Oligopoly-Oligopsony Model: Theory and Applications

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Abstract

This paper develops an Oligopoly-Oligopsony model and shows applications of this framework in the context of competition policy. This model allows studying both labour and product market dynamics in a partial-equilibrium set-up. In a first application, we apply this model to the evaluation of the unilateral effect of mergers in both the product market and the labour market. In a second application, we investigate the effect of a no-poaching agreement on workers and consumers. In both applications, we show that the welfare effect of these practices depends on the size of their associated efficiencies and the intensity of labour market competition.

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1 Introduction

The interplay between labour market power and product market power is an emerging area of focus for policymakers and enforcers, following renewed attention in the economic literature in recent years. In December 2021, the United States Department of Justice Assistant Attorney General Jonathan Kanter said that he "couldn't imagine a more important priority for public antitrust enforcement" than promoting competition in labour markets.[1]

Competition enforcers across jurisdictions are showing a growing interest in the effects of competition on labour market outcomes. We can identify two main areas of focus for enforcement:

- Preventing and punishing anti-competitive behaviour in labour markets. Authorities are stepping up their guidance and enforcement actions in areas such as wage-fixing agreements (*i.e.*, firms agreeing on establishing the same wages for workers), non-compete agreements (*i.e.*, workers committing to their employers to not join a specific competitor, sector or geographic area), and no-poaching agreements (*i.e.*, firms agreeing not to compete for the same workers).
- Incorporating labour market effects in merger review. Authorities are increasingly debating whether and how to practically evaluate the effects of a merger on workers and consumers simultaneously.

In the US, the Biden administration stated its key objective to enforce antitrust laws against harmful effects of "monopoly and monopsony" in the July 2021 Executive Order on Competition. These goals and renewed attention have translated into enforcement priorities for the FTC and DoJ. In January 2022, the FTC and the DoJ launched a public consultation seeking inputs on how to modernise the enforcement of antitrust policy regarding mergers, which dedicates an entire section to "Monopsony Power and Labor Markets". Labour-related concerns have featured in recent enforcement actions, such as the DoJ's recent antitrust lawsuit to block the proposed acquisition of Simon & Schuster by Penguin Random House (where concerns arose around author compensation).[2]

The most recent developments relate to non-compete clauses. In January 2023, the FTC proposed for public comment new rules (under Section 5 of the FTC Act on unfair methods of competition) that would ban employers from imposing non-compete clauses on workers.

[1] Jonathan Kanter, Assistant Attorney General of the Antitrust Division of the US Justice Department, speaking at the joint FTC and DoJ event "Making Competition Work: Promoting Competition in Labor Markets" on 6 December 2021.

[2] Department of Justice Press Release 22-1176, "Justice Department Obtains Permanent Injunction Blocking Penguin Random House's Proposed Acquisition of Simon & Schuster", published on October 31 2022.

These proposed rules follow public and private enforcement actions against no-poaching and wage-fixing agreements. In July 2022, the DoJ entered into a consent decree with three poultry processors and a data consulting firm following allegations of a conspiracy to suppress wages.[3]

In the UK, enforcement has so far been related to anticompetitive behaviour in labour markets, not merger review. As recently as February 2023, the CMA issued guidance to employers on how to avoid anticompetitive behaviour in labour markets (in the form of no-poaching agreements, wage-fixing agreements, and information sharing on terms and conditions for employees). This guidance follows an investigation opened in July 2022 into suspected anti-competitive behaviour from various broadcasters in the purchase of freelance services relating to sports content in the UK.[4]

Labour market considerations have not so far had a significant role in the European Commission's merger review. Various member states have however intervened to safeguard employees in mergers under "public interest considerations" provisions of national law (separate from competition law); a recent example is the PostNL/Sandd merger in 2020 in the Netherlands. In October 2021, Competition Commissioner Vestager described the negative effects of no-poaching agreements and of collusion between companies to fix wages. Various EU national competition authorities have acted against information sharing, wage-fixing and no-poaching agreements, for example in France, Germany, Hungary, and Lithuania.[5]

There is growing empirical literature investigating the relationship between labour market concentration and labour market outcomes. Azar et al. (2022) measure concentration over a vast number of US labour markets and show that higher concentration is associated with lower posted wages. Marinescu et al. (2021) report a negative relationship between labour market concentration and the number and wages of hires in France. Benmelech et al. (2022) observe a negative relation between local labour markets concentration and wages in the US, which is stronger at high levels of concentration and when the unionisation rate is low. Wage growth tends to be more aligned to productivity growth in less concentrated labour markets. Berger et al. (2022) find that employer market power reduces output and welfare in the US. Yeh et al. (2022) observe that employer market power in the US manufacturing sector (as measured by wage markdowns) decreased between the late 1970s and early 2000s, but sharply increased since. Staiger et al. (2010) find evidence that US

[3] Department of Justice Press Release 22-796, "Justice Department Files Lawsuit and Proposed Consent Decrees to End Long-Running Conspiracy to Suppress Worker Pay at Poultry Processing Plants and Address Deceptive Abuses Against Poultry Growers", published on July 25 2022.

[4] Competition and Markets Authority open case, "Suspected anti-competitive behaviour relating to freelance and employed labour in the production and broadcasting of sports content", published on July 13 2022.

[5] In this policy review, we would like to highlight that employment considerations have long been a feature of the South African competition regime, even though we do not review it here.

Veteran Affairs hospitals have monopsony power in setting nurses' wages; labour supply is found to be highly inelastic to changes in wages in the short run.

A strand of the empirical literature also examines links between product market concentration (and mergers) and labour market outcomes. Marinescu et al. (2021) observe that increased product market concentration is associated with lower wages in France, with this relationship being stronger in more unionised industries. Mergers in industries with lower levels of labour market concentration have relatively worse labour market consequences in terms of wages and hires. Arnold (2019) finds that mergers have an effect on wages in the US only where labour market concentration increases as a result of the merger. In contrast with Marinescu et al. (2021), Arnold (2019) observes larger effects in concentrated markets. In Germany, Gehrke et al. (2021) report large declines in net employment at target firms shortly after a merger, with hiring taking place at the acquiring firm. Prager and Schmitt (2019) observe that lower wage growth following US hospital mergers occurs in where the merger has large effects on concentration and workers have industry-specific skills. Rinz (2022) reviews local industrial concentration in the US over a forty-year period up to 2015, showing that increased industrial concentration is associated with increased inequality. Increased industrial concentration is not associated with lower wages for all demographic groups: women see increased earnings, and the effect on black workers' wages is positive, although not significant.

Various research has investigated the effects of non-compete clauses and no-poaching agreements on wages. Starr et al. (2021) find that 18% of the US labour force is bound by non-compete clauses, which have material prevalence not only in higher-compensation technical jobs with access to confidential information, but also for lower-compensation employees without access to such information. Wages tend to be lower when non-compete clauses are easier to enforce. Lipsitz and Starr (2022) rely on a ban on non-compete clauses in Oregon to estimate the effects on wages of such clauses, which is found to be sizeable (potentially as high as 14-21%). Krueger and Ashenfelter (2022) report that no-poaching agreements were present in 58% of franchising contracts for major chains in the US, with special prevalence in industries with low wages and high turnover. Earlier drafts of their paper resulted in several no-poaching agreements being abandoned and in public enforcement actions. Callaci et al. (2022) estimate that enforcement actions brought by Washington State against no-poaching agreements in franchising contracts resulted in a 3.3% increase in wages.

In this paper, we present a theoretical model that allows for imperfect competition on product and labour markets (the 'Oligopoly-Oligopsony', or 'OO' model). In this model, firms compete simultaneously in quantity in the product market and for workers in the labour market. We derive the equilibrium values of quantities produced, employment levels, prices and wages, and discuss the effects of competition in both markets. This allows us to consider two applications to the competition policy matters discussed above: merger review and no-poaching agreements in labour markets.

Using this set-up, we evaluate the impact of a merger on prices, wages, employment and quantities. In the benchmark case, in which the labour market is assumed perfectly competitive, the horizontal merger always decreases consumer surplus, whereas in the OO model, it may decrease the product price, as it reduces wages and therefore marginal costs of production. It may also increase wages when the labour market competition was weak pre-merger, as it increases firms' individual outputs and incentives to hire workers. We demonstrate that there exists a range of synergies and labour market competition intensity for which the merger increases both consumer and worker surplus.

We also investigate the impact of a no-poaching agreement in this context. We show that no-poaching agreements always benefit consumers, as these reduce product price unconditionally. In the benchmark case, in which the product market is assumed perfectly competitive, no-poaching agreements can increase wages whenever the labour productivity increase they trigger is large enough. We show that in the OO model, no-poaching agreements increase wages only when labour market competition is weak and when the labour productivity is not too large. We finally find that, in the OO model, the consumer surplus increase from a no-poaching agreement always compensates the possible decrease in worker surplus.

Tong and Ornaghi (2022) are very close to our framework. They develop a joint oligopoly-oligopsony model with wage markdown power ('JOOM'). They introduce the assumption that firms can exert markdown power on wages to the standard Cournot oligopoly model. Tong and Ornaghi tease out the effects of labour unions, minimum wage regulations, and 'superstar firms' in both labour and product markets. They also present intuitions regarding the effects of mergers and changes in market structure. In this work, we adapt this set-up to investigate two specific competition matters: mergers and no-poaching. In particular, we investigate non-labour synergies from mergers and labour productivity increases for no-poaching, in order to evaluate the validity of these standard efficiency defences when considering both labour and product markets at the same time.

This paper proceeds as follows. In Section 2, we describe the set-up of the game and solve it. In Section 3, we show the effect of a merger under two scenarios: a benchmark case in which the labour market is perfectly competitive and the Oligopoly-Oligopsony model. We assess the impact of synergies in both cases and derive welfare implications. In Section 4, we study the effect of no-poaching agreements in a benchmark case in which the product market is perfectly competitive and in the Oligopoly-Oligopsony model. We derive welfare implications. Finally, in Section 5, we conclude.

2 The Oligopoly-Oligopsony Framework

In this section, we present the Oligopoly-Oligopsony framework. We first introduce its set-up and then solve it.

2.1 The Set-Up

In order to investigate the effect of firm's practices on product and labour markets simultaneously, we study an Oligopoly-Oligopsony of N firms. In this setting, firms compete in quantity in the product market, and they compete for workers in the labour market. For instance, when $N = 2$, the duopolistic competition takes the following form:

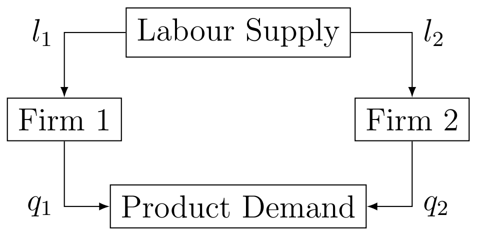

Figure 1: The set-up, for $N = 2$

We assume that firms compete in quantity on both markets. The (inverse) labour supply function of Firm i ($i \in N$ and $i \neq j$) takes the following form:

$$W_i(l_i, L_{-i}) = \alpha + \beta l_i + \epsilon \sum_{j}^{N-1} l_j \tag{1}$$

where $\alpha \geq 0$, $\beta \geq 0$ and $\epsilon \geq 0$. We denote the total labour force $L = \sum_i^N l_i$ and the total labour force of Firm i's competitors $L_{-i} = \sum_{j \neq i}^N l_j$. α denotes the minimum wage that firms need to provide to have a positive labour force (*i.e.*, the intercept of the labour supply curve), β denotes the slope of the labour supply curve with respect to own labour (*e.g.*, when β is very high, firms need to pay a very high wage to attract labour), and ϵ denotes the reaction of Firm i's labour supply to competitors' labour force. When ϵ is equal to zero, firms behave as monopsonists, and as ϵ increases, the firms compete more and more for labour.

On the product market side, the inverse demand function takes the classical Cournot form:

$$P(Q) = A - \sum_{i}^{N} q_i \tag{2}$$

where total quantity is denoted $Q = \sum_i^N q_i$ and market capacity is denoted $A > 0$.[6] Analogously to labour force, we denote competitors' total quantity $Q_{-i} = \sum_j^{N-1} q_j$ where $j \neq i$.

We assume that firms choose quantity and labour simultaneously, and that firms' profits take the following form:

$$\pi_i(q_i, l_i) = (P(Q) - c_i)q_i - W_i(l_i, L_{-i})l_i \tag{3}$$

We assume a constant marginal cost c_i for all costs of production unrelated to labour (*e.g.*, capital, infrastructure, R&D). Costs of production related to labour are captured by the wage function $W_i(L)$ and by a productivity parameter γ_i, which measures output per capita:

$$\gamma_i = \frac{q_i}{l_i} \tag{4}$$

This simple specification allows us to separate shocks to labour productivity from shocks to non-labour costs, which will be useful for the applications described later. Now, we explain how to derive equilibrium conditions.

2.2 Solving the Oligopoly-Oligopsony model

In this subsection, we solve the firms' profit maximisation problem and derive the equilibrium values of wages, labour, quantities and prices. For ease of exposition, we refer to the Oligopoly-Oligopsony model as the OO model. The associated equilibrium values are denoted by a subscript and superscript equal to the letter O (*e.g.*, the OO equilibrium labour is l_o^o). The superscript of equilibrium values indicates the labour market set-up ('o' for oligopsony), while the subscript indicates the product market set-up ('o' for oligopoly).

The firm's profit maximization problem can be reduced to a single variable. From equation (4), we can rewrite the firm's profits as a function of labour l_i only. Firms compete in quantity *à la* Cournot for labour and maximise their profits with respect to l_i:

$$\max_{l_i} \quad \pi_i(l_i) = (P(q_i(l_i), Q_{-i}) - c)q_i(l_i) - W_i(l_i, L_{-i})l_i \tag{5}$$

where $q_i(l_i) = \gamma_i l_i$ and $Q_{-i} = \sum_j^{N-1} q_j(l_j)$, with $j \neq i$.

Using the N first-order conditions and assuming symmetry (*i.e.*, for all i, $c_i = c$ and

[6] For the sake of simplicity, we do not include any differentiation parameters between firms in the product market. This allows to reduce the number of parameters.

$\gamma_i = \gamma$),[7] we obtain the equilibrium labour level, wage, quantity and price.

Proposition 1. *Assuming that firms are symmetric, the Oligopoly-Oligopsony model leads to the following equilibrium values:*

$$
\begin{aligned}
l_o^o &= \frac{(A-c)\gamma - \alpha}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon} \\
W_o^o &= \frac{(A-c)\gamma(\beta + (N-1)\epsilon) + \alpha(\beta + (N+1)\gamma^2)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon} \\
q_o^o &= \frac{\gamma\big((A-c)\gamma - \alpha\big)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon} \\
P_o^o &= \frac{(N-1)A\epsilon + A(2\beta + \gamma^2) + N\gamma(c\gamma + \alpha)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon}
\end{aligned}
\tag{6}
$$

Proof. These equilibrium values are obtained by solving the N first-order conditions from the firms' profits maximisation problem described in equation (5). □

From Proposition 1, we can derive a first set of intuitions concerning the effect of an increase in market concentration (*i.e.*, a decrease in N) or a decrease in labour market competition (*i.e.*, a decrease in ϵ). In Corollary 1, we study the impact of ϵ on the OO equilibrium values.

Corollary 1. *When firms are symmetric, the impact of the degree of competition on the labour market ϵ on equilibrium values is unambiguous. Whenever $(A-c)\gamma - \alpha > 0$, $\frac{\partial l_o^o}{\partial \epsilon} < 0$, $\frac{\partial q_o^o}{\partial \epsilon} < 0$, $\frac{\partial L_o^o}{\partial \epsilon} < 0$, $\frac{\partial Q_o^o}{\partial \epsilon} < 0$, $\frac{\partial P_o^o}{\partial \epsilon} > 0$ and $\frac{\partial W_o^o}{\partial \epsilon} > 0$.*

Proof. These conditions result from the partial derivatives of equations (6). □

Corollary 1 provides some insights about the effect of labour market competition on equilibrium values. The main condition $(A-c)\gamma - \alpha > 0$ simply requires that market capacity is large enough to pay marginal costs, including the minimum wage α.[8] When firms compete more aggressively for labour (*i.e.*, when ϵ increases), they have to pay a higher wage to hire the same amount of labour. This translates into a higher marginal cost of production and will push prices up and quantities down on the product market side. As quantities produced are going down, less labour is needed.

In Corollary 2, we study the impact of N on the OO equilibrium values.

[7] This is assumed for simplicity and it allows us to investigate the impact of N and ϵ on equilibrium values. We allow γ and c to differ across firms for the applications discussed in sections 3 and 4.

[8] Quantities q_o^o and labour l_o^o are positive only when this condition is satisfied; hence we assume it is satisfied for the rest of this paper.

Corollary 2. *When firms are symmetric, the number of firms N has the following impact on equilibrium values:*

- $\frac{\partial l_o^o}{\partial N} < 0$ *and* $\frac{\partial q_o^o}{\partial N} < 0$ *if and only if:*

$$(A - c)\gamma - \alpha > 0$$

- $\frac{\partial L_o^o}{\partial N} < 0$, $\frac{\partial Q_o^o}{\partial N} < 0$ *and* $\frac{\partial P_o^o}{\partial N} > 0$ *if and only if:*

$$\epsilon > \epsilon^p \equiv 2\beta + \gamma^2$$

- $\frac{\partial W_o^o}{\partial N} < 0$ *if and only if:*

$$\epsilon < \epsilon^w \equiv \frac{\beta\gamma^2}{\beta + 2\gamma^2}$$

Proof. These conditions result from the partial derivatives of equations (6). □

Corollary 2 provides some insights about the effect of product market competition on equilibrium values. A decrease in N simply corresponds to a merger in a symmetric market without synergies. The effect of such a merger on individual firms' quantities and labour force is unambiguous.[9] For the other equilibrium values, the effect depends on the intensity of labour market competition.

On the labour market side, when pre-merger competition in the labour market is sufficiently weak (*i.e.*, ϵ is sufficiently low), wage levels increase post-merger. The intuition for this result is as follows: when ϵ is very low, the N firms in the labour market behave as monopsonists. When ϵ is lower than ϵ^w, the labour demand of competitors has little influence on the inverse labour supply curve of a given firm, and this firm can therefore set a wage without fear of losing employees to competitors. However, because of competition in the product market, firms' individual output is higher than pre-merger.[10] As their individual output is higher than pre-merger, their individual labour supply is higher and therefore their wage offering is higher post-merger.

In the product market, the merger does not necessarily raise the price. If firms compete fiercely on the labour market pre-merger (*i.e.*, ϵ is sufficiently high), the transaction will make the price decrease. The intuition is the following: when firms compete aggressively for labour, they are forced to set high wages to reach the labour level necessary to produce their output in the product market. Effectively, this considerably increases the marginal

[9] This effect holds in all cases, as long as market capacity is large enough to pay marginal costs, including the minimum wage α, just like in Corollary 1.

[10] This is a standard Cournot competition result.

cost of production. Post-merger, wages decrease considerably,[11] amounting to a significant reduction in the marginal cost of production, therefore bringing down the price below its pre-merger level.

Therefore, in the OO framework, when firms are symmetric, a reduction in the number of firms may cause prices to decrease or wages to increase, depending on the level of competition for labour market pre-merger. Note that $\epsilon^p > \epsilon^w$ for all values of β and γ,[12] meaning that the region of parameter values for which price decreases post-merger never overlaps with the one for which wage increases. In other words, a merger without synergies can never cause prices to go down and wages to go up at the same time.

Having described the OO framework and its solution, we now explore two applications of this model. First, we investigate the effect of a cost-reducing merger. Second, we describe the effect of a no-poaching agreement.

3 Application 1: Merger Review

A first application of the OO framework is merger review. What are the effects of a merger on product markets and labour markets? How does the inclusion of labour market dynamics in a merger review change the standard assessment of horizontal mergers by competition authorities? In this section, we explore the impact of merger-specific synergies on equilibrium values. More specifically, we consider a non-labour synergy which decreases c post-merger.[13]

Without loss of generality, we denote the merged entity's parameters using the subscript 1. The merged entity may benefit from some synergies (described below), while the rest of the firms are assumed symmetric and unchanged (in cost terms) post-merger. Other firms' parameters and equilibrium values are denoted by the subscript j.

We consider a non-labour synergy such that post-merger, the marginal cost of the merged entity i decreases by factor $\delta_c \in [0, 1]$, such that:

$$c_1^{post-merger} = (1 - \delta_c) c_1^{pre-merger} \tag{7}$$

If $\delta_c = 0.5$, the merged entity's marginal cost c is reduced by 50% post-merger.

In the following subsections, we first introduce the relevant benchmark, and then we

[11] This is the case when ϵ is large enough, that is when $\epsilon > \epsilon^w$.

[12] To see this, it is easy to show that $\epsilon^p - \epsilon^w = \frac{2(\beta+\gamma^2)^2}{\beta+2\gamma^2}$ is always positive as long as β and γ are positive, which is assumed in our model.

[13] We have also considered a labour-related synergy, which increases output per capita γ post-merger, but we do not discuss it in this paper for concision.

discuss the impact of such merger-related synergies on equilibrium values and welfare, both for the benchmark case and for the Oligopoly-Oligopsony case.

3.1 Benchmark case: Perfect Labour Market Competition

In the OO framework, a benchmark corresponds to situations where perfect competition is assumed on one of the markets. In this set-up, there are two possible benchmark cases to be considered, depending on which market is assumed perfectly competitive:

- Perfect Labour Market Competition - Product Market Oligopoly (henceforth, the 'PLMC' benchmark): on the labour market side, firms are "wage takers" and must employ workers at wage w^*. Imperfect competition occurs on the product market side.
- Labour Market Oligopsony - Perfect Product Market Competition (henceforth, the 'PPMC' benchmark): on the product market side, firms are "price takers" and must sell products at price p^*. Imperfect competition occurs on the labour market side.

In this application, we will focus on the first benchmark case, as it corresponds to the current approach of industrial organisation economists and competition authorities when it comes to merger review. However, the second benchmark case, which corresponds to the labour economist's approach, is explored in the second application described in Section 4.

In this section, we assume that firms are wage takers on the product market and the (exogenous) market wage is denoted w^*. Firms only compete on the product market. Hence, firms maximise their profits with respect to l_i:

$$\max_{l_i} \quad \pi_i(l_i) = (P(q_i(l_i), Q_{-i}) - c_i)q_i(l_i) - w^* l_i \tag{8}$$

where $q_i(l_i) = \gamma_i l_i$.

For simplicity, we assume for now that firms are symmetric: for all i, $c_i = c$ and $\gamma_i = \gamma$. This allows us to study directly the effect of a reduction in N on prices and quantities. Maximising the profits and solving for l_i and l_j, we obtain the equilibrium level of labour, quantity, price and profits.

Proposition 2. *Assuming that firms are symmetric, the PLMC benchmark leads to the* *following equilibrium values:*

$$
\begin{aligned}
l_o^{pc}(N) &= \frac{(A-c)\gamma - w^*}{(N+1)\gamma^2} \\
P_o^{pc}(N) &= \frac{A + N(c\gamma + w^*)}{(N+1)\gamma} \\
q_o^{pc}(N) &= \frac{(A-c)\gamma - w^*}{(N+1)\gamma} \\
\pi_o^{pc}(N) &= \frac{((A-c)\gamma - w^*)^2}{(N+1)^2\gamma^2}
\end{aligned}
\tag{9}
$$

Proof. These equilibrium values are obtained by solving the N first-order conditions from the firms' profits maximisation problem described in equation (8). □

The superscript of equilibrium values indicates the labour market set-up ("*pc*" for perfect competition), while the subscript indicates the product market set-up ("*o*" for oligopoly). These equilibrium values are the equivalent of standard Cournot equilibrium, splitting marginal cost between labour and non-labour costs. We can now evaluate the effect of the number of firms on equilibrium values in the symmetric case. Corollary 3 shows that, contrary to the OO case, the effect of N on equilibrium values is unambiguous.

Corollary 3. *In the PLMC benchmark, when firms are symmetric, the impact of the number of firms N on equilibrium values is unambiguous. Whenever $(A-c)\gamma - w^* > 0$, $\frac{\partial l_o^{pc}}{\partial N} < 0$, $\frac{\partial L_o^{pc}}{\partial N} > 0$, $\frac{\partial Q_o^{pc}}{\partial N} > 0$ and $\frac{\partial P_o^{pc}}{\partial N} < 0$.*

Proof. These conditions result from the partial derivatives of equations (9) with respect to N. □

In this set-up, as long as market capacity is large enough and there are no synergies, the merger will unconditionally reduce consumer surplus.[14]

3.2 The effect of a merger with synergies

In the following subsections, we discuss the impact of synergies on equilibrium values, both for the benchmark case and for the Oligopoly-Oligopsony case. In this context, we assume that the merged entity's non-labour cost c decreases post-merger, while the competitors' costs remain symmetric and unchanged.

3.2.1 The impact of synergies in the benchmark case

Let's consider first the benchmark case. In this subsection, we focus on deriving the non-labour cost synergies required for price to decrease post-merger. What non-labour

[14] We extensively discuss consumer surplus definitions and effects in Section 3.3.

cost synergy is needed for post-merger price to remain unchanged? For simplicity, we will denote equilibrium values as a function of the number of firms N and Firm 1's non-labour costs c_1 (*e.g.*, $P_o^{pc}(N, c_1)$). In the PLMC benchmark case, wages are exogenous, so we are only investigating the effect of synergies on prices.

Proposition 3. *In the PLMC benchmark case, the merger will reduce the price post-merger if synergies are large enough. One can show that:*

$$P_o^{pc}(N, c) > P_o^{pc}(N-1, (1-\delta)c) \Leftrightarrow \delta > \delta_b^c \equiv \frac{(A-c)\gamma - w^*}{(N+1)\gamma c} \tag{10}$$

Proof. Straightforward. □

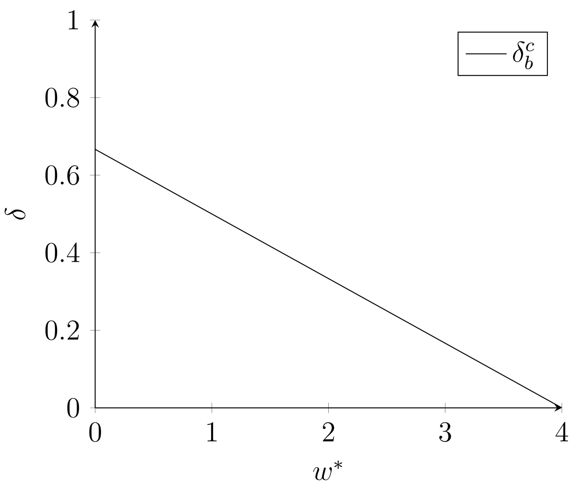

Figure 2: Price decreasing synergies — Benchmark case

Note: In this graph, the parametrization is the following one: $A = 3$, $\gamma = 2$, $c = 1$ and $N = 2$.

The necessary synergy for the merger to reduce price is decreasing with the number of firms, competitive wage and marginal costs, and increasing with labour productivity. Interestingly, as labour becomes more productive, this condition becomes harder to satisfy. The intuition behind this is that when γ is high, all firms pre-merger are producing a high quantity, and therefore the reduction in quantity as a direct result of the merger will have more bite.

3.2.2 The impact of synergies in the Oligopoly-Oligopsony case

Let's now consider the Oligopoly-Oligopsony case. In this subsection, we derive non-labour cost synergies needed to cause a price decrease or a wage increase post-merger. In this set-up, wages are no longer exogenous, so we are investigating the effect of synergies on both prices and wages.

Proposition 4. *In the Oligopoly-Oligopsony case, the merger will reduce the price post-merger if synergies are large enough. There exist unique threshold values δ_p^c and δ_w^c such* *that:*

$$P_o^o(N,c) > P_o^o(N-1,(1-\delta)c) \Leftrightarrow \delta > \delta_p^c \equiv \frac{((A-c)\gamma-\alpha)(2\beta+\gamma^2-\epsilon)}{c\gamma(2\beta+(N+1)\gamma^2+(N-1)\epsilon)}$$

$$W_{1o}^o(N,c) < W_{1o}^o(N-1,(1-\delta)c) \tag{11}$$

$$\Leftrightarrow \delta > \delta_w^c \equiv \frac{((A-c)\gamma-\alpha)(2\beta+\gamma^2-\epsilon)((\beta+2\gamma^2)\epsilon-\beta\gamma^2)}{c\gamma(2\beta+(N+1)\gamma^2+(N-1)\epsilon)(2\beta^2+(N-1)\beta\gamma^2+(N-3)\beta\epsilon-(N-2)\epsilon(\gamma^2+\epsilon))}$$

Proof. Proof is in an online appendix and is available on request. □

This proposition describes the range of synergies for which the merger increases wages and/or decreases prices, represented in Figure 3. When $\delta = 0$, wages increase post-merger if $\epsilon < \epsilon^w$ and prices increase post-merger if $\epsilon > \epsilon^p$. These correspond to the points where the curves hit the x-axis. As the synergy gets larger, the ranges of labour market competition for which wages increase and prices decrease get larger and eventually overlap.

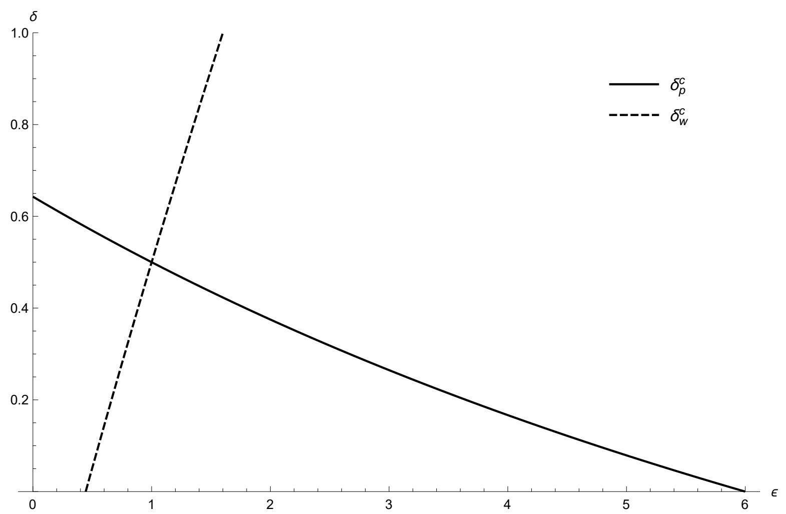

Figure 3: Price decreasing and wage increasing synergies - Oligopoly-Oligopsony case
Note: In this graph, the parametrization is the following one: $A = 3$, $\gamma = 2$, $c = 1$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

Hence, with strong enough non-labour synergies, a horizontal merger may both decrease prices and increase wages. In this area of intermediate ϵ values, a strong enough synergy may provide incentives for the merged entity to increase its volume (and decrease price) to a stage where it needs extra labour and has to pay more for them.

3.3 Welfare implications

In the final subsection of this application, we discuss the welfare implications of a merger in the OO framework, covering both consumers and workers. In particular, we investigate the impact of the merger on both consumer surplus and worker surplus. Since the labour supply and the product curves are linear, these can be summed to assess the overall impact of the merger on workers and consumers. In Cournot competition, consumer surplus is simply measured as follows:

$$CS = \frac{(A - P(Q))Q}{2} \tag{12}$$

This corresponds to the gap between the price charged to consumers and the price they are ready to pay. Analogously, worker surplus can be measured as follows:

$$WS = \frac{(W_1(l_1, L_{-1}) - \alpha)l_1 + (N-1)(W_j(l_j, L_{-j}) - \alpha)l_j}{2} \tag{13}$$

It measures the gap between the wage paid to workers and the wage they are ready to provide labour for.[15] We now investigate the welfare implications of the merger both in the PLMC benchmark case and in the OO framework.

3.3.1 The welfare effect of the merger in the benchmark case

In the PLMC benchmark case, only consumer surplus is to be considered (since labour market is perfectly competitive and is therefore unaffected by the merger). Pre-merger, the consumer surplus in the benchmark case takes the following form:

$$CS_o^{pc}(N, c) = \frac{N^2((A-c)\gamma - w^*)^2}{2(N+1)^2\gamma^2} \tag{14}$$

Post-merger, the consumer surplus in the benchmark case, including non-labour synergies, takes the following form:

$$CS_o^{pc}(N-1, (1-\delta)c) = \frac{\big((N-1)((A-(1-\delta)c)\gamma - w^*)\big)^2}{2N^2\gamma^2} \tag{15}$$

By comparing these, we derive the following proposition.

Proposition 5. *In the PLMC benchmark case, the merger reduces consumer surplus if synergies are too small. In terms of non-labour synergies, one can show that:*

$$\Delta CS_o^{pc} \equiv CS_o^{pc}(N-1, (1-\delta)c) - CS_o^{pc}(N, c) > 0 \Leftrightarrow \delta > \delta_b^c \tag{16}$$

Proof. This threshold is derived from the comparison of equations (14) and (15). □

[15]Note that the wage paid to workers of firm 1 is not identical to the wages paid to workers of other firms, so the worker surplus equation has to incorporate both wages.

Consumer surplus increases post-merger as long as the synergy is large enough to reduce prices. In Figure 4, we plot the range of synergies for which the merger increases consumer surplus. This area gets wider as the exogenous wage decreases. In the PLMC framework (*i.e.*, the current approach of the competition authorities), merger review is not taking into account the impact on labour market competition, and the necessary synergy for the merger to not decrease consumer surplus is a simple function of pre-merger market size and marginal costs.

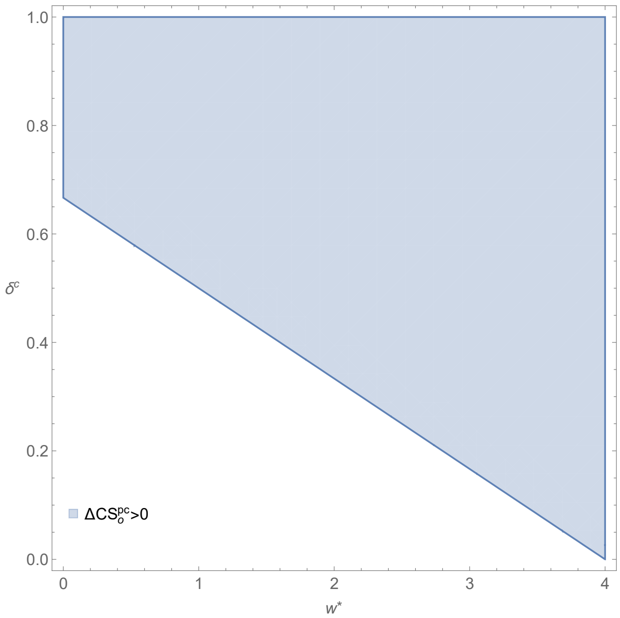

Figure 4: Welfare effect — PLMC benchmark case

Note: In this graph, $A = 3$, $\gamma = 2$, $c = 1$ and $N = 2$. For parameter values within the blue area, the merger increases consumer surplus.

3.3.2 The welfare effect of a merger in the Oligopoly-Oligopsony set-up

In the OO case, the welfare standard must include both consumer surplus and worker surplus. While it is possible to express the below surpluses and solutions in closed-form, the resulting expression is very long and not shown here. Therefore, for ease of exposition, we present the welfare values for the specific case where $N = 2$. Pre-merger, the consumer and worker surpluses in the OO case take the following form:

$$\begin{aligned} CS_o^o(2, c) &= \frac{2\gamma^2((A-c)\gamma - \alpha)^2}{(2\beta + 3\gamma^2 + \epsilon)^2} \\ WS_o^o(2, c) &= \frac{(\beta + \epsilon)((A-c)\gamma - \alpha)^2}{(2\beta + 3\gamma^2 + \epsilon)^2} \end{aligned} \tag{17}$$

Post-merger, including non-labour synergies, consumer surplus in the OO case takes the following form:

$$
\begin{aligned}
CS_o^o(1,(1-\delta)c) &= \frac{\gamma^2\big((A-(1-\delta)c)\gamma-\alpha\big)^2}{8(\beta+\gamma^2)^2} \\
WS_o^o(1,(1-\delta)c) &= \frac{\beta\big((A-(1-\delta)c)\gamma-\alpha\big)^2}{8(\beta+\gamma^2)^2}
\end{aligned}
\tag{18}
$$

Using the above equations, we derive the range of synergies for which consumer surplus increases, for which worker surplus increases, and for which total surplus, defined as the sum of consumer and worker surpluses, increases.

Proposition 6. *In the Oligopoly-Oligopsony case, there exists a unique set of synergy thresholds above which the merger increases consumer surplus and/or worker surplus.*

$$
\begin{aligned}
\Delta CS_o^o &\equiv CS_o^o(1,(1-\delta)c) - CS_o^o(2,c) > 0 \Leftrightarrow \delta > \delta_p^c \\
\Delta WS_o^o &\equiv WS_o^o(1,(1-\delta)c) - WS_o^o(2,c) > 0 \\
&\Leftrightarrow \delta > \delta_{WS}^c \equiv 1 - \frac{c\beta\gamma(A\gamma-\alpha) - 2\sqrt{2}(\beta+\gamma^2)^2\sqrt{\frac{c^2\beta\gamma^2((A-c)\gamma-\alpha)^2(\beta+\epsilon)}{(\beta+\gamma^2)^2(2\beta+3\gamma^2+\epsilon)^2}}}{c^2\beta\gamma^2} \\
\Delta TS_o^o &\equiv CS_o^o(1,(1-\delta)c) - CS_o^o(2,c) + WS_o^o(1,(1-\delta)c) - WS_o^o(2,c) > 0 \\
&\Leftrightarrow \delta > \delta_{TS}^c \equiv 1 - \frac{c\gamma(A\gamma-\alpha) - 2\sqrt{2}(\beta+\gamma^2)\sqrt{\frac{c^2\gamma^2((A-c)\gamma-\alpha)^2(\beta+2\gamma^2+\epsilon)}{(\beta+\gamma^2)(2\beta+3\gamma^2+\epsilon)^2}}}{c^2\gamma^2}
\end{aligned}
\tag{19}
$$

Proof. These thresholds are derived from the comparison of equations (17) and (18). □

It is now possible to plot the area covered by the thresholds defined in Proposition 6. In the orange area, worker surplus is improved by the merger. In the blue area, the consumer surplus is improved post-merger. In the green area, the total surplus is improved post-merger.

The merger has two opposing effects. On the one hand, when ϵ is large (strong labour market competition), the merger reduces prices and is beneficial to consumers. On the other hand, when ϵ is small (strong oligopsony power), the merger increases wages and is beneficial to workers. For a certain level of non-labour synergies δ and for intermediate values of labour market competition ϵ, both workers and consumers may benefit from the merger.

It is important to note that the range of parameters for which the consumer surplus increases is identical to the one for which price decreases. This is because product competition is not in differentiated products, therefore all consumers face the same price. When the merger decreases prices, all consumers benefit equally. However, on the labour market

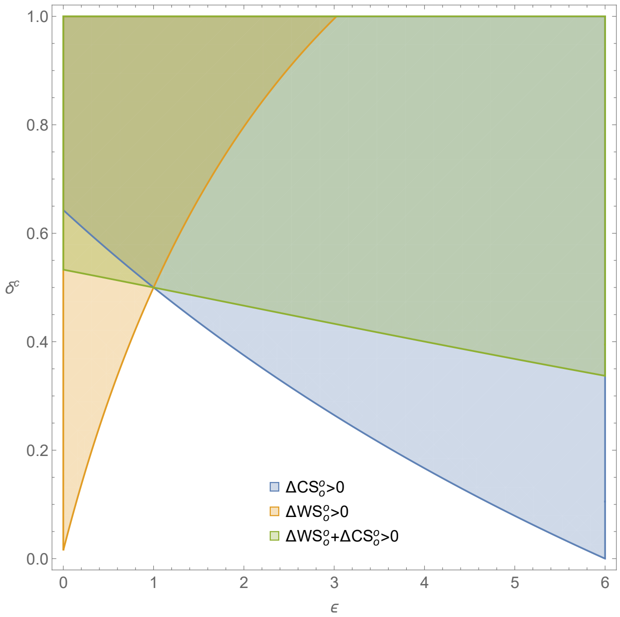

Figure 5: Welfare effect - Oligopoly-Oligopsony case
Note: In this graph, $A = 3$, $\gamma = 2$, $c = 1$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

side, the range of parameters for which the merger increases worker surplus is not identical to the the range of parameters for which the wage paid by merged entity increases (*i.e.*, $\delta^c_{WS} \neq \delta^c_w$). This is because the labour supply function is differentiated, and the workers of merged firm 1 do not benefit from the same wage as employees of competitors. For worker surplus to increase, all workers need to benefit from the merger, not only Firm 1's workers.

The green area in Figure 5 identifies the parameter values for which the merger enhances the surplus of both workers and consumers. Hence, when $\delta^c_p < \delta^c_{TS} < \delta^c_{WS}$, the consumer surplus benefit from the merger is large enough to compensate for the loss experienced by workers. Conversely, when $\delta^c_{WS} < \delta^c_{TS} < \delta^c_p$, the consumer surplus losses from the merger are compensated by the worker surplus gains. Therefore, whenever a merger falls in the green area described above, a competition authority aiming at maximising total surplus should authorise the transaction.

4 Application 2: No-poaching agreements

A second application of the OO framework is no-poaching agreements. What are the effects of a no-poaching agreement on product markets and labour markets? How should competition authorities review such practices? In this section, we explore the impact of a no-poaching agreement improving the productivity of labour. More specifically, we are evaluating the degree of labour productivity improvement (*i.e.*, γ increase) which would compensate the effect of a no-poaching agreement (*i.e.*, bringing ϵ down to zero) on workers and consumers.

This is in line with a specific efficiency defence of no-poaching agreements. As discussed by Krueger and Ashenfelter (2022), no-poaching agreements affect the incentives of employers and workers to invest in human capital. If workers are unable to change firms, employers retain the benefits from training employees. This increases both firms' incentives to invest in human capital and workers' productivity. In a similar mechanism as the classical "hold-up" issue, firms may have lower incentives to invest in its employees' human capital (*e.g.*, training, business secrets, etc.) if they fear that a competitor will steal this "improved" labour force and benefit from such an investment. As a result, no firm invests in human capital. In that context, a no-poaching agreement allows to eliminate this hold-up issue, and firms invest in their workers such that their productivity is improved.

To investigate the effect of no-poaching agreements on product and labour markets, we assume that all competitors sign such an agreement, making ϵ go to zero. We also assume that the agreement increases labour productivity γ by a factor $\delta_\gamma \geq 0$, such that:

$$\gamma_i^{no-poach} = (1 + \delta_\gamma)\gamma_i^{pre-agreement} \tag{20}$$

If $\delta_\gamma = 0.5$, labour productivity γ is increased by 50% when a no-poaching agreement is enforced.

In the following subsections, we first introduce the relevant benchmark. We then discuss the impact of such an agreement on equilibrium values and welfare, both for the benchmark case and for the Oligopoly-Oligopsony case.

4.1 Benchmark case: Perfect Product Market Competition

In this application, we will focus on the PPMC (Perfect Product Market Competition) benchmark case: on the product market side, firms are "price takers" and must sell products at price p^*. Imperfect competition occurs on the labour market side. This corresponds to the current approach of labour economists when analysing the effects of labour market collusion and no-poaching agreements.[16]

In the PPMC benchmark, we assume that firms are price takers on the product market and the (exogenous) market price is denoted p^*. Firms compete for labour only on the labour market. Hence, firms maximise their profits with respect to l_i:

$$\max_{l_i} \quad \pi_i(l_i) = (p^* - c_i)q_i(l_i) - W_i(l_i, L_{-i})l_i \tag{21}$$

where $q_i(l_i) = \gamma_i l_i$.

[16] For example, Shelkova (2015)'s model of collusion in low-wage labour markets assumes perfectly competitive product markets.

For simplicity and for now, we assume that firms are symmetric: for all i, $c_i = c$ and $\gamma_i = \gamma$. This allows us to study directly the effect of a reduction in ϵ on labour supply and wages. Maximising the profits and solving for l_i and l_j, we obtain the equilibrium level of labour, quantity, price and profits.

Proposition 7. *Assuming that firms are symmetric, the PPMC benchmark leads to the following equilibrium values:*

$$\begin{aligned} l^o_{pc}(\epsilon) &= \frac{(p^* - c)\gamma - \alpha}{2\beta + (N-1)\epsilon} \\ W^o_{pc}(\epsilon) &= \frac{(p^* - c)\gamma(\beta + (N-1)\epsilon) + \alpha\beta}{2\beta + (N-1)\epsilon} \\ q^o_{pc}(\epsilon) &= \frac{\gamma((p^* - c)\gamma - \alpha)}{2\beta + (N-1)\epsilon} \\ \pi^o_{pc}(\epsilon) &= \frac{\beta((p^* - c)\gamma - \alpha)^2}{(2\beta + (N-1)\epsilon)^2} \end{aligned} \tag{22}$$

Proof. These equilibrium values are obtained by solving the N first-order conditions from the firms' profits maximisation problem described in equation (21). □

The superscript of equilibrium values indicates the labour market set-up ("*o*" for oligopsony), where the subscript indicates the product market set-up ("*pc*" for perfect product market competition). These equilibrium values define the usual "mark-down" from labour models, in which a firm sets the wage below the price level. We can now evaluate the effect of the strength of competition for labour on equilibrium values in the symmetric case. Corollary 4 shows that the effect of ϵ on equilibrium values is unambiguous.

Corollary 4. *In the PPMC benchmark, when firms are symmetric, the impact of the strength of labour market competition ϵ on equilibrium values is unambiguous. Whenever $(p^* - c)\gamma - \alpha > 0$, $\frac{\partial l^o_{pc}}{\partial \epsilon} < 0$, $\frac{\partial L^o_{pc}}{\partial \epsilon} < 0$, $\frac{\partial Q^o_{pc}}{\partial \epsilon} < 0$ and $\frac{\partial W^o_{pc}}{\partial \epsilon} > 0$.*

Proof. These conditions result from the partial derivatives of equations (22) with respect to ϵ. □

Therefore, the mechanism underlying the effect of ϵ on the PPMC equilibrium values is similar to the one described in Corollary 1. Labour competition forces firms to increase their wage offering, resulting in lower output, labour and profits.

4.2 The effect of a no-poaching agreement

In the following subsections, we discuss the impact of a productivity increasing no-poaching agreement on equilibrium values, both for the benchmark case and for the Oligopoly-Oligopsony case. In this context, we assume that the strength of competition for labour ϵ goes to zero and the productivity parameter γ increases by δ_γ after the no-poaching agreement, for all firms.

4.2.1 The impact of the no-poaching agreement in the benchmark case

Let's consider first the benchmark case. In this subsection, we focus on deriving the δ_γ needed to cause a wage increase once the no-poaching agreement is enforced. What labour productivity increase is needed for wages to remain unchanged by a no-poaching agreement? For simplicity, we denote equilibrium values as a function of the strength of competition for labour ϵ and the firms' productivity of labour γ. Firms are symmetric before and after the enforcement of the no-poaching agreement. In the PPMC benchmark case, prices are exogenous, so we are only investigating the effect of the agreement on wages. In the below, we derive the level of labour market competition (prior to the no-poaching agreement) below which the agreement increases wages.[17]

Proposition 8. *In the PPMC benchmark case, a no-poaching agreement increases wages if the productivity increase is large enough. One can show that:*

$$W^o_{pc}(\epsilon,\gamma) < W^o_{pc}(0,(1+\delta)\gamma) \Leftrightarrow \epsilon < \epsilon^\gamma_b \equiv \frac{2(p^*-c)\beta\gamma\delta}{(N-1)((p^*-c)\gamma(1-\delta)-\alpha)} \tag{23}$$

Proof. This threshold is derived from the equilibrium values described in equations (22). □

The first-order effect of a no-poaching agreement is to reduce labour market competition (*i.e.*, bring ϵ to zero), which shifts wages down. Absent any changes in labour productivity, the no-poaching agreement is necessarily detrimental to workers (as explained in Corollary 4). If the no-poaching agreement increases the productivity of labour (*i.e.*, $\delta_\gamma > 0$), firms have incentives to hire more workers, and as a result, wages increase. The bigger the increase in productivity, the higher the wages. Therefore, if δ_γ is large enough, the no-poaching agreement increases wages.

The level of labour market competition prior to the agreement is very important: the larger ϵ is before the no-poaching agreement, the larger the compensating productivity increase must be. Indeed, when ϵ is high, the no-poaching agreement has a very strong negative impact on wages, such that the labour productivity increase needed to compensate this effect must be larger.

[17] We present the result in terms of ϵ as a function of δ for better comparability with later propositions. It is possible to derive the same proposition in terms of δ as a function of ϵ

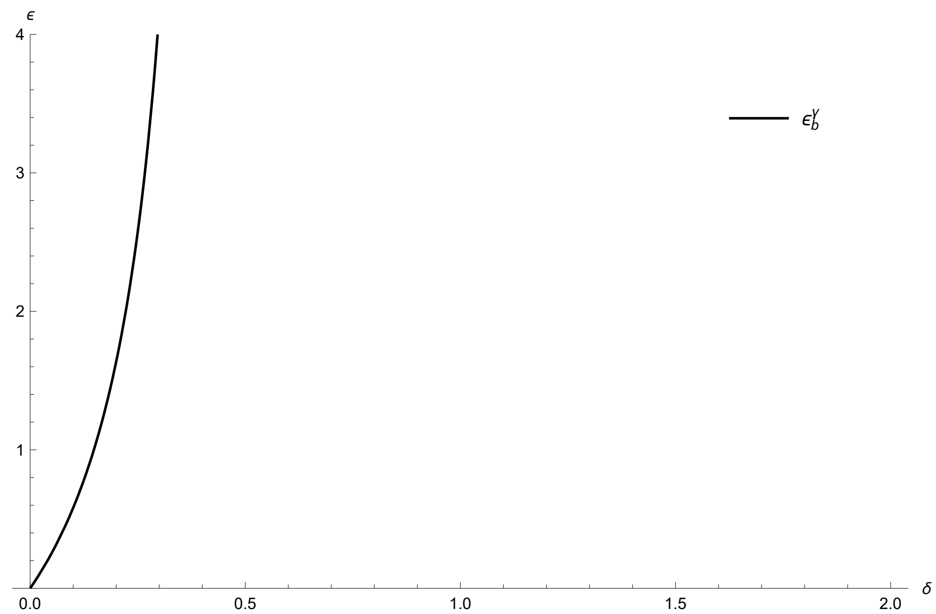

Figure 6: Wage increasing no-poaching — PPMC case

Note: In this graph, $p^* = 3$, $c = 1.2$, $\beta = 1$, $\alpha = 1$, $\gamma = 1$ and $N = 2$.

4.2.2 The impact of a no-poaching agreement in the Oligopoly-Oligopsony case

Let's now consider the Oligopoly-Oligopsony case. In this subsection, we derive the labour productivity increase needed to cause a price decrease and/or a wage increase following the no-poaching agreement. In this set-up, prices are no longer exogenous, so we are investigating the effect of the no-poaching agreement on both prices and wages.

Proposition 9. *In the Oligopoly-Oligopsony case, the no-poaching agreement always reduces product prices. It will increase wages only if labour productivity increase is large enough. There exists a unique threshold value* ϵ_γ^w *such that:*

$$\begin{aligned} &W_o^o(\epsilon,\gamma) < W_o^o(0,(1+\delta)\gamma) \\ &\Leftrightarrow \epsilon < \epsilon_w^\gamma \equiv \frac{\beta\gamma\delta\big(2\beta(A-c)+(N-1)\alpha\gamma-(N+1)\gamma(1+\delta)((A-c)\gamma-\alpha)\big)}{(N-1)\big(((A-c)\gamma-\alpha)(\beta+(N-1)\gamma^2(1+\delta)^2)-\beta(A-c)\gamma\big)} \end{aligned} \tag{24}$$

Proof. The result for prices is implied by Corollary 1. For wages, it results from the comparison of equilibrium values described in equations (6). □

On the product market side, the effect of the no-poaching agreement is unambiguous: it necessarily reduces the product price. This is the case without any labour productivity increase, and when δ_γ is positive, it further reduces the price. This is because reducing labour market competition brings down wages, hence reducing marginal costs of production. A labour productivity increase further expands output, which, in a classic Cournot fashion, reduces prices.

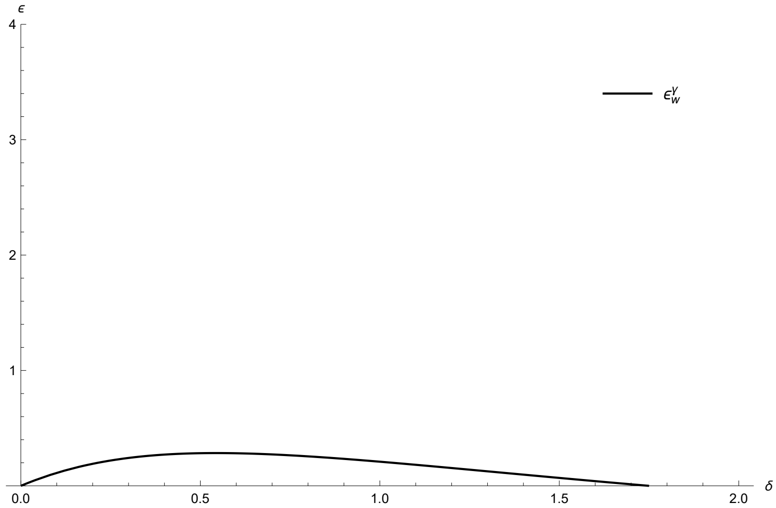

Figure 7: Wage increasing no-poaching - Oligopoly-Oligopsony case
Note: In this graph, the parametrization is the following one: $A = 3$, $\gamma = 1$, $c = 1.2$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

On the labour market side, the comparison of Figure 6 and 7 indicates that the inclusion of product market dynamics has a significant impact on the wage effect of no-poaching agreements. First of all, the no-poaching agreement has a positive impact on wages only if the labour market competition is low enough prior to the agreement. At first, increasing the labour productivity widens the range of ϵ for which the agreement increases wages. This effect is similar to the PPMC benchmark: as the labour productivity is increased, firms have an incentive to expand their output, hire more workers and increase wages. However, as the labour productivity becomes larger, the incentive to expand is compensated by the incentive to increase margins: once the market has reached a certain scale, firms have incentives to maintain their output level to reduce their labour force, and therefore reduce their wage offering.

4.3 Welfare implications

In the final subsection of this application, we discuss the welfare implications of a no-poaching agreement in the OO framework, which includes both consumers and workers. We use the same welfare definitions as in section 3.3, but we express them as a function of competition for labour ϵ and the labour productivity of firms γ. We now investigate welfare implications both in the PLMC benchmark case and in the OO framework.

4.3.1 The welfare effect of the no-poaching agreement in the PPMC benchmark case

In the PPMC benchmark case, only worker surplus is to be considered (since the product market is perfectly competitive and is therefore unaffected by the no-poaching agreement). Before the no-poaching agreement, the worker surplus in the benchmark case takes the following form:

$$WS^{o}_{pc}(\epsilon,\gamma) = \frac{N((p^{*}-c)\gamma-\alpha)^{2}(\beta+(N-1)\epsilon)}{2(2\beta+(N-1)\epsilon)^{2}} \tag{25}$$

When the no-poaching agreement is implemented, the worker surplus in the PPMC benchmark case, including labour productivity increase, takes the following form:

$$WS^{o}_{pc}(0,(1+\delta)\gamma) = \frac{N((p^{*}-c)\gamma(1+\delta)-\alpha)^{2}}{8\beta} \tag{26}$$

By comparing these, we derive the following proposition.

Proposition 10. *In the PPMC benchmark case, the no-poaching agreement will always increase worker surplus.*

Proof. The quantity $WS^{o}_{pc}(\epsilon,\gamma) - WS^{o}_{pc}(0,(1+\delta)\gamma)$ is always negative. □

Hence, in the PPMC benchmark, the no-poaching agreement always increases worker surplus, even when it causes wages to go down. It comes from the fact that labour simultaneously increases, and does so significantly enough to compensate for the loss in wage, from a welfare perspective.

4.3.2 The welfare effect of a no-poaching agreement in the Oligopoly-Oligopsony set-up

In the OO case, the welfare standard changes and must include both consumer surplus and worker surplus. Prior to the no-poaching agreement, the consumer and worker surpluses in the OO case take the same form as equations (17). In this section, we also present a simplified case where there are only two firms in the market. Once the no-poaching agreement is implemented, consumer surplus in the OO case, including non-labour synergies, takes the following form:

$$\begin{aligned} CS^{o}_{o}(0,(1+\delta)\gamma) &= \frac{2\gamma^{2}(1+\delta)^{2}\big((A-c)\gamma(1+\delta)-\alpha\big)^{2}}{(2\beta+3\gamma^{2}(1+\delta)^{2})^{2}} \\ WS^{o}_{o}(0,(1+\delta)\gamma) &= \frac{\beta\big((A-c)\gamma(1+\delta)-\alpha\big)^{2}}{(2\beta+3\gamma^{2}(1+\delta)^{2})^{2}} \end{aligned} \tag{27}$$

Using the above equations, we derive the level of competition for labour and the productivity increase for which consumer surplus increases, for which worker surplus increases, and for which total surplus increases.

Proposition 11. *In the Oligopoly-Oligopsony case, the no-poaching agreement always increases consumer surplus and total surplus. There exist a unique set of labour productivity increase thresholds for which the no-poaching agreement increases the worker surplus.*

$$\Delta WS_o^o \equiv WS_o^o(0,(1+\delta)\gamma) - WS_o^o(\epsilon,\gamma) > 0 \Leftrightarrow \delta < \delta_{WS1}^{\gamma} or \quad \delta > \delta_{WS2}^{\gamma} \tag{28}$$

Proof. Both CS_o^o and TS_o^o are decreasing with ϵ, regardless of the value taken by δ_γ. Solving $WS_o^o(N) - WS_o^o(N-1,\delta) = 0$ with respect to δ yields the two thresholds δ_{WS1}^{γ} and δ_{WS2}^{γ}. The exact formulae are not in this draft but are available on request. A graphical exposition is presented below. □

It is now possible to plot the area covered by the thresholds defined in Proposition 11. In the blue area, the no-poaching agreement improves worker surplus.

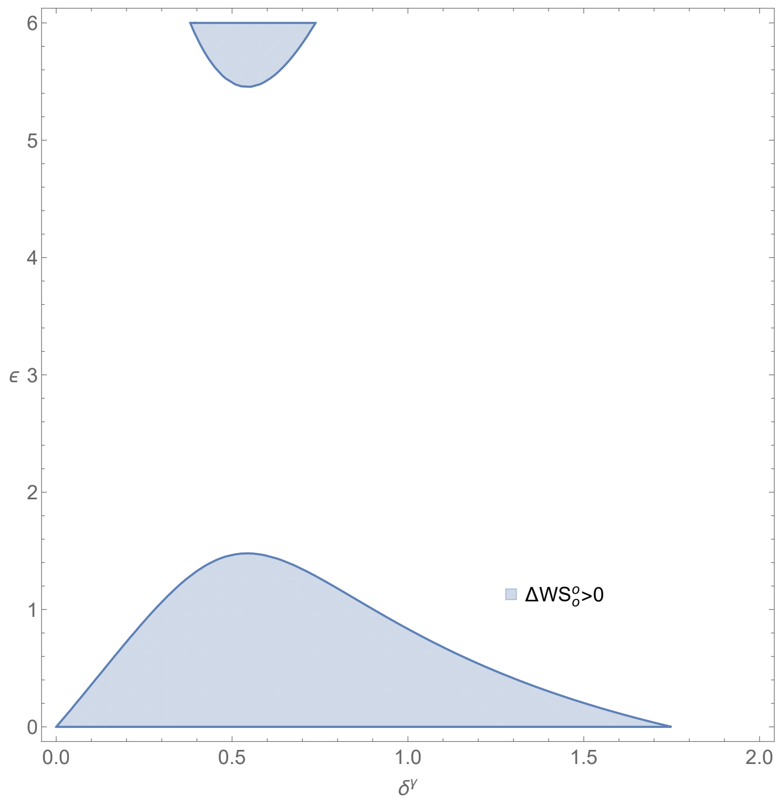

Figure 8: Welfare effect of no-poaching - Oligopoly-Oligopsony case
Note: In this graph, $A = 3$, $\gamma = 1$, $c = 1.2$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

Interestingly, in the OO model, a no-poaching agreement necessarily increases consumer surplus and total surplus. As the labour market competition is eliminated, the end-price considerably decreases and output increases due to the reduction in wages. Even without any productivity improvement, the no-poaching agreement increases consumer surplus due to this effect.

From the workers' perspective, the no-poaching agreement improves surplus only for intermediate values of productivity improvement, and for either small or very high levels of labour market competition. When ϵ is very small, the level of labour market competition was already low prior to the agreement, so the productivity gains from eliminating labour market competition benefit the workers. On the other hand, when ϵ is very high, wages end up very high and firms are constrained to hire a small number of workers and produce small quantities. In that context, the no-poaching agreement is going to drastically increase labour supply and will compensate for the wage loss.

Ultimately, in the OO model, the consumer surplus gains always outweigh the possible worker surplus losses. Interestingly, the OO model suggests that no-poaching agreements should not be prevented.

5 Conclusion

Competition enforcers are looking with increased interest at the labour market effects of consolidation of product market power and no-poaching agreements. The economic literature has shown renewed interest in these issues.

Under a theoretical model that allows for imperfect competition on product and labour markets (the 'OO' model), we analyse the effects of mergers and no-poaching agreements on both product and labour markets, and their welfare effects. Crucially, the OO model allows us to extend the welfare analysis to both consumer surplus and worker surplus.

Absent synergies, mergers unambiguously reduce quantities and the demand for labour. However, the effect on prices is ambiguous: mergers reduce prices when competition for labour is sufficiently high (high ϵ), as such mergers reduce the intensity of labour market competition and therefore reduce wages. When competition for labour is sufficiently low (low ϵ) however, mergers may increase wages.

Sufficiently high non-labour synergies (i.e., synergy that decreases their marginal costs) for the merging firms can reduce prices. As synergies get larger, there is more scope for mergers to both reduce prices and increase wages.

No-poaching agreements, even absent increases in the firms' productivity of labour, reduce product prices. No-poaching agreements generally have a negative impact on wages, but can be beneficial to workers when the increase in productivity of labour is high enough to incentivise firms to expand their output and employment.

We see many potential extensions and applications of our model. In this model, we assumed that firms compete horizontally, in the same labour and product market. In reality, while some firms may compete in a specific labour market, they may compete in a very different product market. Hence, one possible extension of this model would be to evaluate the effect of a merger between firms competing in the labour market, but not competing in the product market. Another extension would be to study different product market structures. For instance, it could be the case that firms in a vertical relationship may compete for the same workers. In that case, one could study the effect of a vertical merger happening in the product market, while on the labour market, this merger would be horizontal.

The extent to which competition authorities should be tasked to assess labour markets remains an open question. It also remains open how competition authorities should in practice consider labour market effects in their review or mergers, and how they should assess no-poaching agreements. Addressing these questions will require developing a framework to extend or adapt to labour markets the standard competition tools, such as market definition and the SSNIP test, the assessment of closeness of competition, the evaluation of a competitive level for wages and wage mark-downs. Our model highlights key market characteristics that should be considered in the assessment. These include the intensity of labour market competition (affected by search costs and idiosyncrasies), the level of synergies brought about by a merger, and the level of productivity increase generated by a no-poaching agreement.

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