equally important, the characteristics of firms that survive in the long-run; and financial performance depends crucially on the market environment.

My objective in this paper is to analyse the interactions between bargaining structures, the market environment and firm performance. To that end, I study a monopolistic competition model in the spirit of Melitz and Ottaviano (2008) with heterogeneous firms and free entry. The model incorporates both differences in firm productivity and endogenous mark-ups that respond to the intensity of competition in a market. The intensity of competition is summarised by the number of competing enterprises and their average price level. I distinguish between three different labour market regimes. Wages are either determined in a perfectly competitive labour market, set by firm-specific unions, or fixed by a binding, sector-wide wage agreement. With decentralised bargaining, wages are firm-specific and increase in productivity. With sector-level bargaining, in contrast, wages are uniform, a singular wage rate that is binding for each and

[1]The OCED does not assess wage setting institutions in central and eastern European OECD countries before the 1990s. Data on the bargaining level are also not provided for Iceland, Luxembourg, Mexico, Turkey and South Korea.

every firm.

The model highlights two effects of unionisation that have been largely overlooked in previous work: First, sector-level bargaining (but not firm-level bargaining) induces tougher selection among heterogeneous producers and changes the productivity distribution among surviving firms. In particular, by increasing wages for all firms, centralised bargaining acts a barrier to entry for low-productivity firms. Second, both bargaining regimes discourage entry and decrease competitive pressures by raising pay. Less intensive competition ceteris paribus results in higher profits of surviving firms and allows less productive enterprises to remain in the market.

Compared to the competitive benchmark, centralised bargaining increases average productivity (due to the selection effect) and boosts average output and profits (due to a combination of the selection and the anti-competitive effect). Firm-level bargaining, in contrast, by allowing less productive firms to survive, decreases average firm productivity and performance. At the level of the individual firm, unionisation creates winners and losers. Decentralised agreements benefit low-productivity firms and harm high-productivity firms, while the opposite is true for centralised wage agreements. Moreover, the paper demonstrates that from a consumer's perspective the choice between the two bargaining regimes can involve a trade-off between product prices and product variety. Firm-level bargaining tends to increase product variety but also induces a less favourable price distribution than centralised bargaining does.

My result that wage compression can be beneficial for productivity is related to earlier work by Moene and Wallerstein (1997). Formalising arguments made in the Swedish debate over 'solidaristic' bargaining (Rehn, 1952), Moene and Wallerstein (1997) compare the effects of decentralised and centralised wage bargaining in a vintage capital model of a small open economy in which the price of output is exogenously given. Firms decide when to open new, more productive plants and when to shut down older, less productive ones. Under decentralised bargaining, less productive plants pay lower wages and can therefore remain in the market for a longer time. Centralised bargaining, in contrast, levels interplant wage differentials and drives less productive plants out of the market. Apart from the very different modeling strategy, the principal difference between Moene and Wallerstein (1997) and the present paper is my focus on the intensity of competition as an additional channel through which unionisation can influence productivity and firm performance.[2] The effects of different unionisation structures on firm productivity are also examined by Haucap and Wey (2004) who find that centralised bargaining provides the greatest incentives to innovate. They develop their argument in an unionised oligopoly model with a fixed number of firms and focus on the interaction between bargaining structures and the hold-up problem associated with unionisation. In contrast to their paper, I take a long-run perspective and examine how different unionisation structures affect

[2]The present paper also shows that the choice between centralised and decentralised bargaining involves a trade-off between product prices and product variety. In Moene and Wallerstein (1997), in contrast, output prices are exogenously given.

firm performance in a model with an endogenous market structure.

The paper is structured as follows: Section 2 presents the basic model setting which I then use in section 3 to analyse the effects of unionisation structures on firm productivity and firm performance. Section 4 studies the impact of wage bargaining on product variety and product prices. Section 5 summarises the main findings and concludes.

2 The Model Setting

I consider a two-sector economy with a representative consumer that inelastically supplies L units of labour.[3]

2.1 Preferences and Demand

Preferences of the representative consumer are given by a quasilinear utility function defined over a continuum of differentiated varieties and a homogeneous numeraire good:

$$U = q_0^c + \alpha \int_{i\in\Omega} q_i^c di - \frac{1}{2}\gamma \int_{i\in\Omega} (q_i^c)^2 di - \frac{1}{2}\eta \left(\int_{i\in\Omega} q_i^c di \right)^2, \tag{1}$$

where q_0^c and q_i^c are the consumption levels of the numeraire good and of variety $i \in \Omega$, respectively. The parameters $\alpha > 0, \eta > 0$ determine demand for the differentiated varieties relative to the numeraire good, while $\gamma > 0$ is an (inverse) measure of the degree of product differentiation between varieties. In the limit, as γ approaches 0, varieties become perfect substitutes and the consumer is only concerned about the total consumption level over all varieties, $Q^c = \int_{i\in\Omega} q_i^c di$. Increases in α and decreases in η both boost demand for the differentiated varieties relative to the numeraire.

The representative consumer maximises (1) subject to her budget constraint. Let $\Omega^* \subset \Omega$ be the subset of varieties that are actually consumed ($q_i^c > 0$). The constraint can then be written as

$$I = q_0^c + \int_{i\in\Omega^*} p_i q_i^c di, \tag{2}$$

where I represents income, p_i is the price of variety i, and the price of the numeraire good has been normalised to unity. Provided that the representative consumer has positive demand for the numeraire, utility maximisation yields the following inverse demand function for each consumed variety i:

$$p_i = \alpha - \gamma q_i^c - \eta Q^c. \tag{3}$$

Let N measure the number of consumed varieties in Ω^*. By inverting (3), demand for these

[3]The model framework is similar to the closed economy version of Melitz and Ottaviano (2008) but in addition to their work I study the effects of firm- and sector-level bargaining.

varieties can be expressed as follows:

$$q_i = \frac{\alpha}{\eta N + \gamma} - \frac{1}{\gamma} p_i + \frac{\eta N}{\eta N + \gamma} \frac{1}{\gamma} \overline{p}, \ \forall i \in \Omega^*, \tag{4}$$

where $\overline{p} = (1/N) \int_{i \in \Omega^*} p_i di$ is the average price of all consumed varieties.

With quasi-linear preferences all income effects are swept up by the numeraire good and q_i is independent of I. Therefore, admittedly, the model has a strong partial equilibrium flavour. However, the price elasticity of demand derived from a quasi-linear utility function has the considerable merit that it is not fixed as in the case of Constant Elasticity of Substitution (CES) preferences but related to the intensity of competition. In fact, the price elasticity $\epsilon_i \equiv |\frac{\partial q_i}{\partial p_i} \frac{p_i}{q_i}| = [(p_{max}/p_i) - 1]^{-1}$ is inversely related to the upper price bound p_{max}, at which demand for a variety i is driven down to zero (i.e. $q_i(p_{max}) = 0$). The price bound is a summary statistic for the 'toughness' of competition and given by

$$p_{max} \equiv \frac{1}{\eta N + \gamma} (\gamma \alpha + \eta N \overline{p}), \tag{5}$$

which from (3) has to be smaller than α. The upper bound on prices is decreasing in the number of competing enterprises and increasing in the average price level. In line with the empirical evidence (see, for instance, Campbell and Hopenhayn, 2005, and Tybout, 2003), an increase in the intensity of competition, as indicated by a lower price bound, thus increases the price elasticity of demand ϵ_i at any given p_i.

2.2 Production, Firm Behaviour and Entry

The numeraire good is sold in a perfectly competitive market and produced under constant returns to scale. One unit of labour is required to produce one unit of the numeraire. As the price of the numeraire is normalised to one, this implies a wage rate of unity in the numeraire good sector.

In the differentiated product sector entry is costly. I take a long-run perspective and assume that there exists a large (unbounded) pool of prospective entrants.[4] In order to enter the market, firms have to incur fixed start-up costs of f_E. Unit costs of production are given by $cw(c)$ with c denoting unit labour requirement and $w(c)$ being the (potentially firm-specific) wage rate. Prior to entry the cost level c of a firm is unknown and each start-up learns its cost level only *after* it has made the initial investment. The cost level is drawn from a common and known distribution $G(c)$ with support on $[0, c_M]$. Following Melitz and Ottaviano (2008), I assume that the productivity draw $1/c$ follows a Pareto distribution with shape parameter $k \geq 1$.[5]

[4] A short-run version of the model could be constructed by considering a fixed number of incumbents only (cf. Melitz and Ottaviano, 2008).

[5] Using firm-level data for manufacturing industries in 11 EU countries, Del Gatto et al. (2006) provide evidence

Accordingly, the distribution of cost draws $G(c)$ is given by

$$G(c) = \left(\frac{c}{c_M}\right)^k, c \in [0, c_M]. \tag{6}$$

The shape parameter k determines the dispersion of cost draws. For $k = 1$ the latter is uniformly distributed on the support. As k increases, the relative frequency of start-ups with high cost levels increases as well.

After a firm has drawn its productivity parameter c it decides whether to remain in the market and to start production. A firm will do so whenever it can cover its marginal costs and earn non-negative (gross) profits. All other entrants leave the market. Surviving firms then maximise their profits $\Pi(c) = [p(c) - cw(c)]q(c)$ taking the number of firms in the market and the average price level as given. Using the demand function in (4), the first-order condition of a firm with cost draw c reads

$$q(c) = \frac{1}{\gamma}[p(c) - cw(c)]. \tag{7}$$

By solving equation (4) for the price level, substituting into (7) and also using the definition of p_{max} the profit-maximising price $p(c)$ can be written as

$$p(c) = \frac{1}{2}\left[p_{max} + cw(c)\right]. \tag{8}$$

Hence, the price level does not only increase with unit costs $cw(c)$, it is also (inversely) related to the endogenous degree of competitiveness in the market. The profit-maximising output level $q(c)$, the corresponding profit level $\Pi(c)$ and the markup $\mu(c) = p(c) - cw(c)$ of a firm can also be expressed in terms of $cw(c)$ and p_{max} only:

$$q(c) = \frac{1}{2\gamma}\left[p_{max} - cw(c)\right], \tag{9}$$

$$\Pi(c) = \frac{1}{4\gamma}\left[p_{max} - cw(c)\right]^2, \tag{10}$$

$$\mu(c) = \frac{1}{2}\left[p_{max} - cw(c)\right]. \tag{11}$$

Now let c_{max} reference the cost level of a firm that just earns zero gross profits. This firm's profit-maximising price level is driven down to its marginal cost and the firm is therefore just indifferent about remaining in the market. All firms with $c < c_{max}$ are sufficiently productive to earn positive gross profits and therefore stay in the market and start production. In contrast,

that the Pareto is a good approximation to the distribution of firm productivity across sectors and countries. They suggest that on average the shape parameter k is close to two.

firms with cost levels above c_{max} exit.[6] From (10) one can directly infer that

$$c_{max} = \frac{p_{max}}{w(c_{max})}. \tag{12}$$

The cut-off level is therefore negatively related to the wage rate of the marginal firm but positively associated with the (endogenous) upper price bound p_{max}. Strong competitive pressures thus deter entry of low-productivity firms.

Prior to entry, i.e. before a prospective entrant has undertaken its initial investment, expected gross profits are given by $\int_0^{c_{max}} \Pi(c)dG(c)$. Unrestricted entry ensures that expected gross profits are driven down to the fixed start-up cost f_E and hence total expected profits are driven down to zero. Accordingly, the free-entry equilibrium condition is given by

$$\int_0^{c_{max}} \Pi(c)dG(c) = f_E. \tag{13}$$

2.3 Labor Market Regimes

Wages in the differentiated good sector can either be determined in a perfectly competitive labour market, fixed by an industry-wide wage agreement, or set by a firm-specific union. These three different scenarios $\rho = P, U, D$ have the following properties:

1. *Competitive Labour Market ($\rho = P$).*[7] Wages in the differentiated good sector just equal the outside option of workers. The latter is determined by the wage rate in the competitive numeraire sector and equals unity. Therefore, in a flexible labour market the corresponding wage rate w^P is given by $\overline{w} = 1$.

2. *Centralised Bargaining ($\rho = U$).* An industry union sets a *uniform* industry-wide wage floor above the competitive wage rate. The wage is given by $w^U = \theta\overline{w} = \theta$ with $\theta > 1$.

3. *Decentralised Bargaining ($\rho = D$).* Union activities are specific to a firm. In particular, there exist N firm-level unions and each union sets a wage rate for its respective firm. In doing so, unions maximise total firm-level rents $[w(c) - \overline{w}]E(c)$, where firm-level employment $E(c)$ is given by $cq(c)$. Solving the maximisation problem then yields a firm-specific wage rate of $w^D(c) = (p_{max} + c)/2c$.[8]

Centralised and decentralised wage bargaining differ in one key characteristic that is crucial for the results to follow. While firm-level bargaining accounts for idiosyncratic firm characteristics, an industry-wide bargaining agreement specifies a uniform wage that is binding for each and

[6] I will assume in the following that c_{max} is below c_M and hence firms with a cost draw of between c_{max} and c_M have to leave the market.

[7] This case has been analysed by Melitz and Ottaviano (2008).

[8] Here I also assume that the bargaining takes place after the entry decision has been made and that firms retain their right-to-manage.

every firm. More specifically, under firm-level bargaining the wage rate is increasing in firm productivity (or decreasing in the cost level c). In contrast, the wage rate under centralised wage bargaining is independent from productivity and has to be paid by any firm in the differentiated product sector. In fact, centralised bargaining agreements are frequently criticised for suppressing regional or plant-specific wage differentials. Although the uniform wage rate w^U could in principle be derived endogenously, e.g., from a simple monopoly union model, a binding and exogenously given wage $\theta > 1$ is the simplest and most flexible way to model this characteristic in the present context.[9] Of course, as modelled here, the uniform wage rate $w^U > \overline{w}$ could also result from a (binding) minimum wage imposed by the state.

3 Productivity and Firm Performance

In this section I use the model described above to analyse the effect of the different labour market regimes on average firm productivity and firm performance. To build intuition, I start with treating the market structure in the differentiated good sector, as summarised by p_{max}, as exogenously given. By substituting the corresponding wage rate into equation (12) the cost cut-off level c^ρ_{max} under each labour market regime $\rho = P, U, D$ can be written as

$$c^P_{max} = p^P_{max}, \quad c^U_{max} = \frac{p^U_{max}}{\theta}, \quad c^D_{max} = p^D_{max}. \tag{14}$$

Inspecting equations (14) shows that for any exogenously given $p^\rho_{max} = p_{max}$ ($\forall \rho = P, U, D$) the cost cut-off level is lowest under centralised wage bargaining. Centralised bargaining induces tougher selection by increasing marginal production costs of *all* firms. Entry of low-productivity enterprises is thus deterred. I call this the selection effect of centralised bargaining. With firm-level bargaining, in contrast, wages are firm-specific. Less productive firms have to pay lower wages and the marginal firm just pays the competitive unit wage $w^D(c_{max}) = 1$[10]. Consequently, the selection effect is absent under firm-level bargaining; for any given p_{max} the cost cut-offs c^P_{max} and c^U_{max} are identical. Notice that this result is not specific to the monopoly union model but follows from any model of union behaviour that yields $w(c_{max}) = \overline{w}$.

Consider next the profit level of a firm producing with cost c under labour market regime

[9] In order to derive a closed form solution for w^U from a monopoly union model, one has to assume that the industry-level union does not take into account its influence on p_{max}. Introducing the free parameter θ will furthermore prove helpful in the following as some of the results depend on the exact level of the binding wage floor. A possible parameter choice of θ is the average wage rate earned by workers under decentralised bargaining.

[10] Evaluating $w^D(c)$ at $c = c_{max}$ yields $p_{max}/2c_{max} + 1/2$. From $c_{max} = p_{max}/w(c_{max})$, it then follows that $w^D(c_{max}) = 1$.

$\rho = P, U, D$:

$$\begin{aligned}\Pi^P(c) &= \frac{1}{4\gamma}(p^P_{max} - c)^2, \quad \Pi^U(c) = \frac{1}{4\gamma}(p^U_{max} - c\theta)^2, \\ \Pi^D(c) &= \frac{1}{16\gamma}(p^D_{max} - c)^2. \end{aligned} \tag{15}$$

Given an exogenous level of competition, profits of a firm with cost draw c are highest in the competitive environment. By increasing wages above the competitive level, both centralised and decentralised wage bargaining ceteris paribus depress profits.[11] Whether a firm is better off under firm- or under sector-level bargaining depends on its cost draw c. Firms with a cost level of above $p_{max}/(2\theta - 1)$ prefer the decentralised over the centralised bargaining mode. High-productivity firms, in contrast, are better off under a uniform wage agreement.

So far I have taken p_{max} as exogenously given. In equilibrium, the cost cut-off level c_{max} and the corresponding upper price bound p_{max} are determined by the free entry condition (13). Using equations (14) and (15), the free entry condition for labour market regime $\rho = P, U, D$ can be rewritten as

$$\begin{aligned}&\int_0^{c^P_{max}} \frac{1}{4\gamma}(c^P_{max} - c)^2 dG(c) = f_E, \qquad \int_0^{c^U_{max}} \frac{\theta^2}{4\gamma}(c^U_{max} - c)^2 dG(c) = f_E, \\ &\int_0^{c^D_{max}} \frac{1}{16\gamma}(c^D_{max} - c)^2 dG(c) = f_E. \end{aligned} \tag{16}$$

The equilibrium cost cut-off levels and upper price bounds are then given by:[12]

$$c^P_{max} = p^P_{max} = \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}, \tag{17}$$

$$c^U_{max} = \frac{p^U_{max}}{\theta} = \left[\frac{1}{\theta^2}\right]^{1/(k+2)} \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}, \tag{18}$$

$$c^D_{max} = p^D_{max} = 4^{1/(k+2)} \left[2(k+1)(k+2)\gamma(c_M)^k f_E\right]^{1/(k+2)}. \tag{19}$$

Comparing these cut-off levels and price bounds yields

Proposition 1. *The orderings of the cost cut-off levels, c^ρ_{max}, and the upper price bounds, p^ρ_{max}, under the different labour market regimes $\rho = P, U, D$ are as follows:*

i. $c^D_{max} > c^P_{max} > c^U_{max}$,

ii. $p^P_{max} < \min\left[p^U_{max}, p^D_{max}\right]$,

[11] The marginal firm under decentralised wage bargaining is an exception in this regard because it just has to pay the competitive wage rate.

[12] These cut-off levels are derived under the assumption that $c^\rho_{max} < c_M$. For the different labour market regimes $\rho = P, U, D$ this assumption is fulfilled for $c_M > \sqrt{2(k+1)(k+2)\gamma f_E}$, $c_M > (1/\theta)\sqrt{2(k+1)(k+2)\gamma f_E}$, $c_M > 2\sqrt{2(k+1)(k+2)\gamma f_E}$, respectively.

iii. $p^U_{max} > (<)\ p^D_{max}$ *for* $\theta^k > (<)\ 4$.

The equilibrium cost cut-off is thus lowest under centralised bargaining and highest under firm-level bargaining. The overall intensity of competition is highest (the upper price bound is lowest) in the competitive environment. These two findings are directly related to our previous observations that for any given market structure centralised bargaining induces tougher selection and both bargaining regimes reduce profits.

The selection effect of centralised bargaining drives the least efficient firms out of the market and therefore decreases the cost cut-off. At the same time, by decreasing expected profits of potential entrants,[13] centralised bargaining also discourages firm entry and thus reduces the 'toughness' of competition. Since tougher competition also induces tougher selection, the anti-competitive effect works against but does not overturn the selection effect. Firm-level bargaining, in contrast, does not induce tougher selection but ceteris paribus only decreases expected profits of surviving firms. Lower expected profits again discourage entry and reduce the intensity of competition. Firms can then charge higher equilibrium prices and entrants with a relatively high cost level that would not break-even in a perfectly competitive environment (let alone under centralised bargaining) remain in the market. Finally, comparing the 'toughness' of competition under centralised and decentralised wage bargaining shows that the upper price bound is higher under the former if and only if $\theta^k > 4$. Competition is therefore weaker under regime U when the specified wage floor θ is relatively high and/or the distribution of cost draws is skewed towards less productive firms.

Having endogenised the market structure (as summarised by p_{max}), I will now assess how the different labour market regimes affect firm-level performance. The (unweighted) average of some performance measure $z^\rho(c)$ under regime $\rho = P, U, D$ is given by $\overline{z}^\rho = \left[\int_0^{c^\rho_{max}} z^\rho dG(c)\right] / G(c^\rho_{max})$. The firm-level cost average $\overline{c}^\rho$, average output $\overline{q}^\rho$, and the average profit level $\overline{\Pi}^\rho$ can all be written as simple functions of c^ρ_{max} and p^ρ_{max} only:

$$\overline{c}^P = \frac{k}{k+1} c^P_{max},\ \overline{c}^U = \frac{k}{k+1} c^U_{max},\ \overline{c}^D = \frac{k}{k+1} c^D_{max}, \tag{20}$$

$$\overline{q}^P = \frac{p^P_{max}}{2\gamma(k+1)},\ \overline{q}^U = \frac{p^U_{max}}{2\gamma(k+1)},\ \overline{q}^D = \frac{p^D_{max}}{4\gamma(k+1)}, \tag{21}$$

$$\overline{\Pi}^P = \frac{(p^P_{max})^2}{2\gamma(k+1)(k+2)},\ \overline{\Pi}^U = \frac{(p^U_{max})^2}{2\gamma(k+1)(k+2)},$$

$$\overline{\Pi}^D = \frac{(p^D_{max})^2}{8\gamma(k+1)(k+2)}. \tag{22}$$

Combining these performance measures with equations (17) to (19) yields

Proposition 2. *The orderings of the firm-level cost averages,* $\overline{c}^\rho$*, the average output levels,* $\overline{q}^\rho$*,*

[13] Centralised bargaining does not only decrease expected profits by increasing pay but also by reducing the ex-ante probability of survival for potential entrants.

and the average profit levels, $\overline{\Pi}^{\rho}$, under the different labour market regimes $\rho = P, U, D$ are as follows:

i. $\overline{c}^{D} > \overline{c}^{P} > \overline{c}^{U}$,

ii. $\overline{q}^{U} > \overline{q}^{P} > \overline{q}^{D}$,

iii. $\overline{\Pi}^{U} > \overline{\Pi}^{P} > \overline{\Pi}^{D}$.

Compared to both the competitive environment and to firm-level bargaining a uniform wage above the competitive level boosts average firm productivity (lowers the cost average), and leads to an increase in average output and profits. The positive impact on average productivity follows directly from the lower cost cut-off level (cf. Proposition 1i.). Two distinct effects are responsible for the positive effect on average output and profits: First, the productivity-enhancing effect of centralised wage bargaining also increases average output and profits because high-productivity firms generally produce and earn more. Second, at the level of the individual firm, the anti-competitive effect of centralised bargaining enables firms to charge higher mark-ups, expand their production and increase their profits. Despite the higher wage rate associated with unionisation, equilibrium profits of highly productive firms are then higher under sector-level bargaining than they are in a flexible-wage economy. For less productive firms, in contrast, the negative direct effect of higher wages on profits prevails.[14]

In stark contrast to these results, firm-level bargaining reduces average productivity and decreases average output and profits. Firm-level bargaining allows entrants with relatively unfavourable cost draws to remain in the market. Since low-productivity firms tend to be small and less profitable, the negative effect on average productivity also reduces average output and profits. The individual firm can again benefit or lose from firm-level bargaining. While enterprises have to pay higher wages compared to the competitive benchmark (with the marginal firm being the exception), surviving firms benefit from the lower equilibrium level of competition. Since firm-specific wages are increasing in productivity, less productive enterprises benefit from firm-level bargaining while more productive firms are hurt.[15] Decentralised wage agreements thus benefit low-productivity firms and harm high-productivity firms, while the opposite is true for centralised wage agreements.

4 Product Prices and Product Variety

After the previous section has studied the effects of different bargaining structures on productivity and firm performance, this section considers the effect on two outcomes that are of central

[14] Calculating and comparing equilibrium profits under the different labour market regimes show that gross profits of firms with $c < [\theta^{k/(k+2)} - 1]c^{P}_{max}/(\theta - 1)$ are higher under centralised bargaining than they are in a competitive labour market regime.

[15] The positive (anti-competitive) effect of decentralised bargaining on output and profits dominates for firms with $c > [2 - 4^{1/(k+2)}]c^{P}_{max}$.

importance to consumers: product prices and product variety.[16]

Consider first the distribution of prices. Using the appropriate wage rate, the profit-maximising price of a variety produced with cost c under labour market regime $\rho = P, U, D$ can be written as:

$$\begin{aligned} p^P(c) &= \frac{1}{2}\left(p^P_{max} + c\right), \quad p^U(c) = \frac{1}{2}\left(p^U_{max} + c\theta\right), \\ p^D(c) &= \frac{1}{2}\left(3/2 p^D_{max} + 1/2c\right). \end{aligned} \tag{24}$$

The corresponding average price level $\overline{p}^\rho$ is given by $\left[\int_0^{c^\rho_{max}} p^\rho(c) dG(c)\right] / \; G(c^\rho_{max})$, while the variance of prices $(\delta^\rho_p)^2$ can be calculated as $\left[\int_0^{c^\rho_{max}} \left(p^\rho(c) - \overline{p}^\rho\right)^2 dG(c)\right] / G(c^\rho_{max})$. Using equations (14) and (24), I then obtain the following first and second moments of the different price distributions:

$$\overline{p}^P = \frac{2k+1}{2(k+1)} p^P_{max}, \quad \overline{p}^U = \frac{2k+1}{2(k+1)} p^U_{max}, \quad \overline{p}^D = \frac{4k+3}{4(k+1)} p^D_{max}, \tag{25}$$

$$(\delta^P_p)^2 = \frac{k(p^P_{max})^2}{4(k+1)^2(k+2)}, \quad (\delta^U_p)^2 = \frac{k(p^U_{max})^2}{4(k+1)^2(k+2)},$$

$$(\delta^D_p)^2 = \frac{k(p^D_{max})^2}{16(k+1)^2(k+2)}. \tag{26}$$

Given the equilibrium upper price bounds in equations (17) to (19), these moments can be ordered as follows:

Proposition 3. *The orderings of the average price levels, $\overline{p}^\rho$, and the variances of prices, $(\delta^\rho_p)^2$, under the different labour market regimes $\rho = P, U, D$ are as follows:*

i. $\overline{p}^P < \min\left(\overline{p}^U, \overline{p}^D\right)$,

ii. $\overline{p}^U < (>)\, \overline{p}^D$ *for* $\theta^k < (>)\, 4\kappa$ *with* $\kappa = [(4k+3)/(4k+2)]^{k+2} > 1$,

iii. $(\delta^U_p)^2 > (\delta^P_p)^2 > (\delta^D_p)^2$.

[16] In fact, the indirect utility function associated with (1) is given by

$$U = I^C + \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)^{-1} (\alpha - \overline{p})^2 + \frac{1}{2}\frac{N}{\gamma}\theta^2_p, \tag{23}$$

where $\theta^2_p = (1/N)\int_{i\in\Omega^*} (p_i - \overline{p})^2 \, di$ is the variance of prices. Utility of the representative consumer is thus decreasing in the average price level $\overline{p}$ and increasing in the variance of prices θ^2_p, in product variety N and in income I^C. While the model is well equipped for analysing product prices and variety in the differentiated good sector, it is less appropriate for studying the income effects of unionisation. Not only does the model postulate a constant marginal utility of income, it also abstracts from economy-wide unemployment. Units of labour not demanded by firms in the differentiated good sector are employed in the numeraire sector. Since union bargaining therefore raises pay but does not create unemployment, unionisation increases income by construction. I thus refrain from analysing overall consumer welfare, and only consider product prices and product variety.

The average price level is lowest in a flexible-wage economy. There are three reasons why the average price level in a flexible-wage economy differs from the mean of prices under centralised wage bargaining: First, a binding sector-wide wage floor increases unit costs cw. Second, centralised bargaining also decreases competition in equilibrium. Both factors increase ceteris paribus the profit-maximising price of a firm producing with cost c. The selection effect, in contrast, reduces the average price level because it singles out the more productive and thus cheaper firms. Equations (25) show that for any given upper price bound $p^P_{max} = p^U_{max} = p_{max}$ average prices under the two regimes P and U are exactly identical. The direct effect on unit costs and the selection effect of centralised wage bargaining hence cancel out. Therefore, the anti-competitive effect of unionisation prevails and $\overline{p}^U$ strictly exceeds $\overline{p}^P$ in equilibrium.

Firm-level bargaining also boosts pay and impedes competition (compared to the competitive benchmark) but does not induce tougher selection. As a result, the average price level is larger under decentralised bargaining than with a perfectly competitive labour market even when we abstract from any anti-competitive effect and take p_{max} as exogenously given. It then also follows that for $\theta^k = 4$ (and hence for $p^U_{max} = p^D_{max}$) $\overline{p}^U$ is strictly lower than $\overline{p}^D$. The average price level thus tends to be smaller under centralised than under decentralised bargaining, because the former regime singles out more productive firms while the latter does not. Only for large θ, when the intensity of competition under centralised bargaining is very weak, can the ordering of $\overline{p}^U$ and $\overline{p}^D$ be reversed.

Finally, part iii of proposition 3 shows that the variance of prices is largest under centralised wage bargaining and lowest under firm-level bargaining. Compared to the flexible labour market regime, centralised wage bargaining increases the average price level and thus the corresponding variance increases as well. Firm-level bargaining, in contrast, reduces the variance of prices. Since firm-specific wages increase in productivity, firm-level bargaining compresses the distribution of marginal production costs $cw(c)$. Prices charged by individual firms therefore depend little on idiosyncratic cost draws but are primarily determined by the overall market structure that is common to all firms (see equation 24). Firms with different cost levels therefore set relatively similar prices and the price variance decreases.

Consider next product variety. Using (25), equation (5) can be solved for the number of firms in equilibrium and thus for the number of varieties consumed:

$$N^P = \frac{2(k+1)\gamma}{\eta}\frac{\alpha - p^P_{max}}{p^P_{max}}, \quad N^U = \frac{2(k+1)\gamma}{\eta}\frac{\alpha - p^U_{max}}{p^U_{max}},$$
$$N^D = \frac{4(k+1)\gamma}{\eta}\frac{\alpha - p^D_{max}}{p^D_{max}}. \tag{27}$$

Equations (27) reveal two factors that are of interest for the ordering of product variety under the different labour market regimes: First, variety is positively associated with the 'toughness' of competition. Second, for any given p_{max} the number of consumed varieties is largest with

decentralised wage bargaining. This second finding mirrors proposition 3, according to which the average price level is highest under decentralised wage bargaining (for any given p_{max}). A high-price environment allows relatively many firms to survive and thus leads to greater product variety. Accounting for both factors, product variety under the different labour market regimes can be ordered as follows:

Proposition 4. *The ordering of the number of consumed varieties, N^ρ, under the different labour market regimes $\rho = P, U, D$ is as follows:*

i. $N^P > N^U$,

ii. $N^P > (<) N^D$ *for* $p_{max}^P > (<) \varphi\alpha$ *with* $0 < \varphi = (2/4^{1/(k+2)} - 1) < 1$,

iii. $N^D > (<) N^U$ *for* $\theta^k > (<) 4\lambda$ *with* $\lambda = \left[\alpha/(2\alpha - 4^{1/(k+2)} p_{max}^P)\right]^{k+2} < 1$.[17]

The number of consumed varieties is thus strictly larger in a flexible-wage economy than under centralised wage bargaining, reflecting the anti-competitive effect of the latter. Decentralised wage bargaining, in contrast, can result in either more or less variety than a competitive labour market. Strong demand for the differentiated varieties relative to the numeraire good (high values of α) and a relatively large share of firms with an unfavourable cost draw (high values of k) tend to increase N^D relative to N^P. Finally, the ordering of product variety under decentralised and centralised wage bargaining is ambiguous and depends on the choice of θ. For $\theta^k = 4$ and thus for $p_{max}^U = p_{max}^D$, however, N^D strictly exceeds N^U.

The choice between centralised and decentralised bargaining therefore involves a potential trade-off between product prices and product variety. Holding p_{max} constant, firm-level bargaining is associated with greater product variety but also with relatively higher prices (and a lower price variance).

5 Conclusion

This paper has studied how the level at which collective wage contracts are negotiated affects firm productivity and firm performance. While centralised bargaining induces tougher selection among heterogeneous producers and thus increases average productivity, firm-level bargaining allows less productive entrants to stay in the market, as inter-firm productivity differences will find consideration in firm-level wage settlements. Centralised bargaining also results in higher average output and in higher profit levels than either decentralised bargaining or a competitive labour market. Moreover, I have shown that moving from centralised to decentralised bargaining is not necessarily beneficial for consumers. While firm-level bargaining tends to increase product variety, it also entails higher product prices.

[17] $\lambda < 1$ follows from $N^D > 0$ (which implies $\alpha - p_{max}^D = \alpha - 4^{1/(k+2)} p_{max}^P > 0$).

The predictions of the theoretical model can be useful in guiding future empirical work on the relation between unionisation, productivity, and firm performance. Existing empirical studies mainly seek to identify the effect of a change in unionisation status on an individual firm in a given industry.[18] My work suggests that a more complete analysis requires complementary evidence on the relation between unionisation structures and average firm performance at the industry level that also accounts for the endogeneity of the market structure.

References

Campbell, J. R., Hopenhayn, H. A., 2005. Market size matters. Journal of Industrial Economics 53(1), 1–25.

Del Gatto, M., Mion, G., Ottaviano, G. I. P., 2006. Trade integration, firm selection and the costs of non-Europe. CEPR Discussion Papers 5730.

Grout, P. A., 1984. Investment and wages in the absence of binding contracts: A nash bargaining approach. Econometrica 52(2), 449–460.

Haucap, J., Wey, C., 2004. Unionisation structures and innovation incentives. Economic Journal 114(494), C149–C165.

Hirsch, B. T., 2004. What do unions do for economic performance? Journal of Labor Research 25(3), 415–456.

Melitz, M. J., Ottaviano, G. I. P., 2008. Market size, trade, and productivity. Review of Economic Studies 75(1), 295–316.

Metcalf, D., 2003. Unions and productivity, financial performance and investment: international evidence. In: Addison, J., Schnabel, C. (Eds.), International Handbook of Trade Unions. Cheltenham: Edward Elgar, pp. 118–171.

Moene, K. O., Wallerstein, M., 1997. Pay inequality. Journal of Labor Economics 15(3), 403–430.

OECD, 2004. OECD Employment Outlook 2004. Paris: OECD.

Rehn, G., 1952. The problem of stability: An analysis of some policy proposals. In: Turvey, R. (Ed.), Wages policy under full employment. London: W. Hodge.

Tauman, Y., Weiss, Y., 1987. Labor unions and the adoption of new technology. Journal of Labor Economics 5(4), 477–501.

[18] Evidence on the link between unionisation and productivity is inconclusive, while the bulk of studies find unionised workplaces to be less profitable than non-unionised ones (cf. Metcalf, 2003; Hirsch, 2004, for recent surveys of the literature). These findings are not at odds with the theoretical predictions of the present paper. Holding the market structure constant, collective bargaining unambiguously decreases firm-level profits.

Tybout, J. R., 2003. Plant- and firm-level evidence on the 'new' trade theories. In: Choi, E. K., Harrigan, J. (Eds.). Handbook of International Trade. Oxford: Basil-Blackwell, pp. 388–415.

Ulph, A., Ulph, D., 2001. Strategic innovation with complete and incomplete labour market contracts. Scandinavian Journal of Economics 103(2), 265–282.

Ulph, A. M., Ulph, D. T., 1994. Labour markets and innovation: Ex-post bargaining. European Economic Review 38(1), 195–210.

Van der Ploeg, F., 1987. Trade unions, investment, and employment. European Economic Review 31, 1465–1492.