
WORKING PAPER

Kjell Erik Lommerud
Frode Meland
Odd Rune Straume

**“International outsourcing and
trade union (de-)centralisation”**

<https://www.eeg.uminho.pt/pt/investigar/nipe>

International outsourcing and trade union (de-)centralisation*

Kjell Erik Lommerud[†] Frode Meland[‡] Odd Rune Straume[§]

September 2019

Abstract

We study the effects of centralised versus decentralised wage setting in a unionised duopoly where firms can outsource parts of input production to foreign subcontractors. We show that decentralised (as opposed to centralised) wage setting allows trade unions to capture a larger share of the rents generated by international outsourcing. Consequently, the equilibrium degree of outsourcing is lower under decentralised wage setting, which benefits unions if they are sufficiently employment oriented. We identify situations in which both firms and unions prefer decentralised over centralised wage setting. Thus, international outsourcing opportunities is a potential driver of trade union decentralisation.

Keywords: Outsourcing; trade unions; decentralisation.

JEL Classification: F16; J51; L24.

*We thank Akihiko Yanase for valuable comments. This paper is financed by National Funds of the FCT – Portuguese Foundation for Science and Technology within the project "UID/ECO/03182/2019".

[†]Department of Economics, University of Bergen, Postboks 7800, 5020 Bergen, Norway. E-mail: kjell-erik.lommerud@uib.no

[‡]Corresponding author. Department of Economics, University of Bergen, Postboks 7800, 5020 Bergen, Norway. E-mail: frode.meland@uib.no

[§]Department of Economics/NIPE, School of Economics and Management, University of Minho, Campus de Gualtar, 4710-057 Braga, Portugal; and Department of Economics, University of Bergen, Norway. E-mail: o.r.straume@eeg.uminho.pt

1 Introduction

Trade unions are waning in importance across the Western world. Membership rates are down, the fraction of workers covered by unionised agreements also. Not only is there a tendency towards deunionisation, but union wage settlements tend to be less centralised than before. Government interference with wage settlements is also dwindling. Documentation of these facts can be found in EEAG (2004) and OECD (1997); for more recent figures, see Krusell and Rudanko (2016). Without necessarily implying causality, all these developments have gone hand in hand with increased globalisation.

This paper studies theoretically the possible impacts of outsourcing possibilities on wages and employment in a unionised economy, with special emphasis on the degree of centralisation of the bargaining system. On the question of union centralisation, Calmfors and Driffill (1988) is perhaps the most influential paper. Their main point is that a central union will internalise many possible externalities in wage setting, simply because most of the working population will be members. Such a central union will therefore try to avoid large-scale inefficiencies and unemployment as results of the presence of union power. While Calmfors and Driffill focus on centralisation to the national level, which now has become rare, centralisation to the industry level can in a similar way internalise externalities inside an industry. However, we find that favorable results may prevail precisely when workers in one firm *do not* consider how their actions impact workers of other firms. Decentralisation can then be advantageous – to workers and firms alike.

We use a model where production takes place in a global value chain, where a series of complementary tasks can be outsourced to a low-cost country. Under the assumption that it is too costly to outsource all tasks, a union will respond to increased outsourcing by enforcing a higher wage for the workers performing the tasks that remain in the host country. With decentralised bargaining, unions will not coordinate their wage setting, so one union will not take into account the effects of its wage policy on other unionised workers. We show that this means that the wage increase following outsourcing will be even higher than in the centralised case. The firms, then, will know that a high degree of outsourcing can make the production that is not so easy to move, more expensive. The wage increase effect therefore deters outsourcing. If the union is sufficiently employment-oriented, this means that decentralisation betters the situation for the unions. Whether or not firms prefer decentralised bargaining will be discussed in the paper, but one argument in favour of decentralisation from a firm’s viewpoint is that union rent extraction (for a given level of outsourcing) is

less. We show that there exists parameter sets where decentralisation is preferred by all involved parties, unions and firms alike.

A driving assumption is precisely that production takes place in a multi-stage process, where the individual tasks and production processes stand in a complementary relationship to each other. In international economics, the idea of global value chains and multi-stage production is much used; see, among many others, Dixit and Grossman (1982), Autor et al. (2003), Acemoglu and Autor (2011), Grossman and Rossi-Hansberg (2008), and Antras and Chor (2013). In the context of trade unions and globalisation the notion appears new, with Skaksen and Sørensen (2001) and Lommerud et al. (2009) as exceptions. An alternative way to depict outsourcing is that a producer owns a series of plants that produce final goods. The production at one plant can substitute for production from other plants. This is the set-up for example in Lommerud et al. (2003) and Lommerud et al. (2012). Then outsourcing will mean that a substitute producer becomes cheaper, so the remaining workers in the home country will not be in a position to raise wages in the aftermath of outsourcing.^{1,2}

Little empirical work exists on the effect of trade unions and outsourcing decisions. We would like to mention Dekker and Koster (2018). They find indications that higher worker power is associated with more outsourcing. However, the analysis is conducted at a rather aggregate level, so it is hard to discern for example what type of bargaining structures the various countries have, or if we are talking about offshoring of tasks in a global production chain or, alternatively, moving the whole production abroad. We would also like to mention Sethupathy (2013). He studies outsourcing from the United States to Mexico, and uses two events of new outsourcing possibilities opening up as natural experiments. US firms likely to take up these new opportunities actually experience higher wages at home. Of course, private sector unionism in the US is in a sorry state, but there could be other mechanisms through which the retained workers at home secure higher wages, given that their strategic position has improved with more outsourcing.

We would like to draw attention to yet another assumption that underlies the analysis. We assume that the degree to which a union cares more for employment or for wages is exogenous

¹There are links between the literature on unions and outsourcing on one hand and unions and innovation on the other. Haucap and Wey (2004), Calabuig and Gonzalez-Maestre (2002) and Mukherjee and Pennings (2011) all study unions, innovation and the degree of (de-)centralisation of bargaining. There are ample differences in model assumptions between this body of work and the present paper, and the research questions raised are also quite different.

²There is a large and varied literature on union wages and globalisation and the organisation of global firms. We mention Carluccio and Bas (2015), Davidson et al. (2014), Egger et al. (2015), Jeon and Kwon (2018), Naylor (1998, 1999) and Sly and Soderberry (2014).

and uninfluenced by whether bargaining is centralised or not. Economists have traditionally not focussed much on how union preferences are formed. Nevertheless, the degree of wage-orientation versus employment-orientation is often crucial both for predictions about how a union will behave and how a given outcome is to be evaluated seen from the union's point of view. For example, Chu et al. (2016) predict that an increase in bargaining power of a trade union will lead to less employment, less innovation and lower economic growth – and that innovation is directed towards a foreign country. However, all of this builds on an assumption that unions are wage-oriented. Oppositely, the beneficial effects of decentralisation of bargaining in the face of possible outsourcing, found in our work, build on unions being relatively employment-oriented. If outsourcing were to take place, wages for the retained workers would go up, which deters outsourcing. In turn, this implies that jobs are saved, but wages go up to a lesser degree. This is attractive to an employment-oriented union.

Are trade unions bad or good for an economy? Market power in the labor market is, of course, a deviation from the competitive model – and efficiency losses are to be expected, although the redistribution effects can be seen as positive. However, this does not tally well with the fact that many economies in Northern Europe both are characterised by high incomes and high productivity – and trade unions that are still relatively strong. Especially in the Swedish trade union movement there is a close to hundred years old argument that strong unions can move the economy towards more rapid structural change and innovation (see for example Agell and Lommerud, 1993, 1997; Moene and Wallerstein, 1997; Lommerud and Straume, 2012; and De Pinto and Lingen, forthcoming). Our analysis is partly in concordance with this positive view of trade unionism. True, we have not incorporated any reason why trade unions may bring about efficiency gains. In our framework, if trade unions were absent, wages would be driven down to the outside option of workers and outsourcing would take place according to an efficient comparison of workers' outside wage and the cost of producing abroad. Nevertheless, our model framework does signify, given unionised bargaining, that more powerful unions deter international outsourcing and keep jobs in the national economy. Strong unions are often seen in conjunction with centralised bargaining – and trade unionised involvement in wage setting now occurs more and more at decentralised levels. But our main and hopefully surprising result is that decentralisation can be a sound response to globalisation of production. For any given level of union power, the job-saving effect of unions is stronger in a decentralised bargaining structure.

Finally, note that what the model depicts is not a picture of globalisation and employers forcing more decentralised solutions upon unions. Rather, firms face cheaper outsourcing possibilities, and it can be a rational adaptation to this from both parties to allow more outsourcing and at the same time to introduce more decentralised modes of bargaining.

2 Model and analysis

Consider a Cournot duopoly market for a homogeneous good with inverse demand given by

$$p = a - b \sum_{i=1}^2 q_i, \quad (1)$$

where q_i is output by Firm i . Each firm produces the final good by using a continuum of perfectly complementary inputs with total measure equal to one. All these inputs can be produced in-house using unionised labour in a one-to-one technology.³ However, each of these inputs can also be bought from a foreign supplier at a unit cost c , which is equal for all outsourced inputs. If Firm i outsources the production of α_i inputs, gross profits are given by

$$\pi_i = (p - \alpha_i c - (1 - \alpha_i) w_i) q_i, \quad (2)$$

where w_i is the wage rate that Firm i must pay per unit of in-house production. We assume that the outsourcing of each input is associated with a fixed cost, which varies across different inputs. If we order the inputs according to the size of the outsourcing cost (from lowest to highest), the fixed cost of outsourcing α_i inputs is given by an increasing and strictly convex cost function $K(\alpha_i)$. Net profits of Firm i are then given by

$$\Pi_i = \pi_i - K(\alpha_i). \quad (3)$$

Domestic workers are organised in trade unions. We assume that the aggregate utility of the trade union members from which Firm i recruits its workers, is given by the following Stone-Geary utility function:

$$U_i = (w_i - \bar{w})^\theta L_i, \quad (4)$$

³Note that all workers are seen as identical. Had they not been, it could have been that the more skilled workers were less prone to lose their jobs to outsourcing. Questions about skill premia and deunionisation would then become relevant (Açikgöz and Kaymak, 2014).

where \bar{w} is the workers' reservation wage, L_i is the number of workers employed by Firm i , and $\theta > 0$ is a parameter measuring the degree to which trade union members value wages over employment; i.e., the *wage orientation* of the trade union. Recall that Firm i 's labour demand is

$$L_i = (1 - \alpha_i) q_i. \tag{5}$$

It is easily shown that a necessary condition for outsourcing to be profitable is $c < \bar{w}$. Thus, without much loss of generality, we simplify the analysis by setting $c = 0$, which implies that \bar{w} also measures the potential profitability of outsourcing (all else equal). In order to ensure that both firms have positive output in the Cournot subgame, for all possible outsourcing configurations and for all $\theta \geq 0$, we assume that $\bar{w} < \frac{a}{2}$.

For analytical simplicity, we adopt a monopoly union model where we give the trade unions the power to unilaterally set the wage at each firm.⁴ However, there are two potential wage setting regimes: *centralised* or *decentralised* wage setting. Under decentralised wage setting, each firm's trade union sets the wage that maximises its utility function without taking into account the utility of workers at the other firm. In contrast, under centralised wage setting, a uniform (industry-wide) wage is set by a union representative who maximises the aggregate utility of both trade unions.

We consider the following three-stage game:

1. The two firms simultaneously and non-cooperatively decide how much of their production that is outsourced to foreign subcontractors.
2. Wages are set, either by both trade unions simultaneously and non-cooperatively (decentralised wage setting) or by a single agent representing both trade unions (centralised wage setting).
3. The two firms simultaneously and non-cooperatively decide how much to produce.

The above-described order of events relies on an implicit assumption that the outsourcing decision should be seen as a relatively inflexible investment decision, implying that the unions cannot credibly commit to a particular wage level prior to this decision. As usual, we solve the game by backwards induction, looking for a subgame perfect Nash equilibrium (SPNE). Since,

⁴In Section 3 we explain how our main results would be affected if wages were determined by Nash bargaining between firms and unions.

by assumption, the outsourcing cost function is identical for both firms, this equilibrium will be symmetric. We also assume that the characteristics of the outsourcing cost function are such that the equilibrium has an interior solution, where some, but not all, production is outsourced.

2.1 Wage responses to outsourcing

If we denote the marginal cost of Firm i by $\sigma_i := \alpha_i c + (1 - \alpha_i) w_i$, the Nash equilibrium in the third-stage Cournot game is given by the following familiar expression:

$$q_i = \frac{a - 2\sigma_i + \sigma_j}{3b}; \quad i, j = 1, 2; \quad i \neq j. \quad (6)$$

The parameters σ_i and σ_j depend both on the firms' outsourcing decisions and on the wage setting regime. In the following we will present the optimal wage setting under each of the two wage setting regimes.

2.1.1 Decentralised wage setting

Under decentralised wage setting, the trade unions set firm-specific wages in a context where they compete with each other for labour demand. For a given outsourcing configuration, equilibrium wages are given by

$$w_i^d(\alpha_i, \alpha_j) = \frac{(3\theta + 2)(\theta a + 2\bar{w}) - 2(2\alpha_i(\theta + 1) + \alpha_j\theta)\bar{w}}{(1 - \alpha_i)(\theta + 2)(3\theta + 2)}; \quad i, j = 1, 2; \quad i \neq j. \quad (7)$$

The effects of outsourcing on equilibrium wages when these are decided at firm level, are the following:⁵

Lemma 1 *An increase in outsourcing by Firm i leads to an increase in w_i and a reduction in w_j .*

More outsourcing leads to higher wages for the remaining workers of the outsourcing firm, a result that is equivalent to Proposition 1 in Lommerud et al. (2009). In the present model, there are two effects contributing to this result. First, partial outsourcing of complementary input production implies that marginal production costs are partly 'exogenised', which makes domestic labour demand less wage elastic. Aggregate trade union utility is consequently maximised at a higher wage level. This is the sole effect that drives the result in Lommerud et al. (2009). However,

⁵Proofs of all Lemmas and Propositions can be found in Appendix A2.

when there is product market competition between firms, and therefore, indirectly, competition between firm-specific trade unions, wages respond positively to outsourcing also for a second reason. Increased outsourcing by Firm i implies lower marginal cost, which improves the firm's competitive position vis-à-vis Firm j . Therefore, the direct domestic employment loss of more outsourcing is compensated by a capture of market share from the competing firm, which, all else equal, leads to higher, and thus less elastic, labour demand by Firm i . In sum, these two effects imply that increased outsourcing by one firm gives that firm's trade union a stronger incentive to increase wages.

However, the second of the two above described effects imply that, under decentralised wage setting, the wage responses to increased outsourcing by Firm i are markedly different for Firm i and Firm j . Higher outsourcing by Firm i implies that the trade union of Firm j has an incentive to reduce its wage claims, because labour demand from this firm drops as a result of a worsening of its competitive position.

It follows from the above analysis and discussion that the effect of (partial) outsourcing as an instrument to reduce marginal production costs is partly counteracted by union wage responses. The strength of this counteracting effect depends on how wage oriented unions are. This can be seen by considering the effect of outsourcing on marginal production costs, which is given by

$$\frac{\partial \sigma_i^d}{\partial \alpha_i} = -\frac{4(\theta + 1)\bar{w}}{(\theta + 2)(3\theta + 2)}. \quad (8)$$

It is easily confirmed that the cost-reducing effect of outsourcing is smaller when unions are more wage oriented,⁶ and eventually vanishes in the extreme case where unions care only about wages.⁷

⁶From (8):

$$\frac{\partial \left(\left| \frac{\partial \sigma_i^d}{\partial \alpha_i} \right| \right)}{\partial \theta} = -\frac{4(6\theta + 3\theta^2 + 4)\bar{w}}{(\theta + 2)^2(3\theta + 2)^2} < 0.$$

⁷From (8):

$$\lim_{\theta \rightarrow \infty} \left(\left| \frac{\partial \sigma_i^d}{\partial \alpha_i} \right| \right) = 0.$$

2.1.2 Centralised wage setting

Under centralised wage setting, a uniform wage w is set by a single agent representing all workers in the industry.⁸ For a given outsourcing configuration, the optimal wage is given by

$$w^c(\alpha_i, \alpha_j) = \frac{\bar{w}}{\theta + 1} + \frac{a\theta(2 - \alpha_i - \alpha_j)}{2(\theta + 1)(1 - \alpha_i - \alpha_j + \alpha_i^2 + \alpha_j^2 - \alpha_i\alpha_j)}. \quad (9)$$

The effect of outsourcing on centralised wage setting is given as follows:

Lemma 2 (i) *A marginal increase in outsourcing by Firm i will lead to a wage increase unless Firm i has already outsourced sufficiently much more than Firm j .* (ii) *For any symmetric outsourcing configuration (i.e., $\alpha_i = \alpha_j$), the wage response to a marginal increase in outsourcing by Firm i is always smaller under centralised than under decentralised wage setting.*

Under centralised wage setting, the wage response to a unilateral increase in outsourcing by Firm i is determined by the following trade-off: On the one hand, the fact that labour demand from Firm i becomes less elastic gives an incentive to increase the wage. On the other hand, because of the relative improvement in the competitive position of Firm i (because of lower marginal costs), labour demand from Firm j becomes *more* elastic and therefore gives the union representative an incentive to *reduce* the wage. The former effect dominates, leading to a positive wage response, if the relative competitiveness of Firm i is not too strong; i.e, if α_i is not too high relative to α_j .

The second part of Lemma 2 describes a key mechanism of the model. Because centralised wage setting implies that the union representative's trade-off between wages and employment takes the interest of all workers into account, the wage response to outsourcing is smaller than if wages are set at firm level. In the former case, the incentive to dampen the loss of employment in Firm j restricts the wage increase when Firm i outsources more production.

2.2 Outsourcing decisions

At the first stage of the game, the two firms simultaneously and non-cooperatively choose the degree of outsourcing. When making this decision, each firm anticipates the subsequent wage responses, which depend on the existing wage setting regime, as we have shown above. Let the outsourcing decisions in the symmetric Nash equilibrium under centralised and decentralised wage

⁸Thus, under centralised wage setting, w is set to maximise $\sum_{i=1}^2 U_i(w) = (w - \bar{w})^\theta \sum_{i=1}^2 L_i(w)$.

setting, respectively, be given by $\alpha_i = \alpha_j = \alpha^c$ and $\alpha_i = \alpha_j = \alpha^d$. As previously mentioned, we assume that the characteristics of the outsourcing cost function is such that both α^c and α^d are interior solutions; i.e., $\alpha^c \in (0, 1)$ and $\alpha^d \in (0, 1)$. This gives the following equilibrium wages under the two different wage setting regimes:⁹

$$w^d(\alpha^d) = \frac{\theta a + 2(1 - \alpha^d)\bar{w}}{(1 - \alpha^d)(\theta + 2)}, \quad (10)$$

$$w^c(\alpha^c) = \frac{\theta a + (1 - \alpha^c)\bar{w}}{(1 - \alpha^c)(\theta + 1)} \quad (11)$$

The following proposition describes the effect of wage setting regime on equilibrium outsourcing:

Proposition 1 *Equilibrium outsourcing is always higher under centralised than under decentralised wage setting; i.e., $\alpha^c > \alpha^d$.*

In other words, decentralised wage setting dampens the firms' incentives for outsourcing. The reason is clearly related to the differences in the unions' wage responses to outsourcing under the two wage setting regimes, as shown by Lemmas 1 and 2. Under decentralised wage setting, there are two effects that make it less attractive to outsource more production: (i) the outsourcing firm's wage increases more, as indicated by the second part of Lemma 2, and (ii) the wage of the competing firm falls, which, in itself, worsens the competitive position of the outsourcing firm, as indicated by Lemma 1.

2.3 Union and firm preferences for wage setting regimes

For a given outsourcing configuration, firms and trade unions have clearly conflicting interests regarding the choice of wage setting regime. Decentralised wage setting implies competition between trade unions which erodes union rents and boosts profits. This competition is eliminated if wage setting is centralised. Thus, all else equal, firms (unions) prefer decentralised (centralised) wage setting.

However, in our setting, all else is not equal. As previously shown, decentralised wage setting dampens outsourcing incentives and might therefore affect preferences for wage setting regimes – for trade unions as well as firms. In order to detail the trade-offs involved, it is instructive first to look at how outsourcing affects union utility for a given wage setting regime.

⁹The expressions for equilibrium profits and union utility under each of the two wage setting regimes are given in Appendix A1.

Lemma 3 *Regardless of whether wage setting is centralised or decentralised: (i) rent-maximising or wage-oriented trade unions always prefer more outsourcing; (ii) trade unions always prefer less outsourcing if they are sufficiently employment oriented.*

Whether outsourcing is beneficial or not for the trade unions essentially boils down to a trade off between wages and employment. On the one hand, partial outsourcing leads to a loss of employment. On the other hand, the remaining domestic workers obtain higher wages. Intuitively, the wage increase more than compensates for the employment loss if the trade unions are sufficiently wage-oriented. In fact, Lemma 3 confirms that this is the case even for rent-maximising unions, the reason being that outsourcing increases total industry rents (as long as $\bar{w} > 0$) without affecting the ability of the trade unions to capture parts of these rents. Thus, a necessary (and sufficient) condition for outsourcing to have a negative effect on union utility is that the wage preference parameter θ is sufficiently below one.

The results in Lemma 3 imply that trade unions might potentially benefit from decentralised wage setting if they are sufficiently employment oriented. This will be the case if the benefits from less outsourcing outweigh the costs of less wage coordination. The next proposition confirms the existence of such cases and provides more specific conditions.

Proposition 2 *Trade unions prefer decentralised over centralised wage setting if two conditions are satisfied: (i) they are sufficiently employment oriented, and (ii) the difference in equilibrium outsourcing between the two wage setting regimes is sufficiently large.*

Whereas the firms always prefer decentralised wage setting for a given level of outsourcing, this might not be the case when the degree of outsourcing is endogenised. On the one hand, decentralisation implies less union rent extraction for a given outsourcing level; on the other hand, decentralisation implies larger union extraction of outsourcing rents, leading to less outsourcing in equilibrium. *A priori*, it is not obvious that the first effect dominates. In other words, it is not obvious whether firms and trade unions have coinciding or conflicting interests with respect to wage setting regimes. However, the next proposition confirms the existence of a parameter set for which the interests of firms and trade unions actually coincide.

Proposition 3 *If trade unions are sufficiently employment oriented, there exists a parameter set for which all parties (firms and trade unions) prefer decentralised over centralised wage setting.*

The proof of this proposition (see Appendix A2) provides sufficient conditions for this parameter set to exist. If these conditions are satisfied, an obvious implication of Proposition 3 is that, under any reasonable set of decision rules, decentralised bargaining will be an equilibrium outcome of an extended game in which the wage setting regime is endogenised.

We can illustrate the general result of Proposition 3 by considering the following specific example:

Example 1 Suppose that $a = 4$, $\bar{w} = 1$, $\theta = 1/4$ and $b = 1$. Suppose also that the outsourcing cost function is given by $K(\alpha_i) = k\alpha_i + (\kappa\alpha_i^2)/2$, where $k = 2^7 (19/3^5 11) \approx 0.91$. With decentralised wage setting, equilibrium outsourcing is given by $\alpha^d = 0$, whereas, under centralised wage setting, equilibrium outsourcing is given by¹⁰

$$\alpha^c = \frac{5(13\,365\kappa - 7408) - 297\sqrt{\frac{4336\,601\,344}{88\,209} + \frac{25}{33}\kappa(66\,825\kappa - 230\,048)}}{594(225\kappa - 64)}.$$

This is an interior solution equilibrium ($\alpha^c < 1$) if $\kappa > 64\sqrt{11}\sqrt{2437}/7425 + 115\,024/66\,825 \approx 3.1325$.

Table 1 shows the relative gain of centralised wage setting for firms and trade unions, based on the parameter values in Example 1, for different values of the parameter κ , which measures both the size and the convexity of outsourcing costs.

Table 1: Centralisation vs. decentralisation

| κ | Relative profits: $\frac{\Pi^c}{\Pi^d}$ | Relative union utility: $\frac{U^c}{U^d}$ |
|----------|---|---|
| 3.2 | 0.17 | 0.84 |
| 4 | 0.31 | 0.94 |
| 6 | 0.38 | 0.99 |
| 10 | 0.42 | 1.02 |
| 100 | 0.45 | 1.04 |

Parameter values as in Example 1

In this example, we see that the unions prefer decentralised (centralised) wage setting if κ is

¹⁰We have chosen the lowest value of k for which $\alpha^d = 0$.

sufficiently low (high). This is quite intuitive. If outsourcing costs are not very convex (which is the case for low values of κ), the difference in equilibrium outsourcing between the two wage setting regimes is sufficiently large to outweigh the benefits of wage coordination. In this case, unionised workers are better off with decentralised wage setting. In contrast, the firms prefer decentralised wage setting for all values of κ . It is quite obvious that decentralised wage setting yields higher firm profits for sufficiently high values of κ , since $\alpha^c \rightarrow \alpha^d = 0$ if $\kappa \rightarrow \infty$. That firms also prefer decentralised wage setting for low values of κ is partly a reflection of the Prisoners' Dilemma nature of the outsourcing game. This is perhaps best seen by noticing that, since $\alpha^d = 0$ for all κ , a larger value of κ increases not only relative but also absolute profits under centralised wage setting. This implies that the firms are better off with higher outsourcing costs which dampens the (destructive) outsourcing competition. Thus, the firms prefer decentralised wage setting for two different reasons: (i) it promotes trade union competition and therefore leads to lower wages for a given outsourcing level, and (ii) it works as mechanism to remove the Prisoners' Dilemma features of the outsourcing game.

3 Extensions

In this section we briefly report the robustness of our main results with respect to three different extensions of the main model: (i) Bertrand competition instead of Cournot competition; (ii) firm-specific instead of uniform wages under centralised wage setting; and (iii) wage bargaining instead of union wage setting.

3.1 Price competition

Suppose that firms compete in prices á la Bertrand. In order to make the analysis meaningful, we relax the simplifying assumption of product homogeneity and assume that the two goods are horizontally differentiated. Adopting a standard Bowley demand system, inverse demand for Good i is given by

$$p_i = a - q_i - \delta q_j; \quad i, j = 1, 2; \quad i \neq j,$$

where $\delta \in (0, 1)$ is an inverse measure of product differentiation. By standard computations, the Bertrand-Nash equilibrium of the third-stage subgame is given by

$$p_i = \frac{a(2 + \delta)(1 - \delta) + 2\sigma_i + \delta\sigma_j}{4 - \delta^2}; \quad i, j = 1, 2; \quad i \neq j. \quad (12)$$

Under *decentralised* wage setting, equilibrium wages in the second-stage subgame are

$$w_i^d(\alpha_i, \alpha_j) = \frac{(\gamma(\theta + 1) + \delta\theta)(\gamma(\bar{w} + a\theta) - a\delta\theta) - \bar{w}\gamma^2(\theta + 1)\alpha_i - \delta\bar{w}\theta\gamma\alpha_j}{(\gamma^2(\theta + 1)^2 - \delta^2\theta^2)(1 - \alpha_i)}; \quad (13)$$

$$i, j = 1, 2; \quad i \neq j,$$

where $\gamma := 2 - \delta^2 > 0$. Under *centralised* wage setting, the equilibrium uniform wage is now

$$w^c(\alpha_i, \alpha_j) = \frac{\bar{w}}{\theta + 1} + \frac{a\theta(2 + \delta)(1 - \delta)(2 - \alpha_i - \alpha_j)}{(\theta + 1)(2(2 + \delta)(1 - \delta)(1 - \alpha_i - \alpha_j) + \gamma(\alpha_i^2 + \alpha_j^2) - 2\delta\alpha_i\alpha_j)}. \quad (14)$$

As before, we assume that symmetric interior equilibria exist. This allows us to derive the following result (see Appendix A2 for a complete proof):

Proposition 4 *All results in Propositions 1-3 hold also with price competition and horizontally differentiated goods.*

The fact that our main results are robust to the assumption of price competition is perhaps not too surprising. The reason is that the main mechanisms behind our results do not critically rely on the mode of competition in the output market. More specifically, the fact that decentralised wage setting implies wage competition between trade unions – which is key to our results – does not depend on the nature of strategic interaction between the firms.

3.2 Firm-specific wages under centralised wage setting

A key assumption in our main analysis is that centralised wage setting implies setting a uniform (industry-wide) wage that applies to all workers in the industry. Given the underlying assumption of homogeneous labour, this is a reasonable assumption that accords with the nature of centralised wage agreements in the real world, where wages are usually specified according to occupational type without being firm-specific. However, whereas a uniform wage might be perceived as the only fair outcome by union members, it is not an *ex post* optimal outcome (i.e., it does not maximise

aggregate union utility) if firms differ in terms of outsourcing levels (and thus marginal production costs).¹¹

If we allow for firm-specific wages under centralised wage setting, this will have an impact on firms' outsourcing incentives. Even under the assumption of Cournot competition with homogeneous products, solving the model analytically is not feasible. We have therefore used simulations to study the validity of Proposition 1, which is the key result and from which the results in Proposition 2 and 3 follow. We only study symmetric equilibria.

With firm-specific wage setting, wage coordination does not necessarily imply a smaller wage response to outsourcing by one of the firms. For this reason, it is no longer clear that centralised wage setting yields stronger outsourcing incentives. Indeed, it turns out that the results depend crucially on the ratio between consumers' reservation price (a) and domestic workers' reservation wage (\bar{w}), which is a measure of the total rents potentially available to domestic workers. Our simulations suggest that Proposition 1 still holds for sufficiently low values of $\frac{a}{\bar{w}}$ and θ . Otherwise, the result is reversed and equilibrium outsourcing is higher under decentralised wage setting.¹²

3.3 Wage bargaining

For analytical tractability, we have in the main analysis adopted the monopoly union model, which gives all bargaining power to the unions. Since our results are to a large degree driven by wage responses to outsourcing, it is natural to ask what happens if unions cannot determine wages unilaterally. We therefore extend the model to allow for Nash bargaining between firms and trade unions. We retain the right-to-manage set-up, implying that bargaining between firms and unions is over wages only, and we keep the Cournot set-up with homogeneous goods. We also assume that the firms are bargaining as a single entity under centralised wage determination, and that bargaining in this case is over a uniform wage.

With *decentralised* wage bargaining, the equilibrium wage is simply found by replacing θ with $\theta\beta/(2-\beta)$ in (7), where β is the relative bargaining power of the trade unions.¹³ Thus, giving the firms some bargaining power (i.e., $\beta < 1$) is equivalent to making monopoly trade unions less wage

¹¹Potential fairness considerations among union members could in principle be incorporated into the union objective functions. However, a departure from the familiar Stone-Geary functional form would make the analysis intractable.

¹²Our simulations were performed using MATLAB, and the file containing the MATLAB codes is available at <http://link.uib.no/supplement>.

¹³The fact that $\lim_{\beta \rightarrow 1} \theta\beta/(2-\beta) = \theta$ illustrates that the monopoly union model is a special case of the Nash bargaining model, where the union has all the bargaining power.

oriented. In turn, this implies that a decrease in union bargaining power increases the equilibrium degree of outsourcing. With *centralised* wage bargaining, it is once more infeasible to solve the model analytically. We have therefore studied this case using simulations. The results suggest that Proposition 1 is only invalid if the unions have little bargaining power *and* outsourcing levels are generally low. If the unions have more than 50% of the bargaining power, Proposition 1 applies in all cases. Thus, our results do not seem to depend critically on the monopoly union assumption.¹⁴

4 Concluding remarks

We have employed a framework where production takes place in a series of complementary stages. Some of these are cheap to outsource, some less so. A general reduction in outsourcing costs will lead to more tasks being outsourced, but the remaining workers will typically perform tasks that are hard to outsource. Knowing this, they will tend to push for higher wages. In such a framework we study the particular question how decentralisation of bargaining influences outsourcing and wages and employment at home – and the utility of unionised workers and the profits of firms. We identify parameter sets where decentralisation is advantageous both for firms and workers. If globalisation is taken to mean that outsourcing abroad generally becomes cheaper, the fact that globalisation and less centralisation in bargaining seem to appear in conjunction must not mean that the employer side uses globalisation to force unions to abandon centralised wage settlements – but rather that employers and unions alike see decentralisation as a rational reaction to better outsourcing possibilities, in a mutually beneficial way. An important building block in reaching this result is precisely the fact that in the described framework, cheaper outsourcing makes it rational for the remaining workers in expensive-to-outsource jobs to drive up wages – and this partly protects workers against outsourcing. When wage setting is decentralised, unions will to a lesser extent care about how a wage hike affects the rest of the economy, and this implies that this wage increase is more pronounced. More decentralisation can therefore be advantageous for workers facing more intense globalisation. Firms can also prefer that unionised workers are less coordinated, which generally makes the workers less powerful.

The potentially advantageous effects of decentralised wage setting – not only for the firms but also for the workers – fly in the face of conventional wisdom regarding the merits of union centralisation as a means to obtain a better outcome for domestic workers. This perhaps surprising

¹⁴The file with MATLAB codes for the simulations is available at <http://link.uib.no/supplement>.

result relies on the key assumption that trade unions are unable to credibly commit to a certain wage level prior to firms' outsourcing decisions. The lack of credible commitment, which we think is highly plausible, means that *ex post internalisation* of competition externalities can be counterproductive from an *ex ante* perspective. Borrowing from the famous business strategy taxonomy of Fudenberg and Tirole (1984), we have shown that, as a response to increased outsourcing opportunities for firms, it can be optimal for trade unions to adopt a 'lean-and-hungry-look' strategy in the form of decentralised wage agreements. Decentralisation leads to lower wages for a given outsourcing level (making the unions more 'lean'), while simultaneously paving the way for stronger wage responses to an increase in the outsourcing intensity (making the unions more 'hungry').

In this model we have not built in any efficiency gain from trade unionism. The efficient outcome would be realised if there were no unions. Though outside the scope of the present paper, it would be interesting to take the model further to incorporate for example technology investments and education, that could be influenced by how many workers are retained at home and how much they earn. Is cheaper outsourcing then good or bad? In line with earlier literature on beneficial trade unionism, there could be inefficiencies in technology and skill formation decisions – and in the full picture these need to be evaluated against the need for efficient outsourcing.

Moreover, we live in a time where the open trade regime which has evolved since WWII seems to be under siege. What if political actions increased the costs of outsourcing? Would this diminish the positive aspects of decentralisation of wage bargaining? This is also an interesting direction for future research.

Appendix

A1. Profits and union utility

Decentralised wage setting

In the subgame that starts at Stage 2, equilibrium gross profits and union utility (at firm level) are given by, respectively,

$$\pi^d(\alpha_i, \alpha_j) = \frac{4((3\theta + 2)(a - \bar{w}) + ((4 + 3\theta)\alpha_i - 2\alpha_j)\bar{w})^2}{9b(\theta + 2)^2(3\theta + 2)^2} \quad (\text{A1})$$

and

$$U^d(\alpha_i, \alpha_j) = \frac{2(1-\alpha_i)^{1-\theta}\theta^\theta}{3b} \left(\frac{(3\theta+2)(a-\bar{w}) + ((4+3\theta)\alpha_i - 2\alpha_j)\bar{w}}{(\theta+2)(3\theta+2)} \right)^{\theta+1}. \quad (\text{A2})$$

The equivalent equilibrium expressions for the full game are

$$\pi^d(\alpha^d) = \frac{4(a - (1-\alpha^d)\bar{w})^2}{9b(\theta+2)^2} \quad (\text{A3})$$

and

$$U^d(\alpha^d) = \frac{2(1-\alpha^d)^{1-\theta}\theta^\theta}{3b} \left(\frac{a - (1-\alpha^d)\bar{w}}{\theta+2} \right)^{\theta+1}. \quad (\text{A4})$$

Centralised wage setting

In the subgame that starts at Stage 2, gross equilibrium profits and union utility (at firm level) are given by, respectively,

$$\pi^d(\alpha_i, \alpha_j) = \frac{(2\Phi(a-\bar{w} + (2\alpha_i - \alpha_j)\bar{w}) + 3a\theta(1-\alpha_j)(\alpha_i - \alpha_j))^2}{36b\Phi^2(\theta+1)^2} \quad (\text{A5})$$

and

$$U^d(\alpha_i, \alpha_j) = \frac{(1-\alpha_i) \left(\begin{array}{c} 2\Phi(a-\bar{w} + (2\alpha_i - \alpha_j)\bar{w}) \\ + 3a\theta(1-\alpha_j)(\alpha_i - \alpha_j) \end{array} \right) \left(\frac{\theta}{2} \left(\begin{array}{c} a(2-\alpha_i - \alpha_j) \\ - 2\bar{w}\Phi \end{array} \right) \right)^\theta}{6b\Phi^{\theta+1}(\theta+1)^{\theta+1}}, \quad (\text{A6})$$

where $\Phi := 1 - \alpha_i - \alpha_j + \alpha_i^2 + \alpha_j^2 - \alpha_i\alpha_j$. The equivalent equilibrium expressions for the full game are

$$\pi^c(\alpha^c) = \frac{(a - (1-\alpha^c)\bar{w})^2}{9b(\theta+1)^2} \quad (\text{A7})$$

and

$$U^c(\alpha^c) = \frac{(1-\alpha^c)^{1-\theta}\theta^\theta}{3b} \left(\frac{a - (1-\alpha^c)\bar{w}}{\theta+1} \right)^{\theta+1}. \quad (\text{A8})$$

A2. Proofs

Proof of Lemma 1

From (7) we derive

$$\frac{\partial w_i^d(\alpha_i, \alpha_j)}{\partial \alpha_i} = \theta \frac{(3\theta+2)a + 2(1-\alpha_j)\bar{w}}{(1-\alpha_i)^2(\theta+2)(3\theta+2)} > 0 \quad (\text{A9})$$

and

$$\frac{\partial w_i^d(\alpha_i, \alpha_j)}{\partial \alpha_j} = -\frac{2\theta\bar{w}}{(\theta+2)(1-\alpha_i)(3\theta+2)} < 0. \quad (\text{A10})$$

Q.E.D.

Proof of Lemma 2

(i) From (9) we derive

$$\begin{aligned} \frac{\partial w^c(\alpha_i, \alpha_j)}{\partial \alpha_i} &= \frac{\theta a(1 - (4 - \alpha_i)\alpha_i + 2(1 - \alpha_j)\alpha_j + 2\alpha_i\alpha_j)}{2(\theta+1)(1 - \alpha_i - \alpha_j + \alpha_i^2 + \alpha_j^2 - \alpha_i\alpha_j)^2} \\ &> (<)0 \quad \text{if } \alpha_i < (>)2 - \alpha_j - (1 - \alpha_j)\sqrt{3}. \end{aligned} \quad (\text{A11})$$

(ii) From (7) and (9) we derive, respectively,

$$\left. \frac{\partial w^d(\alpha_i, \alpha_j)}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha} = \theta \frac{(3\theta+2)a + 2(1-\alpha)\bar{w}}{(1-\alpha)^2(\theta+2)(3\theta+2)} > 0. \quad (\text{A12})$$

and

$$\left. \frac{\partial w^c(\alpha_i, \alpha_j)}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha} = \frac{a\theta}{2(1-\alpha)^2(\theta+1)} > 0, \quad (\text{A13})$$

from which it follows that

$$\left. \frac{\partial w^d(\alpha_i, \alpha_j)}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha} - \left. \frac{\partial w^c(\alpha_i, \alpha_j)}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha} = \theta \frac{a\theta(3\theta+2) + 4\bar{w}(1-\alpha)(\theta+1)}{2(3\theta+2)(\theta+2)(\theta+1)(1-\alpha)^2} > 0. \quad (\text{A14})$$

Q.E.D.

Proof of Proposition 1

The symmetric Nash equilibrium in the outsourcing game under centralised and decentralised wage setting, respectively, is implicitly given by

$$\left. \frac{\partial \Pi_i^c}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha^c} = \frac{(a - \bar{w}(1 - \alpha^c))(4\bar{w}(1 - \alpha^c) + 3\theta a)}{9b(1 - \alpha^c)(\theta + 1)^2} - K'(\alpha^c) = 0 \quad (\text{A15})$$

and

$$\left. \frac{\partial \Pi_i^d}{\partial \alpha_i} \right|_{\alpha_i=\alpha_j=\alpha^d} = \frac{(a - \bar{w}(1 - \alpha^d))8(3\theta + 4)\bar{w}}{9b(3\theta + 2)(\theta + 2)^2} - K'(\alpha^d) = 0. \quad (\text{A16})$$

Suppose that $\alpha^c = \alpha^d$. Subtracting (A16) from (A15) then gives

$$\begin{aligned} & \left. \frac{\partial \Pi_i^c}{\partial \alpha_i} \right|_{\alpha_i = \alpha_j = \alpha^d} - \left. \frac{\partial \Pi_i^d}{\partial \alpha_i} \right|_{\alpha_i = \alpha_j = \alpha^d} \\ = & \frac{\theta (a - \bar{w} (1 - \alpha^d)) \left[3a (3\theta + 2) (\theta + 2)^2 - 4 (1 - \alpha^d) (6\theta + 3\theta^2 + 2) \bar{w} \right]}{9b (3\theta + 2) (\theta + 2)^2 (\theta + 1)^2 (1 - \alpha^d)}. \end{aligned} \quad (\text{A17})$$

The sign of this expression depends on the sign of the expression in square brackets, which is positive for all $\bar{w} < a/2$. Thus, the expression in (A17) is strictly positive for all permissible parameter configurations. Since, by definition of the Nash equilibrium, $(\partial \Pi_i^d / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d} = 0$, this implies $(\partial \Pi_i^c / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d} > 0$. By convexity of $K(\cdot)$, it follows directly that $\alpha^c > \alpha^d$. *Q.E.D.*

Proof of Lemma 3

From (A4) and (A8) we derive

$$\frac{\partial U^d}{\partial \alpha^d} = \frac{2\theta^\theta (a - \bar{w} (1 - \alpha^d))^\theta}{3b (\theta + 2)^{\theta+1} (1 - \alpha^d)^\theta} \left[(\theta - 1) a + 2 (1 - \alpha^d) \bar{w} \right] \quad (\text{A18})$$

and

$$\frac{\partial U^c}{\partial \alpha^c} = \frac{\theta^\theta (a - \bar{w} (1 - \alpha^c))^\theta}{3b (\theta + 1)^{\theta+1} (1 - \alpha^c)^\theta} \left[(\theta - 1) a + 2 (1 - \alpha^c) \bar{w} \right] \quad (\text{A19})$$

Both expressions are positive (negative) if

$$\theta > (<) 1 - \frac{2 (1 - \alpha^k) \bar{w}}{a}, \quad k = d, c. \quad (\text{A20})$$

Since $\bar{w} < a/2$, the parameter set given by $\theta < 1 - (2 (1 - \alpha^k) \bar{w} / a)$ is non-empty. *Q.E.D.*

Proof of Proposition 2

By defining

$$G(\alpha) := \frac{\theta^\theta}{3b} (1 - \alpha)^{1-\theta} (a - \bar{w}(1 - \alpha))^{1+\theta} > 0, \quad (\text{A21})$$

we can re-write $U^d(\alpha^d)$ and $U^c(\alpha^c)$ as

$$U^d(\alpha^d) = \frac{2G(\alpha^d)}{(\theta + 2)^{\theta+1}} \quad (\text{A22})$$

and

$$U^c(\alpha^c) = \frac{G(\alpha^c)}{(\theta + 1)^{\theta+1}}. \quad (\text{A23})$$

The trade unions prefer decentralised wage setting if $U^d(\alpha^d) > U^c(\alpha^c)$. Since $U^d < U^c$ for $\alpha^c = \alpha^d$, and since $\alpha^c > \alpha^d$, it follows from (A22)-(A23) that a necessary (but not sufficient) condition for $U^d(\alpha^d) > U^c(\alpha^c)$ is $G(\alpha^c) < G(\alpha^d)$. We already know from Lemma 3 that this possibility is ruled out for $\theta \geq 1$. Since

$$G'(\alpha) = -\frac{1}{3b} \left(\frac{\theta(a - \bar{w}(1 - \alpha))}{1 - \alpha} \right)^\theta [a(1 - \theta) - 2\bar{w}(1 - \alpha)], \quad (\text{A24})$$

it follows that G is monotonically decreasing in α over the interval $[\alpha^d, \alpha^c]$ if $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$. Since $\lim_{\alpha^c \rightarrow 1} U^c = 0$ and $U^d > 0$ for $\alpha^d < 1$, this means that there exists a threshold $\hat{\alpha}^c(\alpha^d) < 1$, such that the trade unions prefer decentralised over centralised wage setting (i.e., $U^d(\alpha^d) > U^c(\alpha^c)$) if $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$ and if $\alpha^c > \hat{\alpha}^c$. *Q.E.D.*

Proof of Proposition 3

Expressed as a function of wages and outsourcing, equilibrium net profits are given by

$$\Pi(w^k, \alpha^k) = \frac{(a - (1 - \alpha^k)w^k)^2}{9b} - K(\alpha^k), \quad (\text{A25})$$

where $k = c, d$. Since $\alpha^c > \alpha^d$, and since higher outsourcing yields higher outsourcing costs, a sufficient condition for equilibrium profits to be higher under decentralised wage setting is

$$(1 - \alpha^d)w^d < (1 - \alpha^c)w^c. \quad (\text{A26})$$

From (10) and (11) we have

$$(1 - \alpha^d)w^d = \frac{a\theta + 2\bar{w}}{\theta + 2} - \frac{2}{2 + \theta}\bar{w}\alpha^d \quad (\text{A27})$$

and

$$(1 - \alpha^c)w^c = \frac{a\theta + \bar{w}}{\theta + 1} - \frac{1}{\theta + 1}\bar{w}\alpha^c. \quad (\text{A28})$$

Thus, the condition in (A26) can be re-written as

$$\alpha^c < \frac{(a - \bar{w})\theta}{(2 + \theta)\bar{w}} + \frac{2 + 2\theta}{2 + \theta}\alpha^d := \tilde{\alpha}^c(\alpha^d). \quad (\text{A29})$$

It follows that both the trade unions and the firms prefer decentralised wage setting if $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$ and $\alpha^c \in (\hat{\alpha}^c, \tilde{\alpha}^c)$. This parameter set is non-empty if $\hat{\alpha}^c < \tilde{\alpha}^c$, which requires $U^c(\tilde{\alpha}^c(\alpha^d)) < U^d(\alpha^d)$. Using (A4), (A8) and (A29), we have

$$\begin{aligned} \frac{U^c(\tilde{\alpha}^c(\alpha^d))}{U^d(\alpha^d)} &= 2 \left(\left(\frac{\theta + 1}{\theta + 2} \right) \left(1 - \frac{\theta a}{2(\theta + 1)(1 - \alpha^d)\bar{w}} \right) \right)^{1 - \theta} \\ &< (>) 1 \quad \text{if} \quad \frac{a}{(1 - \alpha^d)\bar{w}} > (<) \frac{2(\theta + 1)}{\theta} - \frac{\theta + 2}{\theta 2^{\frac{\theta}{1 - \theta}}}. \end{aligned} \quad (\text{A30})$$

Since the condition $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$ is equivalent to $a/(1 - \alpha^d)\bar{w} > 2/(1 - \theta)$, we have the following sufficient conditions for an agreement between firms and trade unions about the preference for decentralised wage setting:

$$\frac{a}{(1 - \alpha^d)\bar{w}} > \max \left(\frac{2}{1 - \theta}, \frac{2(\theta + 1)}{\theta} - \frac{\theta + 2}{\theta 2^{\frac{\theta}{1 - \theta}}} \right) \quad (\text{A31})$$

and

$$\hat{\alpha}^c < \alpha^c < \tilde{\alpha}^c. \quad (\text{A32})$$

Q.E.D.

Proof of Proposition 4

The equilibrium prices and wages are given by (12)-(14) in Section 3, and quantities are found by inserting these into

$$q_i = \frac{a(\delta + 2)(1 - \delta) - \gamma\sigma_i + \delta\sigma_j}{(1 - \delta^2)(4 - \delta^2)}. \quad (\text{A33})$$

Gross profits are given by $\Pi_i = (1 - \delta^2)q_i^2$. In the following, we repeat the proofs of Proposition 1-3, applied to the case of Bertrand competition with differentiated products. (i) *Proposition 1*. The Nash equilibrium in the outsourcing game under centralised and decentralised wage setting, respectively, is implicitly given by

$$\left. \frac{\partial \Pi_i^c}{\partial \alpha_i} \right|_{\alpha_i = \alpha_j = \alpha^c} = \frac{[a - \bar{w}(1 - \alpha^c)][2\bar{w}\gamma(1 - \alpha^c) + a\theta(1 + \delta)(2 - \delta)]}{(1 + \delta)(\theta + 1)^2(1 - \alpha^c)(2 - \delta)^2(2 + \delta)} - K'(\alpha^c) = 0 \quad (\text{A34})$$

and

$$\frac{\partial \Pi_i^d}{\partial \alpha_i} \Big|_{\alpha_i = \alpha_j = \alpha^d} = \frac{2\bar{w} (a - \bar{w}(1 - \alpha^d)) \gamma^2 [\theta(4 - \delta^2)(1 - \delta^2) + \gamma^2]}{(1 + \delta)(2 + \delta)(2 - \delta)^2 [\gamma(1 + \theta) - \delta\theta]^2 [\gamma(1 + \theta) + \delta\theta]} - K'(\alpha^d) = 0. \quad (\text{A35})$$

Suppose $\alpha^c = \alpha^d$. Define

$$F := \frac{\frac{\partial \Pi_i^c}{\partial \alpha_i} \Big|_{\alpha_i = \alpha_j = \alpha^d} + K'(\alpha^d)}{\frac{\partial \Pi_i^d}{\partial \alpha_i} \Big|_{\alpha_i = \alpha_j = \alpha^d} + K'(\alpha^d)} = \frac{\frac{2\bar{w}\gamma(1 - \alpha^d) + a\theta(1 + \delta)(2 - \delta)}{(\theta + 1)^2(1 - \alpha^d)}}{\frac{2\bar{w}\gamma^2(\theta(4 - \delta^2)(1 - \delta^2) + \gamma^2)}{(\gamma(1 + \theta) - \delta\theta)^2(\gamma(1 + \theta) + \delta\theta)}} \quad (\text{A36})$$

Since

$$\frac{\partial F}{\partial \alpha^d} = \frac{a\theta(1 + \delta)(2 - \delta)(\gamma(1 + \theta) + \delta\theta)(\gamma(1 + \theta) - \delta\theta)^2}{2\bar{w}(\theta + 1)^2(1 - \alpha^d)^2\gamma^2(\theta(4 - 5\delta^2 + \delta^4) + 4(1 - \delta^2) + \delta^4)} > 0 \quad (\text{A37})$$

and

$$\frac{\partial F}{\partial a} = \frac{\theta(1 + \delta)(2 - \delta)(\gamma(\theta + 1) + \delta\theta)(\gamma(\theta + 1) - \delta\theta)^2}{2\bar{w}(\theta + 1)^2(1 - \alpha^d)\gamma^2(\theta(4 - 5\delta^2 + \delta^4) + 4(1 - \delta^2) + \delta^4)} > 0, \quad (\text{A38})$$

F reaches a minimum level at $\alpha^d = 0$ and $a = 2\bar{w}$. At this minimum:

$$F|_{\alpha^d=0, a=2\bar{w}} = \frac{(\gamma^2(\theta + 1)^2 - \delta^2\theta^2)^2}{(\theta + 1)^2\gamma^2(\theta(4 - 5\delta^2 + \delta^4) + 4(1 - \delta^2) + \delta^4)}. \quad (\text{A39})$$

From (A39) we derive

$$\frac{\partial F|_{\alpha^d=0, a=2\bar{w}}}{\partial \theta} = \frac{(\gamma^2(1 + \theta)^2 - \delta^2\theta^2)\Omega}{(\theta + 1)^3\gamma^2(\theta(4 - 5\delta^2 + \delta^4) + 4(1 - \delta^2) + \delta^4)^2}, \quad (\text{A40})$$

where

$$\Omega := (1 - \delta^2)^2(4 - \delta^2)^2(\theta^3 + 3\theta^2) + (3\theta(1 - \delta^2)(4 - \delta^2) + 4 - 3\delta^2 + \delta^4)\gamma^2. \quad (\text{A41})$$

From (A41) we derive $\partial^3\Omega/\partial\theta^3 = 6(1 - \delta^2)^2(4 - \delta^2)^2 \geq 0$, which implies $\partial^2\Omega/\partial\theta^2 \geq \lim_{\theta \rightarrow 0} (\partial^2\Omega/\partial\theta^2) = 6(1 - \delta^2)^2(4 - \delta^2)^2 \geq 0$. Consequently, $\partial\Omega/\partial\theta \geq \lim_{\theta \rightarrow 0} (\partial\Omega/\partial\theta) = 3\gamma^2(1 - \delta^2)(4 - \delta^2) \geq 0$, which implies $\Omega \geq \lim_{\theta \rightarrow 0} \Omega = (4 - 3\delta^2 + \delta^4)\gamma^2 > 0$. Thus, $\partial F|_{\alpha^d=0, a=2\bar{w}}/\partial\theta > 0$ and $F|_{\alpha^d=0, a=2\bar{w}} > \lim_{\theta \rightarrow 0} F|_{\alpha^d=0, a=2\bar{w}} = 1$. Since $F|_{\alpha^d=0, a=2\bar{w}}$ is a minimum of F , we can conclude that $F > 1$ and thus $(\partial \Pi_i^c / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d} > (\partial \Pi_i^d / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d}$. Since, by the definition of the Nash equilibrium, $(\partial \Pi_i^d / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d} = 0$, this implies $(\partial \Pi_i^c / \partial \alpha_i)|_{\alpha_i = \alpha_j = \alpha^d} > 0$. By convexity of $K(\cdot)$, it follows directly that $\alpha^c > \alpha^d$. (ii) *Proposition 2*. Equilibrium union utility in the decentralised

and centralised cases, respectively, are given by

$$U^d(\alpha^d) = \frac{(a - \bar{w}(1 - \alpha^d))^{\theta+1} (1 - \alpha^d)^{1-\theta} \theta^\theta \gamma (2 + \delta)^\theta (1 - \delta)^\theta}{(1 + \delta)(2 - \delta) (\theta (2 + \delta) (1 - \delta) + \gamma)^{\theta+1}} \quad (\text{A42})$$

and

$$U^c(\alpha^c) = \frac{(a - \bar{w}(1 - \alpha^c))^{\theta+1} (1 - \alpha^c)^{1-\theta} \theta^\theta}{(\theta + 1)^{\theta+1} (1 + \delta)(2 - \delta)}. \quad (\text{A43})$$

By defining

$$H(\alpha) := \frac{(1 - \alpha)^{1-\theta} \theta^\theta (a - \bar{w}(1 - \alpha))^{\theta+1}}{(1 + \delta)(2 - \delta)}, \quad (\text{A44})$$

we can re-write $U^d(\alpha^d)$ and $U^c(\alpha^c)$ as

$$U^d(\alpha^d) = \frac{(2 + \delta)^\theta (1 - \delta)^\theta \gamma H(\alpha^d)}{(\theta (2 + \delta) (1 - \delta) + \gamma)^{\theta+1}} \quad (\text{A45})$$

and

$$U^c(\alpha^c) = \frac{H(\alpha^c)}{(\theta + 1)^{\theta+1}}. \quad (\text{A46})$$

$U^d < U^c$ for $\alpha^c = \alpha^d$ and $\delta > 0$, as in the Cournot case. Furthermore, $H(\alpha)$ is always increasing in α for $\theta \geq 1$. Again, therefore, unions might only be worse off under wage centralisation if $\theta < 1$. From (A44) we have

$$H'(\alpha) = \frac{\theta^\theta (a - (1 - \alpha)\bar{w})^\theta (a(1 - \theta) - 2(1 - \alpha)\bar{w})}{(1 - \alpha)^\theta (1 + \delta) (2 - \delta)}, \quad (\text{A47})$$

implying that H is monotonically decreasing in α over the interval $[\alpha^d, \alpha^c]$ if $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$. Since $\lim_{\alpha^c \rightarrow 1} U^c = 0$ and $U^d > 0$ for $\alpha^d < 1$, there exists again a threshold $\hat{\alpha}^c(\alpha^d) < 1$, such that unions prefer decentralised wage setting if $\alpha^c > \hat{\alpha}^c$ and $\theta < 1 - (2(1 - \alpha^d)\bar{w}/a)$. (iii) *Proposition 3*. As in the Cournot case, a sufficient condition for equilibrium profits to be higher under decentralised wage setting is that the effective wage costs are lower in the decentralised case, i.e., $(1 - \alpha^d)w^d < (1 - \alpha^c)w^c$. From previous results we have

$$(1 - \alpha^d)w^d = \frac{(1 - \alpha^d) \gamma \bar{w} + a\theta (2 + \delta) (1 - \delta)}{\gamma + \theta(\gamma - \delta)} \quad (\text{A48})$$

and

$$(1 - \alpha^c)w^c = \frac{a\theta (1 + \delta)^2 + (1 - \alpha^c) \bar{w}}{1 + \theta}. \quad (\text{A49})$$

Thus, $(1 - \alpha^d)w^d < (1 - \alpha^c)w^c$ can be re-written as

$$\alpha^c < \frac{\delta\theta \left(a \left(5 + \delta(\gamma - 2\delta) + \theta(1 - \delta)(2 + \delta)^2 \right) - \bar{w} \right) + (1 + \theta)\gamma\bar{w}\alpha^d}{(\gamma + \theta(\gamma - \delta))\bar{w}} := \tilde{\alpha}^c(\alpha^d). \quad (\text{A50})$$

As in the Cournot case, to establish that the both firms and unions can prefer decentralised wage setting, we need to show that $\hat{\alpha}^c < \tilde{\alpha}^c$. Since the expressions are considerably more involved than in the Cournot case, it is difficult to find an exact parameter cut-off. However, to prove the statement in Proposition 3, we only need to show that the statement is true for one particular parameter configuration. Defining $a/\bar{w} = 3$, $\delta = 1/2$ and $\theta = 1/8$, we have

$$\frac{U^c(\tilde{\alpha}^c(\alpha^d))}{U^d(\alpha^d)} = \frac{\sqrt[8]{305}\sqrt[8]{3796875}(101 - 224\alpha^d)^{\frac{7}{8}}(672\alpha^d + 1649)^{\frac{9}{8}}}{2186240(1 - \alpha^d)^{\frac{7}{8}}(\alpha + 2)^{\frac{9}{8}}}, \quad (\text{A51})$$

which is less than unity, which implies $\hat{\alpha}^c < \tilde{\alpha}^c$, for $\alpha^d < 101/224 \approx 0.45$. Thus, by continuity, a parameter space where both unions and firms prefer decentralised wage setting exists also under Bertrand competition. *Q.E.D.*

References

- [1] Acemoglu, D., Autor, D.H., 2011. Skills, tasks and technologies: implications for employment and earnings, in: Ashenfelter, O., Card, D.E. (Eds.), Handbook of Labor Economics, Vol. 4. North-Holland, Amsterdam, pp. 1043–1171.
- [2] Agell, J., Lommerud, K.E., 1993. Egalitarianism and growth. Scandinavian Journal of Economics, 95, 559–579.
- [3] Agell, J., Lommerud, K.E., 1997. Minimum wages and the incentives for skill formation. Journal of Public Economics, 64, 25–40.
- [4] Açıkgöz, Ö.T., Kaymak, B., 2014. The rising skill premium and deunionization. Journal of Monetary Economics, 63, 37–50.
- [5] Antras, P., Chor, D., 2013. Organizing the global value chain. Econometrica, 81, 2127–2204.
- [6] Autor, D.H., Levy, F., Murnane, R.J., 2003. The skill content of recent technological change: an empirical exploration. Quarterly Journal of Economics, 118, 1279–1333.

- [7] Calabuig, V., Gonzalez-Maestre, M., 2002. Union structure and incentives for innovation. *European Journal of Political Economy*, 18, 177–192.
- [8] Calmfors, L., Driffill, J., 1988. Bargaining structure, corporatism and macroeconomic performance. *Economic Policy*, 3, 13–61.
- [9] Carluccio, J., Bas, M., 2015. The impact of worker bargaining power on the organization of global firms. *Journal of International Economics*, 96, 162–181.
- [10] Chu, A.C., Cozzi, G., Furukawa, Y., 2016. Unions, innovation and cross-country wage inequality. *Journal of Economic Dynamics & Control*, 64, 104–118.
- [11] Davidson, C., Heyman, F., Matusz, S., Sjöholm, F., Zhu, S.C., 2014. Globalization and imperfect labor market sorting. *Journal of International Economics*, 94, 177–194.
- [12] De Pinto, M, Lingens, J., forthcoming. The impact of unionization costs when firm-selection matters. *Canadian Journal of Economics*.
- [13] Dekker, F., Koster, F., 2018. Outsourcing in 18 European countries: The role of worker power. *Economic and Industrial Democracy*, 39, 481–499.
- [14] Dixit, A., Grossman, G.M., 1982. Trade and protection with multistage production. *Review of Economic Studies*, 49, 583–594.
- [15] EEAG (European Economic Advisory Group), 2004. Report on the European economy 2004. CESifo, Munich.
- [16] Egger, H., Kreckemeier, U., Wrona, J., 2015. Offshoring domestic jobs. *Journal of International Economics*, 97, 112–125.
- [17] Fudenberg, D., Tirole, J., 1984. The fat cat effect, the puppy-dog ploy, and the lean and hungry look. *American Economic Review*, 74, 361–366.
- [18] Grossman, G.M., Rossi-Hansberg, E., 2008. Trading tasks: a simple theory of offshoring. *American Economic Review*, 98, 1978–97.
- [19] Haucap, J., Wey, C., 2004. Unionisation structures and innovation incentives. *Economic Journal*, 114, C149–C165.

- [20] Jeon, Y., Kwon, C.W., 2018. The offshoring threat and wage negotiations: Theory and evidence. *Japan and the World Economy*, 45, 19–29.
- [21] Krusell, P., Rudanko, L., 2016. Unions in a frictional labor market. *Journal of Monetary Economics*, 80, 35–50.
- [22] Lommerud, K.E., Meland, F., Sørsgard, L., 2003. Unionised oligopoly, trade liberalisation and location choice. *Economic Journal*, 113, 782–800.
- [23] Lommerud, K.E., Meland, F., Straume, O.R., 2009. Can deunionization lead to international outsourcing? *Journal of International Economics*, 77, 109–119.
- [24] Lommerud, K.E., Straume, O.R., 2012. Employment protection versus flexicurity: On technology adoption in unionized firms. *Scandinavian journal of Economics*, 114, 177–199.
- [25] Lommerud, K.E., Meland, F., Straume, O.R., 2012. North-South technology transfer in unionized multinationals. *Journal of Development Economics*, 99, 385–395.
- [26] Moene, K.O., Wallerstein, M., 1997. Pay inequality. *Journal of Labor Economics*, 15, 403–430.
- [27] Mukherjee, A., Pennings, E., 2005. Unionization structure, licensing and innovation. *International Journal of Industrial Organization*, 29, 232–241.
- [28] Naylor, R., 1998. International trade and economic integration when labour markets are generally unionized. *European Economic Review*, 42, 1252–1267.
- [29] Naylor, R., 1999. Union wage strategies and international trade. *Economic Journal*, 109, 102–125.
- [30] OECD, 1997. *Economic Performance and the structure of collective bargaining*. OECD Employment Outlook. OECD, Paris.
- [31] Sethupathy, G., 2013. Offshoring, wages and employment: Theory and evidence. *European Economic Review*, 62, 73–97.
- [32] Skaksen, M.Y., Sørensen, J.R., 2001. Should trade unions appreciate foreign direct investment. *Journal of International Economics*, 55, 379–390.
- [33] Sly, N., Soderbery, A., 2014. Strategic sourcing and wage bargaining. *Journal of Development Economics*, 109, 172–187.

Most Recent Working Paper

| | |
|--------------------|---|
| NIPE WP 10/2019 | Lommerud, K. E., Meland, F., e Straume, O. R. , “International outsourcing and trade union (de-) centralization”, 2019 |
| NIPE WP 09/2019 | Carvalho, Margarita e João Cerejeira , “ Level Leverage decisions and manager characteristics ”, 2019 |
| NIPE WP 08/2019 | Carvalho, Margarita e João Cerejeira , “ Financialization, Corporate Governance and Employee Pay: A Firm Level Analysis ”, 2019 |
| NIPE WP 07/2019 | Carvalho, Margarita e João Cerejeira , “ Mergers and Acquisitions and wage effects in the Portuguese banking sector ”, 2019 |
| NIPE WP 06/2019 | Biscegla, Michele, Roberto Cellini, Luigi Siciliani and Odd Rune Straume , “ Optimal dynamic volume-based price regulation ”, 2019 |
| NIPE WP 05/2019 | Hélia Costa e Linda Veiga , “ Local labor impact of wind energy investment: an analysis of Portuguese municipalities ”, 2019 |
| NIPE WP 04/2019 | Luís Aguiar-Conraria , Manuel M. F. Martins, Maria Joana Soares, “ The Phillips Curve at 60: time for time and frequency ”, 2019 |
| NIPE WP 03/2019 | Luís Aguiar-Conraria , Pedro C. Magalhães, Christoph A. Vanberg, “ What are the best quorum rules? A Laboratory Investigation ”, 2019 |
| NIPE WP 02/2019 | Ghandour, Ziad R. , “ Public-Private Competition in Regulated Markets ”, 2019 |
| NIPE WP 01/2019 | Alexandre, Fernando , Pedro Bação e Miguel Portela , “ A flatter life-cycle consumption profile ”, 2019 |
| NIPE WP 21/2018 | Veiga, Linda , Georgios Efthyvoulou e Atsuyoshi Morozumi, “ Political Budget Cycles: Conditioning Factors and New Evidence ”, 2018 |
| NIPE WP 20/2018 | Sá, Luís , Luigi Siciliani e Odd Rune Straume , “ Dynamic Hospital Competition Under Rationing by Waiting Times ”, 2018 |
| NIPE WP 19/2018 | Brekke, Kurt R., Chiara Canta, Luigi Siciliani e Odd Rune Straume , “ Hospital Competition in the National Health Service: Evidence from a Patient Choice Reform ”, 2018 |
| NIPE WP 18/2018 | Paulo Soares Esteves, Miguel Portela e António Rua, “ Does domestic demand matter for firms' exports? ”, 2018 |
| NIPE WP 17/2018 | Alexandre, Fernando , Hélder Costa, Miguel Portela e Miguel Rodrigues, “ Asymmetric regional dynamics: from bust to recovery ”, 2018 |
| NIPE WP 16/2018 | Sochirca, Elena e Pedro Cunha Neves, “ Optimal policies, middle class development and human capital accumulation under elite rivalry ”, 2018 |
| NIPE WP 15/2018 | Vítor Castro e Rodrigo Martins, “ Economic and political drivers of the duration of credit booms ”, 2018 |
| NIPE WP 14/2018 | Arash Rezazadeh e Ana Carvalho , “ Towards a survival capabilities framework: Lessons from the Portuguese Textile and Clothing industry ”, 2018 |
| NIPE WP 13/2018 | Areal, Nelson e Ana Carvalho , “ Shoot-at-will: the effect of mass-shootings on US small gun manufacturers ”, 2018 |
| NIPE WP 12/2018 | Rezazadeh, Arash e Ana Carvalho , “ A value-based approach to business model innovation: Defining the elements of the concept ”, 2018 |
| NIPE WP 11/2018 | Carvalho, Ana e Joaquim Silva, “ The Work Preferences of Portuguese Millennials - a Survey of University Students ”, 2018 |
| NIPE WP 10/2018 | Souza, Maria de Fátima e Ana Carvalho , “ An Organizational Capacity model for wine cooperatives ”, 2018 |
| NIPE WP 09/2018 | Kurt R. Brekke, Tor Helge Holmås, Karin Monstad e Odd Rune Straume , “ How does the type of remuneration affect physician behaviour? Fixed salary versus fee-for-service ”, 2018 |
| NIPE WP 08/2018 | Martins, Susana e Cristina Amado , “ Financial Market Contagion and the Sovereign Debt Crisis: A Smooth Transition Approach ”, 2018 |
| NIPE WP 07/2018 | Amado, Cristina , Annastiina Silvennoinen e Timo Teräsvirta, “ Models with Multiplicative Decomposition of Conditional Variances and Correlations ”, 2018 |
| NIPE WP 06/2018 | Lisi, Domenico, Luigi Siciliani e Odd Rune Straume , “ Hospital Competition under Pay-for-Performance: Quality, Mortality and Readmissions ”, 2018 |