Oligopoly-Oligopsony Model: Theory and Applications

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Motivation

- 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, non-compete agreements, and no-poaching agreements.
  - **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.

Motivation - Policy Review

- **The US**: 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.
- **The UK**: As recently as February 2023, the CMA issued guidance to employers on how to avoid anticompetitive behaviour in labour markets.
- **The EU**: Various member states have intervened to safeguard employees in mergers under “public interest considerations” provisions of national law (separate from competition law).

The OO model - Key Results

- In terms of theoretical literature, Ornaghi and Tong (2021) is the only model that considers both product market and labour market (imperfect) competition in a partial equilibrium set-up.
- In this paper, we present a theoretical model that allows for imperfect competition on product and labour markets (the Oligopoly-Oligopsony model). Then, we explore two applications:
  - **Application 1: merger review –** Using this set-up, we evaluate the impact of a cost-reducing merger on prices, wages, employment and quantities.
  - **Application 2: no-poaching agreements –** We also investigate the impact of a productivity-increasing no-poaching agreement.

The Set-Up

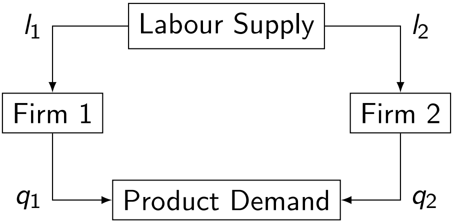

Figure: The set-up, for $N = 2$

Labour Supply, Product Demand and Productivity

- 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 $\alpha \geq 0$, $\beta \geq 0$, $\epsilon \geq 0$ and where $L_{-i} = \sum_{j \neq i}^{N} l_j$.

- The product market inverse demand function is simply

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

where $Q = \sum_{i}^{N} q_i$ and $A > 0$.

Profit function

- 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:

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

Solving the Oligopoly-Oligopsony model - Insights

- We evaluate the equilibrium levels of labour, quantity, price and wage when firms are symmetric. (Proposition 1)
- We show that, when firms are symmetric, the impact of the degree of competition on the labour market ϵ on equilibrium values is unambiguous. (Corollary 1)
  - When firms compete more aggressively for labour, wages and prices are higher, and quantities and employment are lower.
- We show that, when firms are symmetric, the impact of the number of firms N on equilibrium values is ambiguous. (Corollary 2)
  - When labour market competition ϵ is low, a reduction in the number of firms can increase wages.
  - When labour market competition ϵ is high, a reduction in the number of firms can reduce prices.

Proposition 1 Corollary 1 Corollary 2

Application 1: Merger Review

- How does the inclusion of labour market dynamics in a merger review change the standard assessment of horizontal mergers by competition authorities?
- We consider a non-labour synergy such that post-merger, the marginal cost of the merged entity Firm 1 decreases by factor $\delta_c \in [0, 1]$, such that:

$$c_1^{post-merger} = (1 - \delta_c)c_1^{pre-merger} \tag{5}$$

- In the Oligopoly-Oligopsony case, the merger will reduce the price and increase the merged entity's wage post-merger if synergies are large enough. (Proposition 4)

Proposition 3 Proposition 4

The impact of synergies in the Oligopoly-Oligopsony case

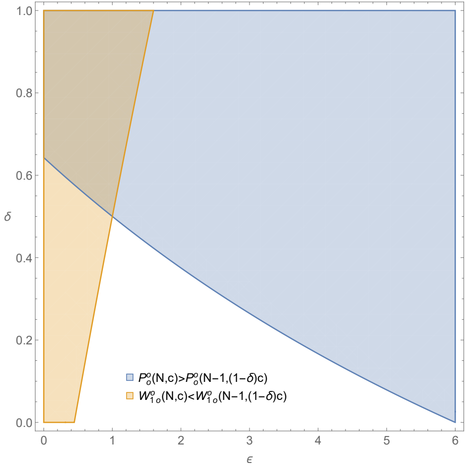

Figure: Price decreasing and wage increasing synergies - Oligopoly-Oligopsony case

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

The welfare effect of the merger

- 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 Cournot competition, consumer surplus is simply $CS = \frac{(A-P(Q))Q}{2}$
- Analogously, worker surplus can be measured as follows:

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

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

Proposition 5 Proposition 6

The welfare effect of a merger in the OO set-up

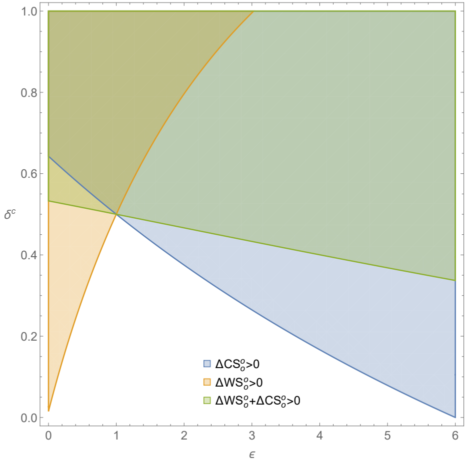

Figure: Welfare effect - Oligopoly-Oligopsony case

Note: In this graph, $A = 3$, $\gamma = 2$, $c = 1$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

Application 2: No-poaching agreements

- What are the effects of a no-poaching agreement increasing labour productivity on product and labour markets?
- We assume that the agreement brings the level of labour competition ϵ to zero and increases labour productivity γ by a factor $\delta_\gamma \geq 0$, such that:

$$\gamma_i^{no-poach} = (1 + \delta_\gamma)\gamma_i^{pre-agreement} \tag{6}$$

- 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. (Proposition 9)

Proposition 8 Proposition 9

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

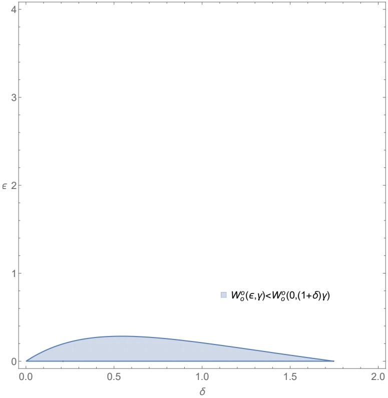

Figure: Wage increasing no-poaching - Oligopoly-Oligopsony case

Note: In this graph, the parametrization is the following one: $A = 3$, $\gamma = 1$, $c = 1.2$, $N = 2$, $\alpha = 1$ and $\beta = 1$.

The welfare effect of the no-poaching agreement

- 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. (Proposition 11)
- Hence, in the OO model, the consumer surplus gains always outweigh the possible worker surplus losses.

Proposition 10 Proposition 11

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

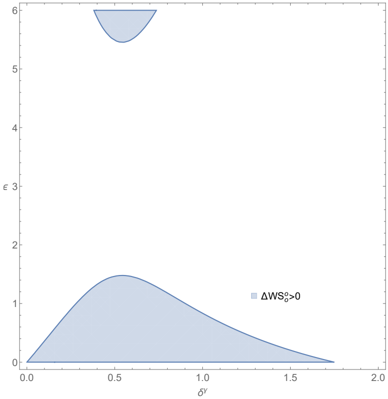

Figure: Welfare effect of no-poaching - Oligopoly-Oligopsony case

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

Conclusion

- Competition enforcers are looking with increased interest at the labour market effects of consolidation of product market power and no-poaching agreements.
- Under a theoretical model that allows for imperfect competition on product and labour markets, we analyse the effects of mergers and no-poaching agreements on both product and labour markets, and their welfare effects.
    - Sufficiently high non-labour synergies 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.
- The extent to which competition authorities should be tasked to assess labour markets remains an open question.

Thank You!

Solving the Oligopoly-Oligopsony model

Proposition 1

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

$$l_o^o = \frac{(A-c)\gamma - \alpha}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon}$$

$$W_o^o = \frac{(A-c)\gamma(\beta + (N-1)\epsilon) + \alpha(\beta + (N+1)\gamma^2)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon}$$

$$q_o^o = \frac{\gamma\big((A-c)\gamma - \alpha\big)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon}$$

$$P_o^o = \frac{(N-1)A\epsilon + A(2\beta + \gamma^2) + N\gamma(c\gamma + \alpha)}{2\beta + (N+1)\gamma^2 + (N-1)\epsilon}$$

Back

Solving the Oligopoly-Oligopsony model

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 $\frac{\partial W_o^o}{\partial \epsilon} > 0$.

- 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.
- 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.

Back

Solving the Oligopoly-Oligopsony model

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:

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

Back

Benchmark case: Perfect Labour Market Competition

Proposition 2

Assuming that firms are symmetric, the PLMC benchmark leads to the following equilibrium values:

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

$$P_o^{pc}(N) = \frac{A + N(c\gamma + w^*)}{(N+1)\gamma}$$

$$q_o^{pc}(N) = \frac{(A-c)\gamma - w^*}{(N+1)\gamma}$$

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

Back

Benchmark case: Perfect Labour Market Competition

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 $\frac{\partial P_o^{pc}}{\partial N} < 0$.

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

Back

The impact of synergies in the benchmark case

Proposition 3

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

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

Back

The impact of synergies in the Oligopoly-Oligopsony case

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:

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

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

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

Back

The welfare effect of the merger in the benchmark case

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:

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

Consumer surplus increases post-merger as long as the synergy is large enough to reduce prices.

Back

The welfare effect of a merger in the OO set-up

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. For $N = 2$:

$$\Delta CS_o^o \equiv CS_o^o(1, (1-\delta)c) - CS_o^o(2, c) > 0 \Leftrightarrow \delta > \delta_p^c$$

$$\Delta WS_o^o \equiv WS_o^o(1, (1-\delta)c) - WS_o^o(2, c) > 0$$

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

$$\Delta TS_o^o \equiv CS_o^o(1, (1-\delta)c) - CS_o^o(2, c) + WS_o^o(1, (1-\delta)c) - WS_o^o(2, c) > 0$$

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

Back

Benchmark case: Perfect Product Market Competition

Proposition 7

Assuming that firms are symmetric, the PPMC benchmark leads to the following equilibrium values:

$$l^o_{pc}(\epsilon) = \frac{(p^* - c)\gamma - \alpha}{2\beta + (N-1)\epsilon}$$

$$W^o_{pc}(\epsilon) = \frac{(p^* - c)\gamma(\beta + (N-1)\epsilon) + \alpha\beta}{2\beta + (N-1)\epsilon}$$

$$q^o_{pc}(\epsilon) = \frac{\gamma((p^* - c)\gamma - \alpha)}{2\beta + (N-1)\epsilon}$$

$$\pi^o_{pc}(\epsilon) = \frac{\beta((p^* - c)\gamma - \alpha)^2}{(2\beta + (N-1)\epsilon)^2}$$

Back

Benchmark case: Perfect Product Market Competition

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 $\frac{\partial W^o_{pc}}{\partial \epsilon} > 0$.

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.

Back

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

- In the following, 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.

Proposition 8

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

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

Back

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

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:

$$W_o^o(\epsilon, \gamma) < W_o^o(0, (1+\delta)\gamma)$$

$$\Leftrightarrow \epsilon < \epsilon_w^{\gamma} \equiv \frac{\beta\gamma\delta\big(2\beta(A-c) + (N-1)\alpha\gamma - (N+1)\gamma(1+\delta)((A-c)\gamma - \alpha)\big)}{(N-1)\big(((A-c)\gamma - \alpha)(\beta + (N-1)\gamma^2(1+\delta)^2) - \beta(A-c)\gamma\big)}$$

Back

The welfare effect of the no-poaching agreement in the PPMC Benchmark

- 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).

Proposition 10

In the PPMC benchmark case, the no-poaching agreement always increases worker surplus.

Back

The welfare effect of the 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.

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.

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

Back