IAAEU
Institut für Arbeitsrecht
und Arbeitsbeziehungen
in der Europäischen Union

IAAEU Discussion Paper Series in Economics
No. 03/2016

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April 2016

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Welfare-enhancing Trade Unions in an Oligopoly with Excessive Entry*

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April 29, 2016

Abstract

If input markets are competitive and output per firm declines with the number of firms (business stealing effect), there will be excessive entry into a Cournot oligopoly for a homogeneous commodity. However, input markets are often imperfectly competitive and the price of labor is determined by collective bargaining. The resulting rise in wages reduces output and profits and can deter entry. We analyze under which conditions greater bargaining power by the trade union reduces entry and raises welfare. Furthermore, we show that collective bargaining loosens the linkage between business stealing and excessive entry.

Keywords: Endogenous Entry, Oligopoly, Trade Union, Wage Bargaining, Welfare

JEL Classification: D 43, J 51, L 13

*We are grateful for helpful comments by Florian Baumann, Jörg Lingens, Karol Mazur, Jürgen Meckl, Jochen Michaelis and Manfred Stadler. We also thank participants of the Annual Conference of the Royal Economic Society 2016 (held in Brighton), of the Spring Meeting of Young Economists 2016 (held in Lisbon) as well as seminar participants in Trier for inspiring discussions. Christoph Tasto provided excellent research assistance.

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1 Introduction

In many OECD and European Union member states, wages and working conditions for an overwhelming fraction of the workforce are determined by collective bargaining (cf. Visser, 2015). A large body of academic research has thus analyzed the consequences of wage negotiations between firms and labor unions. The broad consensus is that labor unions acquire rents to benefit their members but that this redistribution causes allocative inefficiencies. Accordingly, introducing labor unions into a world with perfectly competitive goods markets reduces employment, output and welfare in so-called right-to-manage models.[1] Similar effects of unions also exist in settings with oligopolistic or monopolistic competition, as long as the number of firms is given exogenously.

If (costly) market entry is feasible, however, the endogenously determined number of firms could itself be inefficient. Mankiw and Whinston (1986) and Suzumura and Kiyono (1987) show that market entry is excessive in an oligopolistic market with firms producing a homogenous good, if the so-called business stealing effect prevails. The central reason is that entrants do not take into account that they reduce the payoff of incumbent firms and, thus, do not internalize an externality.[2] This prediction is based on the assumption of perfectly competitive input markets. Introducing trade unions in such a setting causes wages to rise. Firms, in turn, lower output, which reduces consumption possibilities and, hence, has a direct negative welfare impact. However, higher wages also lower profits, which reduces the incentives to enter the market. Since welfare declines with the number of firms if there is excessive entry, trade unions could be welfare-enhancing in an oligopoly with endogenously determined number of firms.

From an empirical perspective, collective wage agreements are most relevant for high-productive and large firms (see Capuano et al., 2014) which often compete in oligopolistic markets. Despite the fact that the co-existence of labor unions and oligopolies seems to be the empirically relevant case, relatively little is known about the allocative effects of this combination of market imperfections. The present paper tries to fill this gap. Our contribution is twofold. First, we investigate how trade unions affect welfare in an oligopolistic market with excessive entry. Second, we analyze whether the presence of trade unions modifies the condition which has to be fulfilled

[1] An inefficiency will also arise if there is bargaining over wages *and* employment, unless there is no input other than labor and the union's payoff is linear in wages and employment.

[2] This kind of externality is also present in other settings with imperfect product markets and not solely in a homogeneous Cournot-oligopoly. Therefore, the theoretical possibility that there can be excessive entry is also of great empirical relevance.

for the excess entry theorem to hold. That is, we inquire whether business stealing remains a necessary and sufficient condition for excessive entry to arise also in a world with collective bargaining.

To address these points, we set up a model in which consumers can allocate their income between two goods. The numeraire good is produced under conditions of perfect competition, while the market for the other commodity is characterized by Cournot competition. Production of this good of interest can only take place if fixed costs of entry are incurred. Input prices, i.e. wages, are negotiated between a firm and a firm-specific trade union. As our main result, we show that trade unions can indeed raise welfare if higher wages reduce the number of firms, as conjectured above. A welfare-enhancing effect is more likely to occur the higher the fixed costs of market entry are and the more concave the inverse demand curve is. High costs of entry imply that the welfare gain from a given reduction in the number of firms is particularly pronounced. Furthermore, if the demand curve is concave, a higher wage results in a relatively small decrease in aggregate output.

We also find that the business stealing effect is a necessary but not a sufficient requirement for excessive entry to occur in the presence of trade unions. This implies that insufficient entry could be the equilibrium outcome even in the presence of business stealing which puts into perspective the original excess entry theorem (cf. Mankiw and Whinston, 1986, Perry, 1984, Suzumura and Kiyono, 1987, von Weizsäcker, 1980). Furthermore, insufficient entry can already arise if trade unions have (virtually) no bargaining power. This is because wage payments (irrespective of their level) always deter entry since they reduce profits. This pure redistribution of income, however, does not alter welfare. The entry effect of wages becomes more pronounced the higher the union's bargaining power and differs from the approaches used in the literature so far (see below) in which the costs of inputs directly lower welfare.

Our results have a number of policy implications. First, anti-competitive strategies which aim to prevent entry should be taken cautiously. Reducing the number of firms would make a welfare-enhancing effect of trade unions less likely. Along the same lines, it can be argued that policies which allow the number of firms to fall, f.e. by raising the costs of market entry or allowing mergers to take place, can be particularly detrimental to welfare if there is no business stealing and wages are negotiated collectively. Second, restricting the legal framework of collective bargaining in order to decrease union bargaining power could be welfare-reducing because a less pronounced labor market inefficiency (high wage payments) might strengthen another inefficiency (excessive entry). Put differently, our analysis reveals a further instance of a classic second-best world in which it is not true that "a situation in which more, but not all, of the optimum conditions are fulfilled is necessarily (...) superior to a situation in which fewer are fulfilled." (Lipsey and Lancaster, 1956, p. 11f.)

Our paper is primarily related to the strand of literature that investigates the robustness of the excess entry theorem with respect to imperfectly competitive input markets. Okuno-Fujiwara and Suzumura (1993) and Suzumura (1995), for example, assume that firms can reduce marginal production costs through R&D investments. They show that this extension of the basic set-up does not fundamentally alter the excess entry result. Ghosh and Morita (2007a) investigate a framework in which upstream firms enter a market until operating profits equal entry costs, produce a homogeneous intermediate good at constant marginal costs and compete in quantities. Each upstream firm is matched to one downstream firm. Downstream firms take the price of the intermediate good as given and produce a final good. The market for the final good is also characterized by Cournot competition. In this setting, the business creation impact may dominate the business stealing effect because upstream firms generate profits for their downstream counterparts which the former ignore when deciding about entry.[3]

In a related paper, Ghosh and Morita (2007b) assume that the number of downstream firms is determined endogenously and that each pair of profit-maximizing downstream and upstream enterprises (Nash-) bargains over the price and the quantity of the downstream firm's input. The authors show that there may be insufficient entry by downstream firms if upstream counterparts have bargaining power. The intuition is similar to the one applicable to their other analysis: downstream firms do not take into account that entry creates business for upstream firms. The higher the difference between the price obtained by the upstream enterprise and its marginal costs is, that is, the greater its bargaining power, the more substantial the externality which downstream firms ignore.

Turning to labor as input, imperfections in this market have basically played no role in the analysis of the excess entry theorem. Marjit and Mukherjee (2013) represent a partial exception. They consider a setting in which a single foreign firm produces at lower marginal cost than its domestic competitors but incurs transport costs. Initially assuming a competitive input market, the authors establish conditions for entry of domestic firms to be excessive. In an extension, they consider an encompassing domestic trade union, while wages paid by the foreign competitor are unaffected by collective bargaining. In such a setting, entry by domestic firms is shown to

[3]Basak and Mukherjee (2016) extend this result by indicating that if input suppliers have market power, social efficiency of the number of firms depends on returns to scale.

be insufficient. This prediction results from a combination of effects, such as wage setting, the focus on domestic welfare, and marginal cost differences between firms.

Further, a number of studies analyze the effect of labor unions on entry deterrence in oligopolistic markets (cf. Bughin, 1999, Haucap et al., 2001, Ishiguro and Zhao, 2009, Ishiguro and Shirai, 1998). This line of research, however, differs from our approach in various perspectives. First, collective bargaining is used as an instrument by the incumbent firms to deter entry. In contrast, in our model there is no strategic wage setting. Second, the number of firms is exogenously determined or varied such that the possibility of excessive entry is ruled out by construction. Third, usually welfare effects of trade unions are not investigated. The studies by Dewatripont (1987, 1988) are a partial exception because they highlight (using a numerical example) that the welfare effects of unions are theoretically ambiguous if unions deter entry.[4]

The remainder of our paper is structured as follows. In Section 2, we develop the analytical framework. In Section 3, we analyze the welfare effects of higher wages due to collective bargaining. Section 4 investigates how collective bargaining alters the excess entry theorem. Section 5 concludes.

2 Analytical Framework

2.1 Set-up

We consider a two-sector economy. In each sector, one labor unit is required to produce one unit of output. In sector 0, good 0 is supplied under conditions of perfect competition on goods and labor markets. We choose good 0 as the numeraire and normalize its price to unity, such that the wage paid in this sector is equal to one. In sector 1, there are $j = 1, ..., n$, $n > 1$, firms and each of them produces the same consumption good. The market for good 1 is imperfectly competitive.

Profits of firm j consist of the difference between revenues and the sum of labor and market entry costs. Revenues are the product of the price $p(X)$ and the quantity x_j produced by firm j. The price decreases with aggregate output, X, which consists of the sum of output by firm j and output of all other firms, X_{-j}: $X \equiv x_j + X_{-j}$. Labor costs equal wage payments $w_j x_j$. Finally, and in order to ensure economies of scale, there are market entry or

[4]In a recent paper, Naylor and Soegaard (2014) show that profits in a Cournot oligopoly can increase in the number of firms if labor markets are unionized. This result suggest that trade unions do not necessarily have to deter entry as argued in related studies.

set-up costs which we denote by k, $k > 0$, and which are the same for all firms.

Profits are, hence, defined by:

$$\pi_j = p\left(x_j + X_{-j}\right) x_j - w_j x_j - k. \tag{1}$$

Firms maximize profits with respect to output and assume the choices by other firms to be given, i.e. we consider a Cournot-Nash-setting. Moreover, firms only enter the market if entry costs are less or equal to operating profits defined by $\pi_j^o = \pi_j + k$.

There is a representative consumer who is a price taker on goods markets and whose preferences are given by a quasi-linear utility function:

$$U = x_0 + u\left(X\right), \tag{2}$$

with x_0 denoting the consumed quantity of the numeraire good. The sub-utility function u satisfies $u''(X) < u(0) = 0 < u'(X)$. The representative consumer inelastically supplies a given quantity of labor. Correctly anticipating labor demand by firm j, the consumer supplies x_j units of labor to firm j, such that total labor supply to sector 1 equals $x_j + X_{-j}$. The remaining amount of labor is supplied to sector 0.[5] The representative consumer owns all firms, receives wages paid in both sectors and, additionally, an exogenously given income $\Theta > 0$. The latter income component guarantees that the consumer is able to purchase the utility-maximizing quantity of good 1 (see, inter alia, Armstrong and Vickers, 1991, Langenmayr et al., 2015, Varian, 1985).

Wages are determined via Nash-bargaining between the firm and a firm-specific trade union. The union attempts to maximize the consumer's utility, taking as given wages obtained in other firms, income from sources other than labor and anticipating the firm's output choice. We assume that labor is fully mobile across firms and sectors ex-ante, i.e. before the wage is determined. Ex-post, labor is immobile within sector 1, i.e. changing jobs across sector 1 firms is not feasible, but labor can always move from sector 1 to the competitive labor market in sector 0.[6]

The timing is as follows:

[5] Alternatively, we could assume that the economy is endowed with an exogenously given mass of (homogenous) labor which would also equal the mass of consumers. Labor units would be inelastically supplied. Moreover, consumers would decide about individual demand given the quasi-linear utility function (2), while the market demand would be the sum of all individual demand schedules. Our approach can be treated as special case of this setting, with the mass of labor normalized to one such that the economy is (quasi) endowed with one representative consumer.

[6] The assumption of ex-post immobility of labor units within sector 1 guarantees that

1. Firms enter the market.
2. Wage bargaining simultaneously takes place at the firm level.
3. Firms simultaneously decide about their output level.
4. Consumption decisions are made.

As usual, we solve the model by backward induction.[7]

2.2 Optimization

2.2.1 Demand

The representative consumer chooses the consumption quantities x_0 and X to maximize utility (2), subject to the constraint that total income I, which is predetermined at the final stage, equals total expenditure. Replacing the consumption quantity of good 0 according to this constraint, the first-order condition for a maximum is:

$$\frac{dU}{dX} = u'(X) - p(X) = 0. \tag{3}$$

The inverse demand function $p(X)$ defined by (3) is downward-sloping in the price-quantity space. Its curvature depends on the third derivative of the utility function which is a priori ambiguous.

For later use, we define the elasticity of the slope of the inverse demand curve with respect to aggregate output which is denoted by η:

$$\eta \equiv p''(X)\frac{X}{p'(X)}. \tag{4}$$

It will be zero if the inverse demand curve is linear and positive (negative) if $p(X)$ is strictly concave (convex), or, put differently, if preferences exhibit imprudence (prudence) as defined by Kimball (1990).

Since Eq. (3) uniquely defines the optimal consumption quantity, X^*, of the good produced in sector 1, the remaining income is used to purchase the numeraire good according to the budget constraint. Therefore, we obtain:

$$x_0^* = I - p\left(X^*\right) X^*. \tag{5}$$

With (5) at hand, utility of the representative consumer can be rewritten as:

$$V \equiv U\left(I, X^*\right) = I - p\left(X^*\right) X^* + u(X^*). \tag{6}$$

trade unions can raise wages above the competitive level. Furthermore, labor mobility across sectors ensures that there is no unemployment. See Oswald (1982) and Oswald (1985) for the basic idea.

[7] In addition to this benchmark model, we consider efficient bargaining below, i.e. both wages and output are negotiated between firms and firm-level trade unions.

2.2.2 Output

The first-order condition for a profit maximum of firm j is given by:

$$\frac{d\pi_j}{dx_j} = p'(X)x_j + p(X) - w_j = 0. \tag{7}$$

We assume that the second-order condition is fulfilled:

$$\frac{d^2\pi_j}{{dx_j}^2} = p''(X)x_j + 2p'(X) < 0. \tag{8}$$

Using (8) and $d^2\pi_j/(dx_j dw_j) = -1$, we can derive the slope of the firm's labor demand curve as:

$$\frac{dx_j}{dw_j} = \frac{1}{p''(X)x_j + 2p'(X)} < 0. \tag{9}$$

2.2.3 Wage Determination

The (firm-specific) trade union and firm j bargain over the wage w_j to maximize the Nash-product, NP_j, subject to (9). The (asymmetric) Nash-product is defined as (see Svejnar, 1986):

$$NP_j = \left(V_j - \tilde{V}_j\right)^{\alpha} (\pi_j - \tilde{\pi}_j)^{1-\alpha}, \tag{10}$$

where V_j (π_j) denotes utility (profits) in case of an agreement between firm j and the trade union, and $\tilde{V}_j$ ($\tilde{\pi}_j$) represents utility (profits) if no agreement is reached. α $(1-\alpha)$, $0 \leq \alpha < 1$, describes the union's (firm's) bargaining power.

In case of an agreement, the representative consumer obtains wage income in firm j, wage income in other firms in sector 1, total wage income earned in sector 0, total profits and the exogenous income Θ. If no agreement is reached, the consumer supplies the amount of labor which is not demanded by firm j to sector 0 and earns the competitive wage. All other income components remain unaffected by the bargaining outcome.[8] The union's gain from negotiating is thus given by: $V_j - \widetilde{V}_j = (w_j - 1)x_j$.

Turning to the firm, profits in case of an agreement are represented by (1). Otherwise, the firm faces a loss in terms of the market entry costs, $\tilde{\pi}_j = -k$. Therefore, the firm's gain from a successful negotiation reads: $\pi_j - \widetilde{\pi}_j = \pi_j^o = (p(X) - w_j)x_j$.

[8] A breakdown of negotiations between firm j and union j reduces aggregate output X which has an additional impact on the representative consumer's utility. To keep our model analytically tractable, we neglect this repercussion effect in the following.

Inserting the union's and firm's gain from negotiating into (10), the Nash-product can be written as:

$$NP_j = ((w_j - 1)x_j)^{\alpha} ((p(X) - w_j)x_j)^{1-\alpha}. \tag{11}$$

The first-order condition for a maximum of NP_j is given by:

$$\alpha \left(V_j - \tilde{V}_j\right)^{\alpha-1} \frac{d\left(V_j - \tilde{V}_j\right)}{dw_j} \left(\pi_j^o\right)^{1-\alpha} + (1-\alpha)\left(V_j - \tilde{V}_j\right)^{\alpha} \frac{d\pi_j^o}{dw_j} \left(\pi_j^o\right)^{-\alpha} = 0. \tag{12}$$

We assume that the solution to (12) is unique and that the second-order condition for a maximum is fulfilled. Canceling common terms, making use of the firm's first-order condition (7), and rearranging, we obtain:

$$(1-\alpha)(w_j - 1)x_j = \alpha(p(X) - w_j)x_j \left(1 - \mu(x_j, w_j)\right). \tag{13}$$

$\mu(w_j, x_j) \in [0, 1]$ is defined as the weighted wage elasticity of labor demand:

$$\mu(x_j, w_j) = -\frac{w_j - 1}{w_j} \frac{w_j}{x_j} \frac{dx_j}{dw_j}, \tag{14}$$

which implies that $w_j \geq 1$.[9]

2.2.4 Market Entry

Firms enter the market until operating profits equal entry costs. The corresponding free-entry condition follows immediately from $\pi_j(n) = 0$ and (1).

Since output per firm and the wage are uniquely determined for a given number of firms, the free-entry condition implicitly defines the equilibrium number of firms, n^*. We assume that n^* is greater than unity, i.e. we do not consider a monopoly outcome. Moreover, we follow the approach commonly pursued (see, for instance, Amir et al., 2014, Besley, 1989, Ghosh and Morita, 2007a, Marjit and Mukherjee, 2013) and ignore the integer constraint with regard to the number of firms.

[9] While we assume firm-specific trade unions, one could also consider more encompassing unions. If the trade union bargains with more than one firm, but does not fully internalize the output consequences of wage variations, the trade-off between wages and output as described by (13) will qualitatively also apply. In the limiting case of a trade union which negotiates for all employees in sector 1 with an employer association including all n firms, however, the increase in total wages is equivalent to the decline in aggregate profits, such that the payoff of the representative consumer is independent of wages paid in sector 1. Output consequences of wage variations are then fully internalized, implying that the bargained wage equals the competitive wage.

2.3 Equilibrium

We consider a symmetric equilibrium such that all firm-specific trade unions set the same wage, $w = w_j \; \forall j$, and all firms choose the same output level, $x = x_j \; \forall j$. For a given number of firms, n, aggregate output, hence, equals $X = nx$. Using (4), we can rewrite the firm's second-order condition (8) as (cf., inter alia, Besley, 1989, Seade, 1980, Suzumura and Kiyono, 1987):

$$\frac{d^2\pi}{dx^2} = \frac{p'(nx)}{n}\,(2n+\eta) < 0. \tag{15}$$

The equilibrium levels of wages, output per firm, the number of firms, and aggregate output are denoted by w^*, x^*, n^* and $X^* = x^* n^*$, respectively. Given the free-entry equilibrium, they are (implicitly) determined by the subsequent conditions:

$$A \equiv (1-\alpha)\,(w^*-1)\,x^* - \alpha k\,(1-\mu(x^*, w^*)) = 0, \tag{16}$$

$$B \equiv p'(X^*)x^* + p(X^*) - w^* = 0, \tag{17}$$

$$C \equiv p(X^*)x^* - w^*x^* - k = 0. \tag{18}$$

The partial derivatives of (16) to (18) with respect to the endogenous variables are given by $A_n = 0$, $B_w = -1$, $C_w = -x$, and the subsequent expressions, where we omit the indication of the endogenous variables as equilibrium outcomes by a $'*'$ for simplicity:

$$\begin{aligned} A_x &= (1-\alpha)(w-1) + \alpha k \mu_x, \\ A_w &= (1-\alpha)x + \alpha k \mu_w, \end{aligned} \tag{19}$$

$$\begin{aligned} B_x &= p'(X)\,(1+n+\eta) < 0, \\ B_n &= p'(X)\frac{x}{n}(\eta+n), \end{aligned} \tag{20}$$

$$\begin{aligned} C_x &= p'(X)x(n-1) < 0, \\ C_n &= p'(X)x^2 < 0. \end{aligned} \tag{21}$$

Note that the derivatives of the (weighted) wage elasticity of labor demand, μ_x and μ_w, are ambiguous. Since stability of the equilibrium requires $1+n+\eta > 0$ in the absence of trade unions (see Seade, 1980), we also assume this restriction to hold.

The determinant of the system consisting of Eqs. (16) to (18) is given by $D = A_x(B_nC_w - B_wC_n) - A_n(B_xC_w - B_wC_x) + A_w(B_xC_n - B_nC_x)$. Inserting the respective terms and simplifying yield:

$$D = \underbrace{p'(X)\frac{x^2}{n}}_{<0}\left[A_w\underbrace{(2n+\eta)p'(X)}_{<0} - A_x\eta\right]. \tag{22}$$

To ensure that the equilibrium is well behaved and stable, profits per firm have to decrease in the number of firms n. As shown in Appendix A.1, this condition is fulfilled if the determinant is positive, $D > 0$, which we assume in the following.

Finally, welfare is given by the representative consumer's utility V as defined by (6) since consumers receive all profit income. Equilibrium income equals $I^* = w^*X^* + W_0 + \Pi^* + \Theta$, where we assume that the oligopolistic sector is sufficiently small such that total wage income in sector 0, W_0, is unaffected by outcomes in sector 1. Using the definition of profits, welfare can be expressed as:

$$V^* = u(X^*) - n^*k + W_0 + \Theta. \tag{23}$$

3 Welfare Effects of Trade Unions

In this section, we first show that union bargaining power raises the equilibrium wage rate w^*. Given this result, which has been established for other output market structures as well (see Dowrick, 1989, Nickell and Andrews, 1983), we subsequently investigate the welfare effects of trade unions by looking at the implications of an increase in the wage. For this purpose, we consider the wage rate as exogenous and vary it accordingly. This approach is convenient because we can directly utilize these findings in Section 4 below.[10]

3.1 Wages and Bargaining Power

Totally differentiating Eqs. (16) – (18) and rearranging the resulting expressions yield:

$$\frac{dw^*}{d\alpha} = -\frac{A_\alpha}{D}\left(p'(X^*)\right)^2 (x^*)^2 \frac{2n^* + \eta}{n^*} > 0, \tag{24}$$

where A_α denotes the partial derivative of (16) with respect to α:

$$A_\alpha = -k\frac{1 - \mu(x^*, w^*)}{(1-\alpha)^2} < 0 \qquad for \qquad 0 < \alpha < 1. \tag{25}$$

This leads to the following Lemma:

Lemma 1 *An increase in the union's bargaining power implies an increase in the equilibrium wage rate.*

[10] Equivalently, and with identical results, we could also calculate the impact of an increase in the union's bargaining power on welfare.

3.2 Wages, Market Entry and Welfare

In the next step of our argument, we consider the wage rate as exogenous and denote it by $\overline{w}$ for notational convenience. The equilibrium is then described by (17) and (18) which determine x^* and n^*. Making use of the assumption that W_0 is unaffected by the outcomes in sector 1 and differentiating welfare as defined by (23) with respect to $\overline{w}$ yields:[11]

$$\frac{dV^*}{d\overline{w}} = u'(X^*) \underbrace{\left[\frac{dx^*}{d\overline{w}} n^* + x^* \frac{dn^*}{d\overline{w}}\right]}_{dX^*/d\overline{w}} - \frac{dn^*}{d\overline{w}} k. \tag{26}$$

As elucidated in the introduction, the welfare effect of a wage increase depends on two effects: (i) the variation in aggregate output X^* because this directly alters the representative consumer's utility and (ii) the variation in the number of firms n^* because this changes market entry costs.

The variations in the equilibrium output per firm x^*, number of firms, n^*, and aggregate output, X^*, owing to a higher wage are given by:

$$\frac{dx^*}{d\overline{w}} = \underbrace{-\frac{p'(X^*)(x^*)^2}{D_{\overline{w}}}}_{>0} \frac{\eta}{n^*}, \tag{27}$$

$$\frac{dn^*}{d\overline{w}} = \underbrace{\frac{p'(X^*)x^*}{D_{\overline{w}}}}_{<0} (2 + \eta), \tag{28}$$

$$\frac{dX^*}{d\overline{w}} = \frac{2p'(X^*)(x^*)^2}{D_{\overline{w}}} < 0, \tag{29}$$

with $D_{\overline{w}} = B_x C_n - B_n C_x = [p'(X^*)]^2 (x^*)^2 [2n^* + \eta]/n^*$ denoting the determinant of the system of Eqs. (17) and (18). The determinant is positive due to the second-order condition for a profit maximum (15).

This leads to the following Proposition:

Proposition 1 *A necessary condition for an increase in the wage rate (or equivalently in the union's bargaining power) to raise welfare is that a wage increase deters entry, that is $\eta > -2$ must hold.*

Proof 1 *see* (24), (28), (29) *and* (26).

[11] As shown in Appendix A.2, the assumption $dW_0/d\overline{w} = 0$ is not essential for the derivation of the welfare effect of a wage increase.

It is evident from (29) that aggregate output unambiguously decreases in wages which, c.p., reduces welfare. If the number of firms would additionally increase with wages, welfare would certainly decline because of higher entry costs. If, however, a wage increase deters entry, welfare, c.p., increases because entry costs can be saved. The sign of $dV/d\overline{w}$ is then parameter-dependent. In the following, we restrict our analysis to situations in which wage hikes deter entry, i.e. $dn^*/d\overline{w} < 0$, and presume $\eta > -2$.

As a result, welfare increases in wages if and only if savings in market entry costs are sufficiently strong such that they outweigh the reduction of aggregate output. The next Proposition formalizes this requirement:

Proposition 2 *An increase in the wage rate (or equivalently in the union's bargaining power) raises welfare if and only if* $2\left(x^*p(X^*) - k\right) - \eta k < 0$. *A necessary but not a sufficient condition for that is* $\eta > 0$, *i.e., that the inverse demand curve is strictly concave.*

Proof 2 *Inserting* (28) *and* (29) *into* (26) *as well as using* (3) *yields:*

$$\frac{dV^*}{d\overline{w}} = \frac{p'(X^*)x^*}{D_{\overline{w}}}\left[2\left(x^*p(X^*) - k\right) - \eta k\right], \tag{30}$$

where $x^*p(X^*) - k > 0$ *holds because of free entry.*

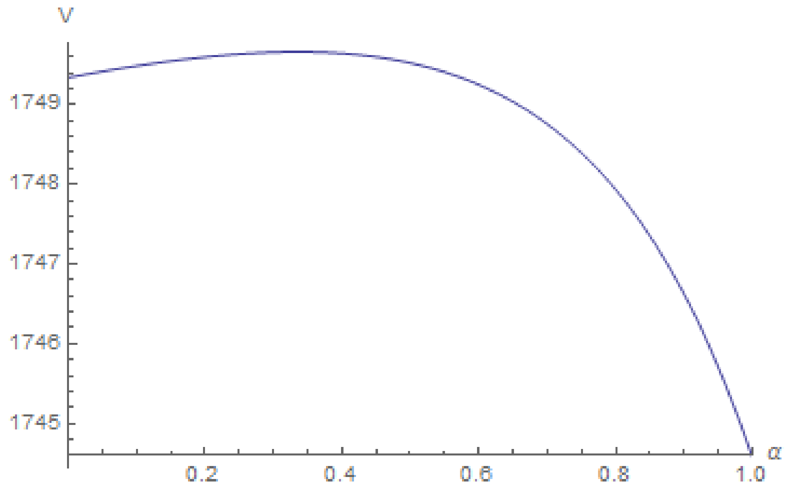
To provide an intuition, note that higher wages c.p. increase labor costs and, hence, reduce profits. As a consequence, the number of firms n^* declines. Note further that irrespective of the elasticity of the slope of the inverse demand curve, aggregate output goes down. The strength of the former effect, i.e. of deterring entry, depends on the costs of entry, k. The larger these costs are, the greater will be the welfare gain of a given reduction in the number of firms. The strength of the latter effect, i.e. the decline in aggregate output, crucially depends on the elasticity of the slope of the inverse demand curve η. From (29), we find that the decline in X^*, owing to a higher wage, will be the smaller the larger is η. This is because lower competition raises prices relatively strongly in this case and, hence, output per firm increases.[12] The less pronounced the fall in aggregate output is, the smaller will be the decline in welfare because of higher wages. Hence, a welfare-enhancing effect is more likely to occur the higher k and η are.

[12]Note that output per firm is influenced by two countervailing effects. On the one hand, a wage increase enhances marginal costs and output per firm goes down. On the other hand, the number of firms decline in $\overline{w}$ such that competition becomes less intensive. Consequently, prices rise, marginal revenue and hence output per firm increase.

In a further step, we solve our model numerically. To that end, we follow Roitman (2011) and assume that the sub-utility function is given by: $u = 200X - X^3/3$. For appropriate values of X, we thus have $\eta > 0$ such that a welfare-enhancing effect is possible. Assuming $\Theta = 10$, $W_0 = 1$ and $k = 4$ yields:[13]

Corollary 1 *An increase in the union's bargaining power enhances welfare, i.e. $dV^*/d\alpha > 0$, if $\alpha < \alpha^{crit}$. Given our numerical example, we find that $\alpha^{crit} = 0.34$ (see Figure 1).*

Figure 1: Welfare and Bargaining Power



As a result, the relationship between the union's bargaining power and welfare is hump-shaped. This is similar to the finding of Calmfors and Driffill (1988) who derive such a relationship between the bargaining level and unemployment. Note, however, that we consider only firm-level negotiations, but vary the bargaining power of firm-specific unions, an issue not looked at by Calmfors and Driffill (1988).

Finally, we also consider the case of efficient bargaining. As shown in Appendix A.3, Nash-bargaining over wages *and* output leads to results that are qualitatively identical to bargaining over wages alone. In particular, the welfare-enhancing effect of trade unions requires $\eta > 0$ and is more likely the higher k and η are.

[13]Simulations are available upon request. The results are robust to alterations of the values of Θ, W_0 and k.

4 Excess Entry Theorem and Trade Unions

In a world with competitive input markets, there will be excessive entry only if there is a business stealing effect, i.e. if output per firm declines with the number of competitors (see Amir et al., 2014). In our model, however, labor markets are imperfect due to collective wage bargaining and it is thus a priori questionable whether business stealing remains a sufficient condition for excessive entry.

In order to analyze this point, we consider how an exogenous increase in the number of firms, denoted by $\overline{n}$, alters output per firm and welfare if there is wage bargaining. We focus on a second-best outcome and assume that welfare V as defined by (23) can be maximized, e.g. by a social planner, solely with regard to the number of firms. As before, firms decide about output while wages are the outcome of Nash-bargaining, where the equilibrium levels of w^* and x^* are given by (16) and (17).

This yields the second-best optimal number of firms, $\overline{n}^{**}$:

$$\frac{dV}{d\overline{n}} = u'\left(X(\overline{n}^{**})\right)\left[x^*(\overline{n}^{**}) + \overline{n}^{**}\frac{dx^*}{d\overline{n}}\right] - k = 0. \tag{31}$$

Evaluating (31) at $\overline{n}^{**} = n^*$ as well as using (18) and $p(X^*) = u'(X^*)$, we obtain:

$$\frac{dV}{d\overline{n}}_{\overline{n}^{**}=n^*} \equiv \hat{V} = p\left(X^*\right) n^* \frac{dx^*}{d\overline{n}} + w^* x^*, \tag{32}$$

where $dx^*/d\overline{n}$ describes the business stealing effect. If $\hat{V} < 0$ and utility V is strictly concave in n, there is excessive entry, i.e. the number of firms entering sector 1 in market equilibrium, n^*, exceeds the second-best, welfare-maximizing optimal number. This yields.

Proposition 3 *In the presence of wage payments (and thus also in the presence of trade unions), the existence of a business stealing effect is a necessary but not a sufficient condition for excessive entry.*

Proof 3 *see* (32).

To illustrate Proposition 3, suppose that labor is not required as input such that firms do not incur wage payments. In such a setting, excessive entry will occur if and only if there is business stealing. Each entrant does not take into account the negative output and profit effect occurring in other firms, i.e. ignores a negative externality. If production costs do not directly reduce welfare, because they raise the income of consumers, there is a further externality. Each firm which enters the market is less likely to do so the higher wages are. Thus, labor costs c.p. mitigate entry. From a welfare perspective wages are, however, irrelevant. This implies that entry features a positive income externality ignored by firms. A trade union which raises wages above the competitive level strengthens this positive welfare effect. Consequently, the existence of a negative business stealing externality does not guarantee excessive entry.

Proposition 3 can be compared to the findings derived by Ghosh and Morita (2007b). They show that if there is efficient bargaining between an upstream and a downstream firm which both maximize profits, there will be insufficient (excessive) entry if the upstream firm has full (no) bargaining power. This prediction differs from our findings in that insufficient entry can already arise if the trade union has (virtually) no bargaining power. Wage payments always reduce the incentives to enter the market because they reduce profits. However, they do not lower welfare since they represent a redistribution of income. This entry effect of wages becomes more pronounced the higher wages are on account of collective bargaining. This cost effect will be different if the upstream firm's production costs directly lower welfare, as in Ghosh and Morita (2007b). Moreover, in our setting entry may still be excessive if the trade union is endowed with maximum bargaining power, i.e. in a monopoly union model. This also in contrast to the finding by Ghosh and Morita (2007b) because the maximum wage a trade union will desire in a right-to-manage model is determined by the slope of the labor demand curve, inter alia, and not a zero-profit level. Finally, our analysis in Section 3 clarifies that excessive or insufficient entry in a world with trade unions is not tantamount to a statement about their welfare effects.

5 Conclusion

In this paper, we analyze a model with oligopolistic competition and costly market entry. In such setting, there can be excessive entry if output per firm declines with the number of competitors, i.e. if there is a business stealing effect. The excessive entry prediction has usually been derived, assuming perfectly competitive input markets. We extend this setting and introduce imperfections in the labor market by assuming that wages (and potentially employment) are negotiated by firms and firm-specific trade unions.

As our main result, we find that trade unions can deter entry and may thus raise welfare. Such a welfare-enhancing effect of trade unions is more likely to occur the larger market entry costs are and the smaller the reduction in aggregate output due to the wage increase is. In addition, we show that excessive entry need not arise even in the presence of a business stealing externality. This is the case because wage payments reduce profits and, hence, make entry less attractive. Since trade unions cause the wage to rise, this positive externality surely mitigates and may even dominate the negative externality due to business stealing.

Our paper also contributes to the series of studies that investigate how robust the excessive entry prediction is. Mostly, these analyses focus on alternative assumptions with regard to the output but not with respect to the input market. Despite the relative neglect of input markets, we believe that our analysis has wider implications. First, while the robustness of the excess entry theorem has been looked at from a variety of perspectives, the implications of non-competitive input markets and of the assumption that production costs constitute welfare losses need to be considered more intensively. Second, trade unions are often viewed as institutions which cause inefficiencies or exploit them to the advantage of their members. We adopt an alternative perspective and show that one inefficiency can counteract the effects of another, such that trade unions may be welfare-enhancing. Third, if output and input market imperfections interact, industrial and labor market policies should not be based on the analysis of only one type of deviation from the competitive benchmark.

A Appendix

A.1 Stability of the Equilibrium

To ensure that the equilibrium is well-behaved and stable, profits have to decline in the number of firms operating in the market. In order to analyze under which conditions this restriction is fulfilled, we vary the number of firms exogenously and calculate $d\pi/d\overline{n}$, where $\overline{n}$ denotes the exogenously given number of firms.

This approach implies that only the wage rate w and output per firm x are determined endogenously according to Eqs. (16) and (17). The determinant of this reduced system of Eqs. is given by $D_{\overline{n}} = A_x B_w - A_w B_x$. Inserting the respective terms yields:

$$D_{\overline{n}} = -\left[(1-\alpha)(w-1) + \alpha k \mu_x\right] - \left[(1-\alpha)x + \alpha k \mu_w\right] p'(X)(1+n+\eta). \quad \text{(A.1)}$$

If labor markets are not unionized, i.e. $\alpha = 0$, stability of the equilibrium requires $1 + n + \eta > 0$ (see Seade, 1980), which in turn implies that the determinant is positive. We suppose that wage negotiations do not give rise to instability and assume $D_{\overline{n}} > 0$.

Differentiating (1) with respect to $\overline{n}$ yields:

$$\frac{d\pi}{d\overline{n}} = \underbrace{C_n}_{<0} + \underbrace{C_x}_{<0} \frac{dx}{d\overline{n}} + C_w \frac{dw}{w\overline{n}}. \tag{A.2}$$

The effect of a variation in the number of firms on x and w can be calculated as:

$$\frac{dx}{d\overline{n}} = \frac{A_w B_n}{D_{\overline{n}}}, \tag{A.3}$$

$$\frac{dw}{d\overline{n}} = -\frac{A_x B_n}{D_{\overline{n}}}. \tag{A.4}$$

Inserting (A.3) and (A.4) into (A.2), rearranging as well as observing the definition of the determinant D, we obtain:

$$\frac{d\pi}{d\overline{n}} = -\frac{D}{D_{\overline{n}}}. \tag{A.5}$$

Given $D_{\overline{n}} > 0$, profits decline in $\overline{n}$ if and only if $D > 0$. This proves the claim in the main text (see Section 2.3).

A.2 Welfare Effect and Changes in W_0

Suppose that the representative consumer is endowed with L labor units. Total wage income in sector 0 is then given by:

$$W_0^* = L - X^*. \tag{A.6}$$

Welfare (23) can thus be rewritten as:

$$V^* = u(X^*) - n^*k + L - X^* + \Theta. \tag{A.7}$$

Differentiating (A.7) with respect to $\overline{w}$ yields:

$$\frac{dV}{d\overline{w}} = (u'(X^*) - 1) \underbrace{\left[\frac{dx^*}{d\overline{w}} n^* + x^* \frac{dn^*}{d\overline{w}}\right]}_{dX^*/d\overline{w}} - \frac{dn^*}{d\overline{w}} k. \tag{A.8}$$

This shows that the welfare effect of an increasing wage with $dW_0/d\overline{w} \neq 0$ is qualitatively identical to the one described by Eq. (26) as long as $u'(X^*) > 1$. This inequality holds in our setting because (i) the zero profit condition requires $p(X) > w$, (ii) the union's gain from bargaining will only be positive if $w > 1$, and (iii) $u'(X) = p(X)$ holds [see (3)].

A.3 Efficient Bargaining

Maximizing (10) with respect to x^{eff} and w^{eff}, where the superscript eff indicates the equilibrium outcomes of efficient bargaining, yields:

$$A^{eff} = \alpha p(X^{eff}) + 1 - \alpha - w^{eff} = 0, \tag{A.9}$$

$$B^{eff} = p'(X^{eff})x^{eff} + p(X^{eff}) - 1 = 0. \tag{A.10}$$

Differentiating (A.9), (A.10) and (18) with respect to α yields:

$$\frac{dx^{eff}}{d\alpha} = \underbrace{\frac{p'(X^{eff})(x^{eff})^2}{n^{eff}D^{eff}}}_{>0} \underbrace{A_\alpha^{eff}}_{>0}(\eta + n^{eff}), \tag{A.11}$$

$$\frac{dn^{eff}}{d\alpha} = -\underbrace{\frac{A_\alpha^{eff}p'(X^{eff})x^{eff}}{D^{eff}}}_{>0}\underbrace{(1 + n^{eff} + \eta)}_{>0} < 0, \tag{A.12}$$

$$\frac{dX^{eff}}{d\alpha} = -\underbrace{\frac{A_\alpha^{eff}p'(X^{eff})(x^{eff})^2}{D^{eff}}}_{>0} < 0. \tag{A.13}$$

Note that $D^{eff} < 0$ holds such that the stability of the equilibrium is guaranteed. Inserting (A.12) and (A.13) into $dV^{eff}/d\alpha$, we can calculate the welfare-effect of an increase in union's bargaining power as:

$$\frac{dV^{eff}}{d\alpha} = -\underbrace{\frac{A_\alpha^{eff}u''(X^{eff})x^{eff}}{D^{eff}}}_{>0}(2w^{eff}x^{eff} - k\eta), \tag{A.14}$$

which shows that the welfare-enhancing effect of trade unions requires $\eta > 0$ and is more likely the higher k and η are.

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