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Abstract

We analyse takeovers in an industry with bilateral capital-linked firms in Cross Partial Ownerships (CPO). We find conditions for stable equilibria in takeovers with the target being inside or outside of a CPO arrangement. The impact of CPO upon profitability for the raider, the target and the rest of the industry is two-sided in a Cournot setting and depends on the value of CPO and on the type of target. CPO shows anticompetitive effects by facilitating mergers in most cases. However, a protective threshold (takeover ratio<1) exists below which CPO arrangements can reduce the incentives for a hostile takeover of a targeted member of the CPO agreement. Further, even above this protective threshold CPO may make hostile (protected) takeovers less profitable than a benchmark industry without CPO (a result with potentially significant regulatory implications). An empirical application showcases the potential relevance of CPO as a defence against hostile takeovers across different industries.

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1 Introduction

The analysis of takeovers incentives is generally associated with the "outsider effect" of mergers (Salant et al, 1983). In a Cournot-organized industry, the benefits of staying outside of a merger outweigh the gains of triggering a takeover. Others have confirmed this effect by deriving negative incentives to merge (Willig, 1991; Inderst and Wey, 2004). Partial ownership itself shows anti-competitive effects similar to those of mergers such as output reduction, profit increase and welfare losses (Reynolds and Snapp, 1986; Reitman, 1994). When associated with partial ownership mergers and takeovers mostly rely on toeholds in the literature (see e.g. Choi, 1991; Betton et al., 2009). In this case, an initial equity participation facilitates a complete acquisition because it raises the cost of being outbid by a competitor (Bulow et al., 1999). The strategy of acquiring a toehold raises antitrust issues as it is detrimental for consumers. However, it is not accounted for by regulation agencies (Jovanovic and Wey, 2014). Jovanovic and Wey (2014)

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study the impact of an acquisition (with synergies) on the consumer surplus when preceded by an initial ownership and show a post-merger improvement. Our paper completes this literature by presenting a model where the target of a takeover can be a firm engaged in a cross partial ownership with another firm, different from the acquirer. Our results (with no synergies involved) demonstrate a disincentivising effect of CPOs leading to a more competitive industry than in a traditional Cournot oligopoly.

CPO arrangements are common between horizontally competing firms on both side of the Atlantic. Examples include Multi System Operators (MSOs) in the US such as Tele-Communications Inc. (TCI), Turner Broadcasting Systems (TBS) and Time-Warner (see Table 1). In Europe examples include BNP Paribas with UAP (AXA) in France and the multiple interlocks between Dresdner Bank, Allianz and Munich Re in Germany (see Table 2).

Multi System Operators	Time Warner - TBS	TCI-TBS (before merger)	TCI - Time Warner (after merger)	Seagram - Time Warner (before) after merger
Partial Ownerships	18%	22%	9%	(15%) 10%

Table 1: Partial Ownerships in major communication networks in 1996 before and after the merger of Time Warner and Turner. Source `www.lesechos.fr`.

Germany (2000)	Munich Re-Allianz 20%-20%	Deutsche Bank-Allianz 7%-5%	Munich Re-Dresdner Bank 2.3%-8.3%
France (1994)	UAP-BNP 10%-10%	ELF-Renault 4%-1.5%	ELF-BNP 2%-1%

Table 2: Example Cross Partial Ownerships in Germany and France. Source `www.lesechos.fr`.

In a homogeneous Cournot industry we are able to determine the profitability of a takeover as a function of the endogenous parameters (CPO and the number of firms). We explore the implications of CPO for takeover profitability. We introduce the concept of partial ownership as a defence against hostile takeover by allowing two cases (see Definition 2, in Section 3) with two different takeover targets. Exploring asymmetric CPOs allows us to obtain competitive results on takeover incentives that are markedly different to the traditional model of mergers within a Cournot oligopoly (Tirole, 1988). We show that CPO increase incentives for takeovers in most cases. However in the protected case, CPO arrangements can be constructed to reduce the incentives to raid the protected firm. Firstly, we demonstrate that CPO reduces the incentives to merge relative to a benchmark industry without CPO. Secondly, in certain circumstances, even greater levels of protection may be possible. If the minimum takeover ratio is less than 1 a protective CPO threshold can be constructed that reduces incentives to raid the protected firm. This highlights the anticompetitive effect of CPO by making the target less desirable in reducing the overall profitability of the merger. This protective CPO threshold can be defined in terms of the endogenous parameters (the other CPO and the number of firms in the industry) and constitutes an important finding in this study. Thus, in both cases, CPO constitutes a defence in participations against hostile takeovers.

CPO may have regulatory implications for competition policy as they improve social welfare.

In addition, governments willing to protect strategic sectors from hostile takeovers could use a defence in participations. Indeed, the use of CPO as a defence against hostile takeovers has been implemented both in Europe ("golden shares") and in the US (see e.g. Lantenois, 2011; Yergin and Stanislaw, 1998; Goldstein, 1996). Finally, we discuss three decisions of the European Court of Justice (ECJ) related to the use CPO by governments to block foreign investment in strategic sectors. The ruling of the ECJ against these protective polices based on free market "laissez-faire" arguments is thus criticized as CPOs may prove socially more beneficial than traditional competition frameworks.

The layout of this paper is as follows. Section 2 reviews the literature on partial ownership. Section 3 outlines the model used. Section 4 highlights the key analytical results obtained. Section 5 discusses an empirical application which allows comparison of the theoretical protective threshold to real-world CPO arrangements. The results of our model can hence be shown to have empirical relevance for real-world CPO arrangements. Section 6 provides information to European regulators about the positive social impact of CPO in the context of mergers. We thus highlight an important trade-off between a free-market and an interventionist approach. Section 7 concludes and discusses the opportunities for further work. A mathematical appendix is included at the end of this paper.

2 Literature Review

2.1 Partial ownership

Partial Ownership (PO) consists in a firm acquiring a fraction of equity capital of a rival at the horizontal level or of a supplier/manufacturer in a vertical relationship. The capital in participations does not generally give the majority of voting rights and in this case is a non-controlling operation or silent participation (Reitman, 1994; Bresnahan and Salop, 1986). Thresholds or ceilings in participations exist (usually at the 5%, 10%, 20% and 30% levels) and listed companies have to notify regulatory agencies when they cross these levels. The importance of partial ownership is threefold. Firstly, the impact of partial ownership on competition is much studied and is very important for antitrust regulation agencies. As for mergers (see e.g. Jullien and Rey, 2007; Compte et al., 2002) the collusive aspect of partial ownership causes a trade-off between firms' efficiency (profits) and reduced consumer surplus. Secondly, as for mergers more generally, the study of incentives to engage in PO is also important. Similarly, there is an "outsider effect" (Salant et al., 1983) when partial ownerships do not involve any synergies. Thirdly, the link between participations and technological investment is also significant (see e.g Barcena-Ruiz and Olaizola, 2007; Minetti et al., 2015).

The impact of PO on competition and market structure is substantial. Reynolds and Snapp (1986) show that PO reduces output and increases prices in a Cournot model with barriers to entry. Even when the amount of PO is small this result has anticompetitive effects similar to those of mergers. O'Brien and Salop (2000) analyze the effects of POs in comparison to those of mergers. They conclude that though passive participations do not carry corporate control they may present anticompetitive aspects similar to those of mergers. Gilo et al. (2006) consider the case of cross participations in a dynamic Bertrand model and conclude that tacit collusion can be sustained in the long-run. In the case of vertically-related industries Jullien and Rey (2007) study the impact of the resale price maintenance contract on collusion. Vertical contract models are empirically tested by Bonnet and Dubois (2010). The issue of reinforced market power also applies after the privatization of historically public companies and the subsequent liberalization

of the market (see e.g. Amundsen and Bergman, 2002; Lee and Hwang; 2003). In an application to the US and Japanese automobile industries Alley (1997) derives empirical results confirming the collusive effects of PO. In contrast, Malueg (1992) finds that in a dynamic Cournot framework repeated interactions between competitors can produce less collusion. Further, other authors study competitive aspects of participations either in a vertical supplier-dealer relationship or in a mixed framework (see e.g. Greenlee and Raskovich, 2006; Serbera, 2010). Our article extends the study of the competitive role of PO by introducing asymmetric CPO and leads to modified results depending on whether or not CPO are used to prevent further concentration (takeovers).

2.2 Mergers and partial ownership

Allied to the above the explicit comparison of partial ownership and mergers is also of interest. The literature on toehold acquisitions is significant. Acquiring participations prior to a merger can be effective as it raises the cost of rival bids (see e.g. Bulow et al., 1999; Choi, 1991). However, Betton et al. (2009) explain the recent decline in the number of toehold arrangements by the need to acquire a sufficient amount of shares for the deal to be completed. Similarly, Jovanovic and Wey (2014) find that the acquisition of equity participations into the capital of a firm facilitates a later takeover – ultimately reinforcing market power. Fatica (2010) studies the effects of POs prior to foreign direct investments. It is shown that toeholds can facilitate full acquisition over a greenfield investment though the result depends on the value of investment costs. Foros et al. (2011) investigate the effect of controlling participations on the pay-tv industry in Scandinavia and find that the anti-competitive effects are potentially greater than for full mergers.

Complex arrangements in cross participations are a practical reality and exist in various different forms worldwide. They have been much studied in the literature. Cases include horizontal and vertical PO in the Cable TV industry in the US (Besen et al., 1999), "Keiretsu" in Japan (Brown and Fung, 2009), "Deutschland AG" in Germany (Lantenois, 2011), "noyaux-durs" in France (Goldstein, 1996), and "golden shares" in the United Kingdom (Yergin and Stanislaw, 1998). The study of these reciprocal participations can be compared with the effect of toeholds on takeovers. However, in this case, the focus is on external takeovers incentives from outside companies. This paper considers CPO as "golden shares" used as protection to guard against foreign hostile takeovers. See Sections 3-4.

Defensive strategies against hostile buyouts are of great importance. Numerous defensive strategies (also known as shark repellents such as "Pac-Man", "Nancy Reagan", "greenmail", or "white knight") against hostile buyouts have been devised and implemented (see e.g. Barry and Hatfield, 2012). Most of these takeover defences do not directly modify the capital structure of the target. However, in the context of buy-outs, the question of capital appears to be crucial. This motivates our study of the use of CPO as a defence to protect from a hostile takeover. We highlight the defensive role of cross participations against hostile takeovers useful to protect national interest in strategic sectors. In addition, we demonstrate that bilateral partial ownerships have a competitive impact as they may limit further market concentration. This important innovation brings our model closer into line with financial reality and may also have important regulatory implications. See Section 6.

3 The model: Takeovers in a Cournot oligopoly with cross partial ownerships

Our analysis uses the traditional model of a Cournot oligopoly with homogenous goods that has $n \geq 1$ firms $f_1, f_2, \ldots, f_n \in F$, $n \in \mathbb{N}$ (Tirole, 1988). Assuming a quadratic utility function for the consumption q_i of firm f_i with associated price p_i the homogeneous substitutability condition gives $p_i(q) = a - \sum_k q_k$. Whilst an obvious simplification the homogeneous substitutability condition seems to have empirical relevance to applications spanning the oil, automobile and finance industries. See Section 5. Set up in this way this model arises as an important special case of the classical model in Farrell and Shapiro (1990). Finally, firms' marginal costs $c_i = c$ are assumed constant.

Definition 1 *A cross partial ownership is a mutual agreement in which two firms acquire cross equity participations in each other's capital structure.*
(i) Cross partial ownership are silent participations (Reitman, 1994; Bresnahan and Salop, 1986), giving the acquirer no right in the other firm management decisions.
(ii) The cost of acquisition is a transfer price $t_{i,j}$ with $f_i, f_j \in F$ is normalised to zero.*

Let $\beta_{i,j} \in [0, 0.5)$ denote the capital of firm f_j held by firm f_i. Two firms f_1 and f_2 say are in a cross partial ownership agreement if $\beta_{1,2} > 0$ and $\beta_{2,1} > 0$. We write $f_1, f_2 \in CPO$. The special case $\beta_{i,j} = \beta_{j,1} = 0$ represents a benchmark case and reduces to the traditional model of a Cournot oligopoly without CPO (Tirole, 1988).

Profits for the two protected firms $f_1, f_2 \in CPO$ are given by $\Pi_i = (1 - \beta_{j,i})\pi_i + \beta_{i,j}\pi_j$, where $\pi_i = [p_i(q) - c]q_i$, $i, j \in \{1, 2\}$. The operating profit of an unprotected firm without equity participations and representative of the majority of the industry is denoted by $\pi_r = [p_r(q) - c]q_r$, $r \geq 3$. The merger profit of a non-protected firm is given by $\Pi_M = 2\pi_r$. The takeover profits on a protected firm are given by $\Pi'_M = \pi_r + \Pi_i$.

Definition 2 *The type of ownership depends on if:*
(i) The target is a firm with no CPO arrangement in which case it is an unprotected takeover.
(ii) The target is a firm with a CPO arrangement in which case it is a protected takeover.

We have two cases: pre-takeover and post-takeover. In the pre-takeover case there are n firms and equilibrium values are denoted ^{n}. In the post-takeover case there are $n-1$ firms and we observe two possibilities: a takeover of an unprotected firm (denoted $^{n-1}$) and a takeover of a protected firm (denoted $^{n-1,p}$). Benchmark values are denoted ^{b}. An illustration of the organisation of the industry is shown below in Figure 1.

Pre-takeover. The $n-2$ firms with no CPO arrangements choose to maximise their individual profit over q_r:

$$\pi_r = \max_{q_r} \left\{ (a - \sum_k q_k - c)q_r \right\}; \; q_r = \frac{a - c - \sum_{k \neq r} q_k}{2} \tag{1}$$

For the two protected firms $f_1, f_2 \in CPO$ with $i, j \in \{1, 2\}$ we have that

$$\Pi_i = \max_{q_i} \left\{ (1 - \beta_{j,i})[a - \sum_k q_k - c]q_i + \beta_{i,j}[a - \sum_k q_k - c]q_j \right\}.$$

*The transfer price is thus independent of produced quantities and offset with each other when CPO are equal as in the "golden shares" framework.

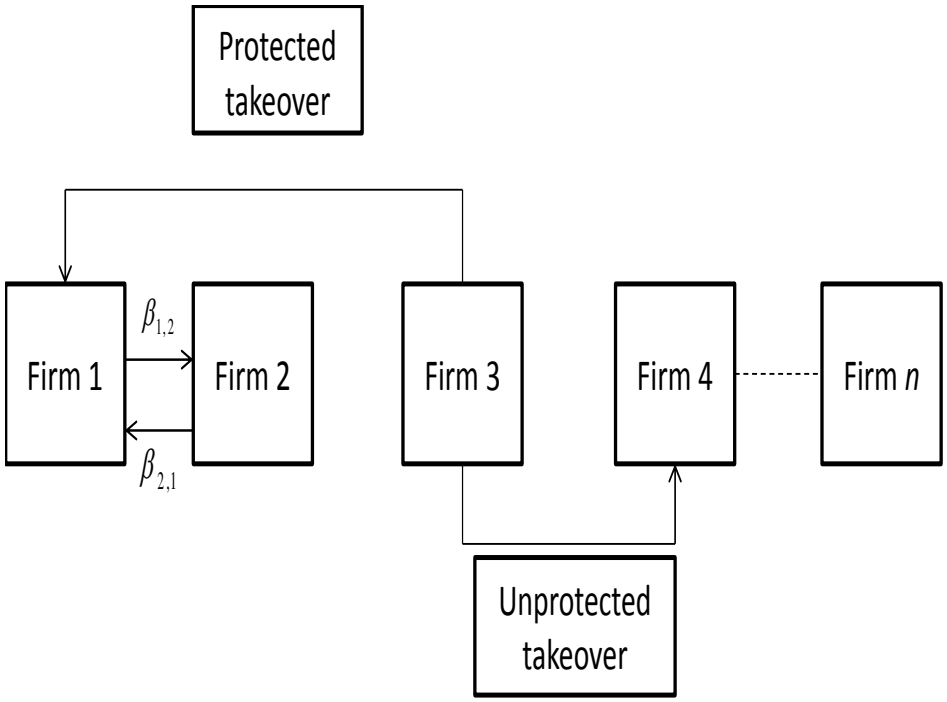

Figure 1: Schematic model of hostile takeovers within an industry with cross partial ownership.

This can be solved to give the first-order conditions

$$\frac{\partial \Pi_1}{\partial q_1} = -2q_1(1-\beta_{2,1}) + (1-\beta_{2,1})(a - \sum_{k\neq 1} q_k - c) - \beta_{1,2}q_2 = 0$$

$$q_1(2-2\beta_{2,1}) + q_2(1+\beta_{1,2}-\beta_{2,1}) = (1-\beta_{2,1})(a - \sum_{k\notin\{1,2\}} q_k - c) \tag{2}$$

$$\frac{\partial \Pi_2}{\partial q_2} = -2q_2(1-\beta_{1,2}) + (1-\beta_{1,2})(a - \sum_{k\neq 2} q_k - c) - \beta_{2,1}q_1 = 0$$

$$q_2(2-2\beta_{1,2}) + q_1(1+\beta_{2,1}-\beta_{1,2}) = (1-\beta_{1,2})(a - \sum_{k\notin\{1,2\}} q_k - c), \tag{3}$$

since $\sum_{k\neq 1} q_k = \sum_{k\notin\{1,2\}} q_k + q_2$ and $\sum_{k\neq 2} q_k = \sum_{k\notin\{1,2\}} q_k + q_1$.

Takeover of an unprotected firm. The $n-4$ firms with no CPO arrangement and outside of the merger choose to maximise π_r as per equation (1). The two protected firms $f_1, f_2 \in CPO$ maximise the partially joint profits Π_i, $i = 1, 2$ given in (2-3). The two merged firms, f_3 and f_4 say, maximise their consolidated joint profit:

$$\Pi_M = \max_{q_3,q_4} \left\{ (a - \sum_k q_k - c)q_3 + (a - \sum_k q_k - c)q_4 \right\}.$$

This gives

$$\frac{\partial \Pi_M}{\partial q_3} = (a - \sum_{k\neq 3} q_k - c) - 2q_3 - q_4 = 0;\ 2q_3 = a - \sum_{k\notin\{3,4\}} q_k - c = 2q_4.$$

Takeover of a protected firm. The $n-3$ firms with no CPO arrangement and out of the merger choose to maximise π_r as per equation (1). The protected firm f_1 is the target of a takeover by a firm f_3, say. The protected firm outside of the merger, f_2 say, maximises the joint profit shown in equation (3). Here, it is convenient to re-write this equation as

$$q_2(2-2\beta_{1,2})+q_1(1+\beta_{2,1}-\beta_{1,2})+q_3(1-\beta_{1,2})=(1-\beta_{1,2})\left(a-\sum_{k>3}q_k-c\right). \tag{4}$$

The merged firm solves

$$\max_{q_1,q_3}\Pi'_M=(1-\beta_{2,1})[a-\sum_k q_k-c]q_1+\beta_{1,2}[a-\sum_k q_k-c]q_2+[a-\sum_k q_k-c]q_3,$$

leading to the first-order conditions

$$\frac{\partial\Pi'_M}{\partial q_1}=-2(1-\beta_{2,1})q_1+(1-\beta_{2,1})(a-\sum_{k\neq 1}q_k-c)-\beta_{1,2}q_2-q_3=0$$

$$q_1(2-2\beta_{2,1})+q_2(1+\beta_{1,2}-\beta_{2,1})+q_3(2-\beta_{2,1})=(1-\beta_{2,1})(a-\sum_{k>3}q_k-c) \tag{5}$$

$$\frac{\partial\Pi'_M}{\partial q_3}=-q_1(1-\beta_{2,1})-\beta_{1,2}q_2-2q_3+(a-\sum_{k\neq 3}q_k-c)=0$$

$$q_1(2-\beta_{2,1})+q_2(1+\beta_{1,2})+2q_3=a-\sum_{k>3}q_k-c \tag{6}$$

since $\sum_{k\neq 1}q_k=\sum_{k>3}q_k+q_2+q_3$ and $\sum_{k\neq 3}q_k=\sum_{k>3}q_k+q_1+q_2$.

4 Analytical results

In this section we establish the results of cross partial ownership both before and after the takeover.

Proposition 1 (Equilibrium values.) *The equilibrium solution of the model is as follows:*
(i) Pre-takeover case.

$$\begin{aligned}\Pi_i^n &= \frac{(a-c)^2(1-\beta_{j,i})}{(n+1-\beta_{j,i}-\beta_{i,j})^2}\\ \pi_r^n &= \frac{(a-c)^2}{(n+1-\beta_{j,i}-\beta_{i,j})^2}\end{aligned}$$

Benchmark

$$\pi_r^{n,b}=\frac{(a-c)^2}{(n+1)^2}$$

(ii) Post-takeover unprotected.

$$\begin{aligned}\Pi_i^{n-1} &= \frac{(a-c)^2(1-\beta_{j,i})}{(n-\beta_{j,i}-\beta_{i,j})^2}\\ \Pi_M^{n-1}=\pi_r^{n-1} &= \frac{(a-c)^2}{(n-\beta_{j,i}-\beta_{i,j})^2}\end{aligned}$$

Benchmark

$$\pi_r^{n-1,b} = \frac{(a-c)^2}{n^2}$$

(iii) Post-takeover protected.

$$\begin{aligned}
\Pi_M^{n-1,p} &= \frac{(1-\beta_{2,1})(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2} \\
\pi_2^{n-1,p} &= \frac{(1-\beta_{1,2})(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2} \\
\pi_r^{n-1,b} &= \frac{(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2}
\end{aligned}$$

Benchmark

$$\pi_r^{n-1,b} = \frac{(a-c)^2}{n^2}$$

Proof
See the Appendix.

Proposition 2 confirms the collusive role of partial ownership (Reitman, 1994) and the "outsider effect" as the firms inside the CPO arrangement are worse off than the firms outside (Salant et al., 1983). As with full mergers CPO reinforce the concentration in the industry leading to an increase of market power and a strategic output's reduction in the oligopoly. As a corollary to Proposition 1 we obtain the following propositions:

Proposition 2 *The impact of CPO upon profit margins is as follows:*
(i) The CPO increases the profits of the wider industry outside the CPO.
(ii) The CPO reduces the combined profits of the firms inside the CPO.

Proof
(i) From Proposition 1 π_r^n is an increasing function of $\beta_{1,2}$ and $\beta_{2,1}$.
(ii) The combined profit of Firms 1-2 is $\frac{2-\beta_{1,2}-\beta_{2,1}}{(n+1-\beta_{1,2}-\beta_{2,1})^2}$ which is a decreasing function of $\beta_{1,2}$ and $\beta_{2,1}$, since it is assumed we have $n \geq 3$ firms. □

Proposition 3 (Post Unprotected Takeover.) *In the case of an unprotected takeover the CPO have an anti-competitive impact as:*
(i) The profit of the merged firm increases.
(ii) The incentives for an unprotected takeover are greater than in a benchmark industry.

Proof
From Proposition 1 the profit increases from $\frac{(a-c)^2}{(n+1-\beta_{1,2}-\beta_{2,1})^2}$ to $\frac{(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2} > \frac{(a-c)^2}{n^2}$. □

Following a protected takeover define the takeover ratio to be the ratio of the profit of the merged firm compared to the initial profit of the raider outside the original CPO agreement:

$$\text{Protected Takeover Ratio} := \frac{\Pi_M^{n-1,p}}{\pi_3^n} = \frac{(1-\beta_{2,1})^2(n+1-\beta_{2,1}-\beta_{1,2})^2}{(n-\beta_{2,1}-\beta_{1,2})^2}. \tag{7}$$

The economic interpretation of equation (7) is that values of $\beta_{1,2}$ and $\beta_{2,1}$ may be chosen to make this ratio smaller – thus rendering the form less vulnerable to a hostile takeover. Proposition 4 shows that in an industry with CPO the incentives for a hostile takeover are reduced relative to a benchmark industry.

Proposition 4 (Competition relative to a benchmark industry.) *In an industry with a CPO the incentives for a hostile takeover on a protected target are lower than in a benchmark industry.*

Proof
See the Appendix.

In the sequel we discuss the potential for asymmetric CPO to render hostile takeovers obsolete by eroding the possibility of making surplus profits. This is a stronger condition and appears to be chiefly of theoretical interest only. The implied thresholds appear to be violated by empirical data. See Section 5.

Definition 3 *An asymmetric CPO $\beta_{1,2}$ and $\beta_{2,1}$ is said to be effective against hostile takeovers iff*

$$\textit{Protected Takeover Ratio} = \frac{\Pi_M^{n-1,p}}{\pi_3^n} = \frac{(1-\beta_{2,1})(n+1-\beta_{2,1}-\beta_{1,2})^2}{(n-\beta_{2,1}-\beta_{1,2})^2} < 1, \tag{8}$$

where $\Pi_M^{n-1,p}$ denotes the profit of the merged firm and π_3^n denotes the profit of the raider prior to the merger.

Definition 3 thus enables us to pinpoint precisely when a CPO can protect against hostile takeovers be reducing the profit levels that can be achieved by the raiding firm. The conditions are prescribed in Proposition 5:

Proposition 5 *An asymmetric CPO can be effective against hostile takeovers iff*

$$\textit{Minimum Takeover Ratio} := \frac{(1-\beta_{2,1})(n+1-\beta_{2,1})^2}{(n-\beta_{2,1})^2} < 1. \tag{9}$$

Proof
Since the takeover ratio defined in equation (7) is an increasing function of $\beta_{1,2}$ the constraint in equation (8) can only be satisfied for some $\beta_{1,2} > 0$ precisely when it is also satisfied at the boundary condition $\beta_{1,2} = 0$. □

If a CPO is effective against hostile takeovers we can define the following protective CPO threshold.

Proposition 6 (Protective CPO threshold.) *If an asymmetric CPO $\beta_{1,2}$ and $\beta_{2,1}$ is effective against hostile takeovers then*

$$0 < \beta_{1,2} < n+1-\beta_{2,1} - \frac{(1+\sqrt{1-\beta_{2,1}})}{\beta_{2,1}},$$

provided

$$0 < n+1-\beta_{2,1} - \frac{(1+\sqrt{1-\beta_{2,1}})}{\beta_{2,1}} < \frac{1}{2}.$$

Proof
If $\beta_{1,2} = n + 1 - \beta_{2,1} - \frac{(1+\sqrt{1-\beta_{2,1}})}{\beta_{2,1}}$ the Protected Takeover Ratio shown in equation (8) is equal to 1. □

Following on from Propositions 4-6 an empirical application to CPOs as a defence against hostile takeovers is given in Section 5.

5 Empirical application

In this section we compare the prediction given by (9) with empirical data on the "Deutschland AG" and "noyaux-durs" policies much discussed in the academic literature (Franks and Mayer, 1998; Lantenois, 2011; Yergin and Stanislaw, 1998; Goldstein, 1996). See Table 3.

Observed $\beta_{1,2}$	No. of major firms	Observed $\beta_{2,1}$	Minimal Takeover Ratio
Munich Re 0.2	6	Allianz 0.2	1.0996
Allianz 0.2	6	Munich Re 0.2	1.0996
Deutsche Bank 0.07	6	Allianz 0.05	1.2962
Allianz 0.05	6	Deutsche Bank 0.07	1.2701
Munich Re 0.023	6	Dresden Bank 0.083	1.2531
Dresden Bank 0.083	6	Munich Re 0.023	1.3313
UAP 0.1	10	BNP 0.1	1.0910
BNP 0.1	10	UAP 0.1	1.0910
ELF 0.04	10	Renault 0.015	1.1922
Renault 0.015	10	ELF 0.04	1.1624
ELF 0.02	10	BNP 0.01	1.1981
BNP 0.01	10	ELF 0.02	1.1862

Table 3: Minimal takeover ratios and compared to actual CPO values for Deutschland AG and noyaux-durs arrangements.

Based on available data from the Bloomberg database results constructed in Table 3 correspond to taking $n = 6$ large financial companies in Germany and $n = 10$ large French conglomerates across the oil, automobile and finance industries. Overall, results give a reasonable reconstruction of empirical CPO arrangements given the extreme simplicity of the model. However, in each case the minimal takeover ratio exceeds 1. Thus, whilst CPO may play a valid role in guarding against hostile takeovers and market concentration (see Section 6), real-world CPO arrangements appear insufficient to fully deter hostile takeovers. However, it is also possible that the transaction costs associated with real-world takeovers are sufficiently high that, in practice, theoretical models may over-estimate the true value of the protective threshold required. In this case results would suggest that in practice the level of profit required in order to undertake takeovers may be around 20% higher than the value suggested by simple theoretical models.

6 Regulation

In addition to literature results on the anticompetitive role of horizontal participations (see e.g., Reitman, 1994; Gilo et al., 2006) alone or as a toehold before a full takeover (Jovanovic and Wey, 2014), our analysis introduces the social benefits of CPO under certain conditions of the model. Indeed, if protected by a CPO hostile takeovers become less profitable than in a benchmark industry without CPO. Further, even higher levels of protection may be possible if the Minimum Takeover Ratio shown in equation (9) is less than one. These results thus have regulatory implications since, in both cases, they highlight the competitive role of cross horizontal participations.

The use of CPO as a defence against hostile takeovers was explored in Europe with the "golden shares, "Deutschland AG or "noyaux-durs policy (Franks and Mayer, 1998; Lantenois, 2011; Yergin and Stanislaw, 1998; Goldstein, 1996). This policy defers to the regulation of the European Commission and to the ruling the European Court of Justice (ECJ) in the case of a dispute. Special rights of the Union's members on private undertakings are discussed and examined to determine whether or not this is consistent with the free movement of capital and payments. Lustig and Weil (2002) relate three ECJ rulings on participations and their link with corporate governance. In Belgium the government holds shares in the "Société Nationale de Transport par Canalisation" as well as the "Société de Distribution du Gaz SA". The ECJ granted the Belgian government the right to ask for notice or to oppose any decisions about infrastructure changes if this runs counter to their strategic domestic interests. In France the Minister of Economic Affairs was given, by means of a golden share, the right to oppose any change in capital structure (i.e. crossings of the 10%, 20%, 33% thresholds for 'Société Nationale Elf-Aquitaine'. This right was opposed by the ECJ in its ruling. Finally, the ECJ ruled against Portugal in its use of participations to block foreign share acquisitions in recently privatised companies. In these three cases the European Commission attacked these countries decision to protect privatised companies using a defence in participations on the basis of an infringement of the principle of the free movement of capital and payments. The theoretical justification of such a "laissez-faire" policy is the belief that self-regulation of the market improves competition and leads to more economic efficiency. However, in this particular case, the ruling against a protection in CPO proves anti-competitive on the long run. We then suggest more competitive regulation by allowing short-term market consolidation with CPO as a way to limit future hostile takeovers that may ultimately have a more detrimental impact upon social welfare.

Our paper explores mathematically the competition approach on this topic, and our theoretical results on the potential competitive role of CPO send a contrarian signal to the regulation agencies and the courts. We argue that the regulators and governments should take a wider view regarding the potential benefits of partial ownerships. Though CPO arrangements used as a protection could be counter to the free movement of capital on markets, they should be allowed under specific countries strategic circumstances (e.g. BAE-EADS merger deal vetoed by the UK government) and also to prevent the increase of concentration and market power in a particular industry.

7 Conclusions and discussion

This paper explores the theoretical study of the impact of CPO in the context of mergers. A mixture of theoretical work (see e.g. Malueg, 1992; O'Brien and Salop, 2000) and applied work (see e.g. Perotti, 1992; Reiffen, 1998) investigate participations but does not explicitly link

them with takeover incentives. Our contribution is also timely and relevant. Numerous articles highlight the role and functioning of different forms of "golden shares" across several countries. Examples include O'Brien and Salop (2000) in the US, Brown and Fung (2009) on Keiretsu, Lantenois (2011) on "Deutschland AG", Yergin and Stanislaw (1998) on UK "golden shares", and Goldstein (1996) for French "noyaux-durs". In addition, Jovanovic and Wey (2014) study the role of CPO when takeovers offer synergies.

In this paper we study takeover incentives in a Cournot oligopoly model with two firms linked by cross participations. The use of CPO can increase market concentration by offering incentives for firms to takeover rivals. However, asymmetric CPO can also serve as an effective defence against hostile takeovers by making the target less attractive. The implications for competition policy are compelling. This competitive aspect is highlighted by a comparison of takeover incentives between two industries – one with CPO and one benchmark industry without such participations. Higher levels of protection may also be possible if the Minimum Takeover Ratio shown in equation (9) is less than one. Since the full integration of a rival's profits (buyout) is more harmful in terms of competition than partial ownerships authorizing CPO could thus prove socially beneficial.

This paper sheds new light on the analysis of competition and market power. It also raises questions in the case of an "attack" and thus gives ample scope for additional investigations. Results shown in Section 5 also shows that our model may have some empirical relevance across a diverse range of industries. Future work will examine the consequences of cross participations on protected firms' incentives to raid competitors. This protection could be used in this case to "attack" competitors. This could prove decisive in the analysis of the influence of CPO on market concentration and on economic welfare. Other types of demand function with non-homogeneous goods could allow for further extensions of the model to other settings e.g. Bertrand competition. Further studies of equity strategies, against or in support of a buyout, may have important implications both for policy makers in charge of the current regulatory monitoring process and for continued applied research in the subject.

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Appendix

Proof of Proposition 1
(i) Summing (1) over the $n-2$ firms outside the CPO gives

$$2\sum_{k\notin\{1,2\}} q_k = (n-2)(a-c) - (n-3)\sum_{k\notin\{1,2\}} q_k - (n-2)(q_1+q_2) \tag{10}$$

Adding (10) and equations (2-3) gives

$$\sum_k q_k = \frac{n-\beta_{2,1}-\beta_{1,2}}{n+1-\beta_{2,1}-\beta_{1,2}}(a-c). \tag{11}$$

It follows from equation (11) that

$$q_r = \frac{a-c}{2} - \frac{\sum_k q_k}{2} + \frac{q_r}{2};\ q_r = \frac{a-c}{n+1-\beta_{2,1}-\beta_{1,2}} \tag{12}$$

$$\pi_r^n = [a - \sum_k q_k - c]q_r = \frac{(a-c)^2}{(n+1-\beta_{2,1}-\beta_{1,2})^2} \tag{13}$$

It follows from equations (11-12) that

$$q_1 + q_2 + (n-2)q_r = \frac{(n-\beta_{2,1}-\beta_{1,2})(a-c)}{n+1-\beta_{2,1}-\beta_{1,2}}; q_1 + q_2 = \frac{(2-\beta_{2,1}-\beta_{1,2})(a-c)}{n+1-\beta_{2,1}-\beta_{1,2}}. \tag{14}$$

Combining (11) and equations (2-3) it follows that

$$q_i = \frac{(1-\beta_{j,i})(a-c)}{n+1-\beta_{2,1}-\beta_{1,2}};\ \Pi_i^n = \frac{(1-\beta_{j,i})(a-c)^2}{(n+1-\beta_{2,1}-\beta_{1,2})^2}.$$

(ii) Since in this case the $n-3$ outside of the CPO solve the optimisation problem shown in equation (1) this reduces to Case (i) discussed above with n replaced by $n-1$.
(iii) Summing (1) over the $n-3$ firms outside the CPO and outside of the merger gives

$$(n-3)(q_1+q_2+q_3) = (n-3)(a-c) - (n-2)\sum_{k>3} q_k. \tag{15}$$

Summing equations (4-6) and (15) gives

$$(n+1-\beta_{1,2}-\beta_{2,1})\sum_k q_k + (1-\beta_{2,1})q_1 + \beta_{1,2}q_2 + q_3 = (n-\beta_{1,2}-\beta_{2,1})(a-c)$$

$$(n+1-\beta_{1,2}-\beta_{2,1})\sum_k q_k + (a - \sum_k q_k - c) = (n-\beta_{1,2}-\beta_{2,1})(a-c)$$

where the second equality follows from equation (6). This gives

$$\sum_k q_k = \left(\frac{n-1-\beta_{1,2}-\beta_{2,1}}{n-\beta_{1,2}-\beta_{2,1}}\right)(a-c). \tag{16}$$

Combining equations (1) and (16) gives

$$q_r = (a - \sum_k q_k - c) = \frac{(a-c)}{n-\beta_{1,2}-\beta_{2,1}};\ \pi_r = \frac{(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2}$$

From equations (4) and (5) it follows that

$$\Pi_2^{n-1,p} = \frac{(1-\beta_{1,2})(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2};\ \Pi_M^{n-1,p} = \frac{(1-\beta_{2,1})(a-c)^2}{(n-\beta_{1,2}-\beta_{2,1})^2}$$

□

Proof of Proposition 4
We show that the takeover ratio given by equation (7) is less than the corresponding value

of $\frac{(n+1)^2}{n^2}$ in a benchmark industry. Firstly, it is easy to show, e.g. by taking logarithms and differentiating, that equation (7) is an increasing function of $\beta_{1,2}$. This gives that

$$\frac{(1-\beta_{2,1})(n+1-\beta_{2,1}-\beta_{1,2})^2}{(n-\beta_{2,1}-\beta_{1,2})^2} < \frac{(n+\frac{1}{2}-\beta_{2,1})^2}{(n-\frac{1}{2}-\beta_{2,1})^2}$$

Since the right hand side is an increasing function of $\beta_{2,1}$ it follows that we must have that

$$\frac{(1-\beta_{2,1})(n+1-\beta_{2,1}-\beta_{1,2})^2}{(n-\beta_{2,1}-\beta_{1,2})^2} < \frac{n^2}{(n-1)^2} < \frac{(n+1)^2}{n^2}$$

□

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